ISBR-2020

2nd INTERNATIONAL SYMPOSIUM ON BIODIVERSITY RESEARCH

THE BOOK OF FULL TEXTS AND ABSTRACTS OF THE ISBR-2020

18-20 November 2020

Recep Tayyip Erdoğan University

Rize, Turkey

2nd International Symposium on Biodiversity Research

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Rize, 2020

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PREFACE

Dear Rector and distinguished participants,

As chair of the second international biodiversity research symposium, it is a great pleasure for me to declare open the second international biodiversity research symposium and to welcome the participants from different parts of the World who are here to exchange experience and work together a few days on this exciting symposium hosted by the Department of Biology, Faculty of Arts and Sciences of Recep Tayyip Erdoğan University.

I first wish to extend to you the greetings of the organizing and scientific committee. Without them, this organization will not have been come true. Since lockdown because of the global pandemic, our lives and works are affected deeply. In these times calling for solidarity of scientists like you, we have to stand with strength to adapt to new normal and further our studies for a safe planet.

Now, I would like to give a brief information about the history of the conference. The first symposium was organized by Department of Biology of Çanakkale Onsekiz Mart University, I would like to take this opportunity to thank the organizing committee of the event, especially Prof. Dr. Murat Tosunoğlu, who also gave us the opportunity to organize the event in our university.

As you know, all our plans were made to hold the symposium face to face in June. However, due to the pandemic, we first postponed it and then decided to have it virtual. The global andemic has many drawbacks, one of which is that such organizations cannot be held face to face during this period. We wish to host you in person in our lovely city, Rize, however it would not be possible. As you may have heard, there are great news about vaccine to end the Covid-19 pandemic. I hope it will end soon for the coming months.

It is a fact that biodiversity is the diversity of life on our planet. It forms the basis of our well-being and economy. Biodiversity is one of the most fundamental factors in the continuation of life on Earth. Unfortunately, biodiversity is declining rapidly day by day. Thus, biodiversity has become one of the most important issues today affecting all living things. Today, biodiversity is disappearing at thousand times the normal rate. Overuse of resources, climate change, excessive increase in air pollution and spread of diseases; accelerates the loss of biodiversity. It is very important to take measures to slow down or stop the decrease in biodiversity and to pass it on to future generations.

Being the first symposium held in our department, with this symposium, we aim to preserve the biological diversity in our country and the world, and to convey our biological richness and natural beauties to future generations.

Before closing, I have to extend further thanks to our Honorary president of the symposium, our rector Prof. Dr. Huseyin Karaman, and our Dean Prof. Dr. Serdar Makbul. Secondly, we are indebted to our organizing and scientific committees to have made this event possible. Lastly, I would like to express my gratitude to you who participated in our symposium with presentations from Turkey and abroad.

Prof. Dr. Nurhayat ÖZDEMİR

Chair of the Symposium

CLOSING DECLARATION

2nd International Symposium on Biodiversity Research hosted by the department of Biology of Recep Tayyip Erdoğan University has been organized virtually between November 18 and 20, 2020.

136 participants from 12 different countries have been gathered to supply presentations about variable topics of biodiversity.

I would like to thank each participant for his or her contributions.

Today, we all know that climate change and biodiversity loss are happening before our eyes. The need to give a chance to nature was addressed in the symposium.

As a result of the presentations, we come to this conclusion that we all are responsible for the biodiversity conservation.

I believe that 2nd International Biodiversity Research Symposium has achieved its objectives in biodiversity conservation and our responsibilities for passing it on to future generations.

International Biodiversity Research Symposium is planned to be held at different universities in different countries. Thus, the third edition of this international event will be hosted by Erzurum Technical University, Turkey next year.

Prof. Dr. Nurhayat ÖZDEMİR

Chair of the Symposium

Rize 2020

2nd INTERNATIONAL SYMPOSIUM ON BIODIVERSITY RESEARCH

www.isbr2020.erdogan.edu.tr

18.11.2020, WEDNESDAY

OPENING CEREMONY HALL 1 - 2

CLICK TO ATTEND HALL 1, CLICK TO ATTEND HALL 2

Opening Program	
10:30 – 11.00	Opening Ceremony (Presentation of Rize and RTEU, Opening Speeches)

18.11.2020, WEDNESDAY

13:00	**Keynote_ Western Caucasus refugial areas, based on the multiple evidence, and its importance for the modern biodiversity of the Caucasus and the Southern and the Eastern Black Sea area** ***David Tarkhnishvili – GEORGIA*** CLICK TO ATTEND KEYNOTE HALL 1, CLICK TO ATTEND KEYNOTE HALL 2

HALL 1		HALL 2		HALL 3	
CLICK TO ATTEND		CLICK TO ATTEND		CLICK TO ATTEND	
Session 1 : Diversity of Animal species, Systematics and Phylogeny-1		**Session 1 : Biodiversity, Landscape, Tourism-1**		**Session 1 : Diversity of Plant species, Systematics and Phylogeny-1**	
Session Chair: Tuğba Ergül Kalaycı		**Session Chair: Gökhan Aydın**		**Session Chair: M. Mustafa Akıner**	
13:45	Testing and Utility of Microsatellite loci in *Hyla orientalis* T.Ergül Kalayci , N. Özdemir	**13:45**	Perceptions of Facebook Users on The Reinstatement of Consumptive Tourism in Botswana W. L. Hambira	**13:45**	Genome wide analysis and characterization of *Phaseolus vulgaris* GPAT gene family under different abiotic stress conditions A. G. Kasapoğlu, S. Muslu, A. S. Aygören, E. Güneş, M. Aydın, E. İlhan
14:00	Mitochondrial D-loop Heteroplasmy in Anatolian Domestic Pigeon Breeds B. Biray, Ç. Akın Pekşen, C. C. Bilgin	**14:00**	Determination of the Recreational Potential of Erzurum Palandöken Urban Forest by the Gülez Method I. Sezen, N. S. İspirli	**14:00**	Determination of Genetic Diversity of *Liquidambar orientalis* Mill. var *integriloba* Fiori Populations in Muğla Province Using ISSR Markers Ö. Yüzer, A. Tonguç, E. Doğaç
14:15	Geometric Morphometric Analysis of Dorsal Head Shape Variation in Anatolian *Bufo* Toads C. Dursun, N. Özdemir, S. Gül, N. Üzüm, Bilal Kutrup	**14:15**	Classification of Perennial Plants and Utilization Possibilities in Landscape Architecture D. Dinçer, F. Bekiryazici, H. Dündar	**14:15**	Molecular Biodiversity of *Salix alba* L. and *Salix excelsa* J.F. Gmelin Populations in Turkey P. Acar, F. Ö. Değirmenci, Z. Kaya
14:30	Range Extension of Squalius fellowesii (Günther, 1868) in the Southern Anatolia (Teleostei: Leuciscidae) E. Bayçelebi, D. Turan	**14:30**	Investigation of Recep Tayyip Erdoğan University Main Campus Green Areas in Terms of Ecosystem Services F. Bekiryazici, D. Dinçer, H. Dündar	**14:30**	Taxonomical Notes on *Paronychia kurdica* Boiss. Complex Based on nrDNA ITS in Turkey Z. Türker, K. Coşkunçelebi, Ü. Budak

15:00	**Keynote_ Applying Innovative Approaches of Biodiversity and Ecosystem Studies in Azerbaijan: Achievements and Challenges**

Rashad Salimov – AZERBAIJAN

CLICK TO ATTEND KEYNOTE HALL 1, CLICK TO ATTEND KEYNOTE HALL 2

HALL 1		HALL 2		HALL 3	
CLICK TO ATTEND		CLICK TO ATTEND		CLICK TO ATTEND	
Session 2 : Environmental Toxicology-1 & Microbial Biodiversity-1		**Session 2 : Environmental Stress on Biodiversity**		**Session 2 : Diversity of Plant species, Systematics and Phylogeny-2**	
Session Chair: Şule Güzel İzmirli		**Session Chair: Rena Hüseyinoğlu**		**Session Chair: Meryem Bozkurt**	
15:45	~~Assessment Of River Water Quality Using Biotic Index (IBMWP): study case -Tiferguine Stream In The Moroccan High Atlas~~ ~~H. Rassam, H. Benaissa, N. Fetnassi, S. Moutaouakil, M. Ghamizi~~	**15:45**	Determination of Astrobiological Compatibility of Plants with Different Photosynthesis Metabolisms: UV Radiation, Salt and Boron Tolerance G. Bilgenoğlu, G. Işık	**15:45**	Phylogenetic and Phenotypic Studies of *Coffea* and *Psilanthus* Genus E. N. Raharimalala, P. Hamon, S. Sabatier, J. J. Rakotomalala, D. Crouzillat, R. Guyot
16:00	Accumulation of Heavy Metals in Olive Grown Under Different Soils H. Kayan, A. Bilgin, Ş. Güzel İzmirli	**16:00**	Effects of Culture Media and Culture Conditions on Seed Germination of *Physalis minima* L. M. Cüce	**16:00**	Analysis Of Morphological, Micromorphological And Molecular Systematic Properties Of *Rubus* L. (Rosaceae) Species In Rize Province F. Kuyumcu, V. Atamov, F. Ş. Beriş
16:15	~~The influence of salicylic acid on the absorption of oxygen in the wheat sprout roots~~ ~~V.B. Abdiyev., S.M. Ismayilova, B.A. Jafarzadeh, Y.T. Aghammadova, N.F. Aliyeva~~	**16:15**	Genome Wide Analysis of Glutathione S-Transferase Gene Family in Phaseolus vulgaris under Drought and Salinity Stress S. Muslu, A.G. Kasapoğlu, E. Güneş, A. S. Aygören, M. Aydın, E. İlhan	**16:15**	Importance of Using Multisampling for Plant Molecular Phylogenetic Studies: A Case Study on *Nonea bakuensis* (Boraginaceae) Endemic to Azerbaijan M. E. Güzel
16:30	Orchid Originated from Root B. popilliae 5O8 Isolate's Bioremedant Properties and Effect of Zea Mays Germination on Copper Being Ü. Z. Üreyen Esertaş, E. Uzunalioğlu, Ş. Alpay Karaoğlu	**16:30**	Comparative Effects Of Melatonin On Callus Formation And Proliferation Via Leaf Explants In Alfalfa (*Medicago sativa* L.) M. Şimşek, B. Yazicilar, B. N. Akgul, İ. Bezirganoglu	**16:30**	The globulin and leaf protein profiles of *Medicago sativa* for the determination of protein content among varieties in Turkey B. Albayrak, İ. Bezirganoğlu
16:45	Determination of Physico-Chemical Water Quality Values of Pazar Stream T. Mutlu, B. Verep	**16:45**		**16:45**	The Achene Surface Morphology and Karyomorphology of Two Populations belonging to *Psephellus simplicicaulis* (Asteraceae) K. Ertuğrul, T. Uysal, M. Bozkurt

19.11.2020 THURSDAY

10:00	**Keynote_ Relationship between shape, function and phylogeny in armadillos** ***Soledad De Esteban-Trivigno - SPAIN*** CLICK TO ATTEND KEYNOTE HALL 1, CLICK TO ATTEND KEYNOTE HALL 2

HALL 1		HALL 2		HALL 3	
CLICK TO ATTEND		CLICK TO ATTEND		CLICK TO ATTEND	
Session 3: Diversity of Animal species, Systematics and Phylogeny-2		**Session 3 : Diversity of Plant species, Systematics and Phylogeny-3**		**Session 3 : Microbial Biodiversity-2**	
Session Chair: Kamil Candan		**Session Chair: Seher Güven**		**Session Chair: Zeynep Bayramoğlu**	
10:45	Preliminary Indications of the Determined Aphid Species on *Populus spp*. from Karaman, Muğla and Antalya Provinces of Turkey G. Görür, Ö. Şenol, H. Akyıldırım Beğen, G. Başer	**10:45**	Pollen Morphology of Some Apocynaceae Genera from Turkey S. Güven, S. Makbul, K. Coşkunçelebi	**10:45**	Isolation and identificaton of Thermophilic Actinomycetes and investigation of their effect in composting S. G. Ertekin, A. Kumaş, L. Değirmenci, F. Özdemir Koçak
11:00	Cranial Osteology on *Heremites auratus* and *Heremites vittatus* (Lacertilia: Scincidae) species G. Özcan Kavak, M. Tosunoğlu	**11:00**	A palynomorphological and anatomical study about *Frankenia* (Frankeniaceae) genus in Turkey B. Yılmaz Çıtak	**11:00**	Detection of Phage and Plasmid Biodiversity of *Lactobacillus pentosus* strains through CRISPR/Cas Systems Spacer Analyses Ö. Kahraman Ilıkkan
11:15	Efficiency of DNA Barcoding in the Identification of Salmo Species from Turkey İ. Aksu, Y. Bektas, C. Kaya, E. Baycelebi, D. Turan	**11:15**	Distribution, Ecology and Anatomy of *Groenlandia* densa in Turkey N. Bayındır, N. İkinci	**11:15**	~~Microbial Diversity In Biofilm on Water Distribution Pipes in the City Of Bechar – Algeria~~ ~~H. Zineb, S. Kheira~~
11:30	Field-Sampling Based Inventories of Invertebrates (Arthropoda and Mollusca) from Caves in West Black Sea Region of Turkey M. Elverici, K. B. Kunt, B. A. Gümüş, D. Stojanović, D. Antić , E. C. Fidan, K. Kurt, M. E. Bulut, M. S. Taylan, O. Hekimoğlu, S. Anlaş, H. U. Demiriz, E. Kulaksızoğlu, E. Çankaya	**11:30**	Floral Morphology of Section *Persicaria* (*Polygonum* - Polygonaceae) in Turkey S. Kundakçı, S. Makbul, M. Gültepe, K. Coşkunçelebi	**11:30**	Isolation and Molecular Characterization of Nitrogen-Fixing *Azotobacter spp*. from Wheat Rhizosphere S. Çam, S. Bicek

13:00	**Keynote_ The Contribution of Italian Research to Biodiversity Assessment and Conservation in Anatolia and Adjacent Areas** ***Pierangelo Crucitti – ITALY*** CLICK TO ATTEND KEYNOTE HALL 1, CLICK TO ATTEND KEYNOTE HALL 2

HALL 1		HALL 2		HALL 3	
CLICK TO ATTEND		CLICK TO ATTEND		CLICK TO ATTEND	
Session 4 : Diversity of Animal species, Systematics and Phylogeny-3		**Session 4 : Aquatic (Marine and Freshwater) Biodiversity-1**		**Session 4 : Microbial Biodiversity-3**	
Session Chair: Necmiye Şahin Aslan		**Session Chair: Özge Kahraman Ilıkkan**		**Session Chair: Sedat Çam**	
13:45	A Large Knowledge Gap of Farmland Bird Populations of Turkey N. Şahin Arslan	**13:45**	New records of *Atherina boyeri*, *Carassius gibelio* and *Gambusia holbrooki* in Gökçeada (Çanakkale, Turkey) S. Ağdamar, G. Saç, Ö. Gaygusuz	**13:45**	~~Characterization of Phythopathogenicity Traits and Abiotic Stress Resistances of Some Rhizospheric Strains of Pseudomonas Azotoformans~~ ~~M. Slimane, E. H. Nabti B. Lakhder~~
14:00	Fish Fauna of the Upper Porsuk River Basin S. Aksu	**14:00**	Soft-Bottom Molluscs Biodiversity in the Turkish Western Coast of the Black Sea A. M. Gözler, H. Baytaşoğlu	**14:00**	Against Fungal Disease Agents In Kaçkar Mountains National Park Boxwood Forest, Biological Control With Trichoderma Species Ş. Alpay Karaoğlu, A. Bozdeveci, Ş. Suyabatmaz, S. Vatandaşlar, S. Aytan, A. Usta
14:15	Effects Of Lantana Camara On Small Mammals Biodiversity in Groenkloof Nature Reserve, South Africa T. Raphela, K. Duffy	**14:15**	A Study on Freshwater Gammaridea (Crustacea, Amphipoda) Fauna in Lakes and Ponds of Ordu and Surrounding Provinces (Turkey) A. Miroğlu, M. Bodur	**14:15**	~~Detection of LuxS gene in Pathogenci Bacteria isolated from Pear Plants in Morocco~~ ~~N. Lemjiber, K. Naamani, X. Lin, A. Dihazi~~
14:30	Faunistic Studies on Dorcadion Dalman, 1817 (Coleoptera: Cerambycidae) Species of Collected from the Province of Erzurum and EMET Collection M. Tatar, G. Tozlu	**14:30**	Experimental Longline fisheries in artificial reefs in the northern Aegean Sea A. Özgül, A. Lök	**14:30**	Preference of Biofilm Mode of Growth of Vibrio Species S. Çam

HALL 1		HALL 2		HALL 3	
CLICK TO ATTEND		CLICK TO ATTEND		CLICK TO ATTEND	
Session 5 : Diversity of Plant species, Systematics and Phylogeny-4		**Session 5 : Aquatic (Marine and Freshwater) Biodiversity-2**		**Session 5 : Biodiversity, Landscape, Tourism-2**	
Session Chair: Ümit İncekara		**Session Chair: Ahmet Mutlu Gözler**		**Session Chair: Işık Sezen**	
15:00	Notes on *Anastrophyllum minutum* (Schreb.) Schust in Turkey H. Erata, N. Batan, M. Alataş	**15:00**	Biodiversity and SHE Analysis of Recent Foraminifera from The Benthic Zone of Marine Ecosystem in Ilıca Bay (Izmir, Eastern Aegean, Turkey)	**15:00**	Could biodiversity parameter results be misleading? G. Aydın, C. Kazak

			Ş. Parlar		
15:15	Notes on *Scapania obscura* (Arn. & Jens.) Schiffn. in Turkey (Scapaniaceae, Hepaticae) H. Erata, G. Abay, N. Batan, T. Özdemir	**15:15**	Benthic Foraminiferal Biodiversity of Demre Coasts (Antalya, Turkey) Ş. Parlar, H Duran	**15:15**	Comparison of Insect Biological Diversity Parameters in Natural and Degraded Habitats in Gölcük Nature Park Forest (Isparta, Turkey) G. Aydın
15:30	Survival Struggle of Local Endemic Paeonia mascula subsp. bodurii in Çanakkale B. Kökçü, E. Karabacak	**15:30**	Length-Weight Relationship of Neogobius melanostomus and Gobius niger species from the Eastern Black Sea, Turkey H. Onay, G. Dalgıç	**15:30**	Connectivity is Vitally Important in a Fragmented Forest Ecosystem To Sustain Biodiversity: An Analysis for Rize H. Simten Sütünç, Ö. L. Çorbacı
15:45	A View to Floristic Richness of Gallipoli Peninsula (Çanakkale) S. İşlek, E. Karabacak	**15:45**	The Occurrence of Caulobacteraceae Members in the Different Marine Regions of Turkey G. Altuğ, S. Kalkan, P. S. Çiftçi Türetken	**15:45**	Detecting Barriers Between Protected Areas to Restore Ecological Connectivity H. Simten Sütünç
16:00	Comparative Analysis of the Flora of Mud Volcanoes Alyat (Azerbaijan) S. Isayeva	**16:00**	Seasonal Changes of Fish Diversity and Species Composition in Borçka Dam Lake (Lower Çoruh River Basin, NE Turkey) T. Yeşilçiçek	**16:00**	
16:15	Historical Background of Biodiversity of Erzurum Province and its Contribution to the Turkey's Biodiversity Ü. İncekara, A. Polat	**16:15**	~~Feeding Habits and Diet Composition of Atlas Barbel, *Luciobarbus ksibi* (Boulenger, 1905) in Zat Basin, Morocco~~ ~~H. Benaissa, H. Rassam, S. Moutaouakil, N. Fetnassi, M. Ghamizi~~	**16:15**	
16:30		**16:30**	Comparison of Fatty Acid Composition in Edible Muscle Tissue of Three Native Trout Species: *Salmo rizeensis*, *Salmo coruhensis*, and *Salmo caspius* B. Karslı	**16:30**	

20.11.2020, FRIDAY

10:00	**Keynote_ Material Transfer from Nature to Technology** ***Murat Kaya – TURKEY*** CLICK TO ATTEND KEYNOTE HALL 1, CLICK TO ATTEND KEYNOTE HALL 2

HALL 1 CLICK TO ATTEND		**HALL 2** CLICK TO ATTEND		**HALL 3** CLICK TO ATTEND	
Session 6: Effects of Biodiversity to Human Health-1		**Session 6: Conservation Biology, Policy And Strategies & Protected**		**Session 6 : Invasive Species & Biodiversity of Parasites and Their Hosts-1**	
Session Chair: Şule Güzel Izmirli		**Session Chair: Ayşenur Eminoğlu**		**Session Chair: Gazi Görür**	
10:45	Antibacterial Activity of Orange (*Citrus aurantium*) and Stinging Nettle (*Urtica dioica*) Extracts Against Selected Fish Pathogenic Bacteria O. Kobya, B. Kara, E. Uzun-Yaylaci, E. Çağlak	**10:45**	New Data on Rare Beetle *Chrysochares asiaticus* (Pallas, 1771) (Coleoptera: Chrysomelidae) from Turkey and a Call for Conservation N. Gültekin, C. Gözüaçık, R. Gürbüz, M. Güdek	**10:45**	*Sitona germar* (Coleoptera: Curculionidae) Species and Ecological Observations in Alfalfa Areas in Iğdır Province, Turkey C. Gözüaçık, N. Gültekin, E. Aykut
11:00	Melissopalynological and Physico-Chemical Properties of Ayder (Camlihemsin / Rize) Honeys E. Demir, V. Atamov, K. Sorkun	**11:00**	Determination of Mammalian Diversity with Their Conservation Status in Kamilet Valley (Arhavi, Artvin): The Preliminary Results P. S. Şeker, G. A. Keleş	**11:00**	New data on Astragalus L. feeder *Sitonini gistel* (Coleoptera: Curculionidae: Entiminae) species from eastern Anatolia, Turkey C. Gözüaçık, A. J. V. De Castro, N. Gültekin, A. J. V. De Castro
11:15	The Biological Activity of *Pistacia terebinthus* subsp. *terebhinthus* L. N. Erden, N. Hacıoğlu Doğru	**11:15**	~~State Practice of India In Protection Of Marine Environment With Specific Reference to UNCLOS~~ ~~S. Goswami~~	**11:15**	*Culicoides tbilisicus* Dzhafarov, 1964 (Diptera: Ceratopogonidae), A New Record For Turkish Biting Midges F. Turgut, Ş. Küçük
11:30	~~E-Waste: The unerasable Footprints~~ ~~H. Goswami~~	**11:30**	Endangered Species: Sturgeons Conservation and Management Strategies K. Ak	**11:30**	Investigation on Weevil (Curculionoidea) Diversity at Burnaz Coastal Dunes in Eastern Mediterranean Turkey L. Gültekin, M. Güdek, N. Gültekin
HALL 1 CLICK TO ATTEND		**HALL 2** CLICK TO ATTEND		**HALL 3** CLICK TO ATTEND	
Session 7 : Effects of Biodiversity to Human Health-2		**Session 7 : Population Ecology**		**Session 7 : Invasive Species & Biodiversity of Parasites And Their Hosts-2**	

Session Chair: Nusret Özbay		Session Chair: Ertuğrul Ağırbaş		Session Chair: Ali Miroğlu	
13:00	An Ethnobotanical Properties Of The Some Taxa of Şebinkarahisar District In The Giresun Province (Turkey) R. Hüseyinoğlu	**13:00**	Cranial Osteology of *Lacerta trilineata* Bedriaga, 1886 and *Lacerta viridis* (Laurenti, 1768) (Sauria: Lacertidae) Populations Distributed in Thrace Region A. Köse, Ç. Gül	**13:00**	The Bruchus L. (Coleoptera: Chrysomeliadae) Species Feeding on Vicia Plants in Northeastern Anatolia M. Güdek Güçlü, L. Gültekin
13:15	Abilities and Behaviours of some Monocotyledonous and Dicotyledonous Plant Species Consumed as Food in Perceiving the Water Source S. Özgün, G. Işık	**13:15**	Age and Body Size of the Mediterranean Chameleon, *Chamaeleo chamaeleon*, (Linnaeus, 1758) from Adana, Turkey K.I Candan	**13:15**	The Deterrent Effect of Some Natural Chemicals on the Feeding of *Thaumetopoea pityocampa* Den. & Schiff. (Lep: Thaumetopoeidae) Larvae B. Firidin, N. Altun
13:30	Specification and Functional Properties Evaluation of Some Tropical Fruits M. A. Ndisanze, H. Pashazadeh, I. Koca	**13:30**	Life-history traits in a population of the Artvin lizard, *Darevskia derjugini* H. Eksilmez, A. Altunışık	**13:30**	Aphids (Hemiptera: Aphididae) Diversity on Oaks (*Quercus spp*.) in the South Marmara Region and the Presence and Distribution of the Oak Aphids in Turkey Ş. Kök
13:45	~~Repellent effect of plant extracts from *Hertia cheirifolia* and *Marrubium deserti*~~ ~~S. Lebbal, A. Zeraib, F. Amamri~~	**13:45**		**13:45**	Reassess of the *Valgothrombium alpinum* Willmann, 1940 (Actinedida: Microtrombidiidae) İ. Karakurt, S. Sevsay
14:00	Types of *Paeonia* and Their Use in Phytotherapy G. Demirboğa, Y. Demirboğa, N. Özbay	**14:00**	Seasonality of Phytoplankton Size Classes and Pigment Indices along the South-Eastern Black Sea E.Ağırbaş, M. N. Karadeniz	**14:00**	Bruchinae Species (Coleoptera: Chrysomeliadae) Feeding on Field Bindweeds in Northeastern Anatolia Region M. Güdek Güçlü, L. Gültekin
14:15	Antimicrobial Activity of *Ajuga chamaepitys* subsp. *chia* (Schreb.) Arcang A. N. Savaş, N. Hacıoğlu Doğru	**14:15**	First Report on the Herpetofauna of Belezma Biosphere Reserve, Province of Batna, North-Eastern Algeria I. Bouam	**14:15**	

HALL 1 CLICK TO ATTEND		HALL 2 CLICK TO ATTEND		HALL 3 CLICK TO ATTEND	
Session 8 : Environmental Toxicology-2		**Session 8 : Biogeography and Global Climate Change Effects on Biodiversity Areas**		**Session 8 : Diversity of Plant species, Systematics and Phylogeny-5**	
Session Chair: Mustafa Cüce		**Session Chair: Abdullah Altunışık**		**Session Chair: Hüseyin Baykal**	
15:00	The Effect of Different Malathion Concentrations on Algal Growth in Cultural Conditions B.Temizel, E. N. Soylu	**15:00**	Is the Substrate an Important Factor in the Investigation of Gypsophile Endemism? A. Kayabaş, L. Kurt	**15:00**	Preliminary Studies on Reproductive Success in *Fritillaria aurea* Schott (Liliaceae) F. Yıldız, M. Aslay, A. Kandemir
15:15	Effects of Juglone on the Antioxidant Metabolism in the Larval Hemolymph of the Greater Wax Moth Galleria mellonella L. (Lepidoptera: Pyralidae) E. Duman Erbaş, H. Altuntaş	**15:15**	Importance of Stones for Soil Invertebrate Diversity of Mediterranean Oak Forests in Fire Events J. Puga, J. J. Keizer, N. Abrantes	**15:15**	Preliminary studies on the effects of different pollination types on reproductive success in *Scrophularia erzincanica* R.R.Mil (Scrophulariaceae) and *Scrophularia fatmae* Kandemir & İlhan F. Yıldız, H. İ. Türkoğlu, A. Kandemir, E. Kılıç, N. Yıldırım Doğan, M. Bekdemir
15:30	~~A Study of the Toxicity of EGME to a few Reproductive Parameters in male Wistar Rats.~~ ~~L. Hamdi, F. Arkoub, R. Boukarine, K. Khelili~~	**15:30**	Biogeography of Turkish Salix L. species P. Acar, F. Ö. Değirmenci, Z. Kaya	**15:30**	The Diversity Of Vascular Plants And Conservation In Rize V. Atamov, A. Süzen, H. Baykal, E. Demir

16:00	**Keynote_ Water and Climate: Education as a tool for understanding change** ***John Edward Etgen – USA*** CLICK TO ATTEND KEYNOTE HALL 1, CLICK TO ATTEND KEYNOTE HALL 2

POSTER PROGRAMME

19.11.2020 THURSDAY
(between 10.00 – 16.00)

POSTERS	
Hunting Dogs as a potential source of *Toxoplasma gondii* infection in humans	A.Y.Bellatreche, R. Bouzid, A. Blaizot, R. Blaga, D. Le Roux, K. Ait-Oudhia
Investigation of the public health risks of the invasive species *Aedes albopictus* and *Aedes aegypti* in Turkey	M. Öztürk, H. Bedir, B.Demirci, M. M. Akıner
Determination of the effects of lead treatment on development period, fecundity, sex ratio and longevity of *Bracon hebetor* (Hymenoptera: Braconidae)	N. Korkmaz Boz, N. E. Akman Gündüz
The Interaction of Lead with Protein, Lipid and Carbohydrate Concentrations in Bracon hebetor Say (Hymenoptera: Braconidae) Adults	N. Korkmaz Boz, N. E. Akman Gündüz
Survey of the possible fungal pathogens of *Orosanga japonica* (Hemiptera: Ricanidae) in Eastern Black Sea Area	Z. Bayramoğlu, S.Biryol, İ. Demir
Biocontrol efficacy of *Trichoderma atroviride* ID20G against biotic stress of *Rhizoctonia solani* B227 in bean development	A. Bozdeveci, M. Pınarbaş, E. Demirci, Ş. Alpay Karaoğlu
Monitoring of the development of a bacterial community for the strain "*Pseudomonas fluorescens*" and characterization by several microscopies	D. Nesrine, K. Houssem, L. Béven, F. Moroté, C. Grauby-Heywang, H. Sbartai, T. Cohen-Bouhacina
Atomic force microscopy study of telluric bacteria "*Pseudomonas fluorescens*" used in the bioremediation of soils contaminated with xenobiotics	K.i Houssem, N. Debez, L. Béven, F. Moroté, C. Grauby-Heywang, H. Sbartai, T. Cohen-Bouhacina
Dairy effluents disinfection from contaminating bacteria by local clay of Kenadsa-Bechar (Southwest of Algeria).	Nouria Nabbou, Elhassan Benyagoub, Meriem Belhachemi, Moncef Benyahia
Evaluation of the chemical risk of liquid effluents from a dairy unit in South West of Algeria	N. Nabbou, E. Benyagoub, A. Mellouk

~~Effect of temperature on plant cell wall degrading enzymes produced by pathogenic bacteria isolated from pear plants in Morocco~~	~~N. Lemjiber, N. Khalid, A. Dihazi~~
CRISPR/Cas system and phage/plasmid biodiversity of *Vagococcus* spp. through protospacer analyses	Ö. Kahraman Ilıkkan
Biocontrol efficacy of *Trichoderma lixii* ID11D against biotic stress of *Rhizoctonia solani* B227 in bean development	Ş. Alpay Karaoğlu, A. Bozdeveci, M. Pınarbaş, E. Demirci
Three new potential cargo microorganisms wıth isolated from honeybees in Turkey	Ş. Alpay Karaoğlu, Ş. Suyabatmaz, A. Bozdeveci, R. Akpınar, E. Sevim, A. Sevim
Plant use and diversity in urban homegardens in Latin America – A Review	L. Rojas, V. Verner, P. Van Damme

20.11.2020 FRIDAY
(between 10.00 – 16.00)

POSTERS	
Contribution to the divergence time of *Bufo bufo* Species group using new anatolian dataset	C. Dursun, N. Özdemir, S. Gül
Digging past: bayesian skyline plot analysis of *Bufo bufo* and *B. verrucosissimus* populations from Anatolia and Caucasia	N. Özdemir, C. Dursun, S. Gül
Impact of fires on post-fire plant diversity ın a portion of the Blidaean Atlas (Northen Algeria)	A. Debieb, L. Kadik
Ecophysiological responses of *Zea mays* L. against thermal power plant fly ash applications	S. Özgün, G. Işık
Comparison of *Tragopogon abbreviatus* and its close relative taxa based on anatomical data	G. Kaya, M. Gültepe, S. Makbul, K. Coşkunçelebi
New taxonomic findings for the wild *Vaccinium* L. (Ericaceae) Taxa Distributed in Turkey	G. Yılmaz, M. E. Güzel, K. Coşkunçelebi
Achene anatomy of *Lactuca* (Asteraceae) taxa endemic to Turkey	M. E. Güzel, S. Makbul, K. Coşkunçelebi
Morphological and molecular characterization of different garlic genotypes grown in Kayseri conditions	N. Kıraç, H. Kıraç, A. Koca, O. Gülşen
Determination of genetic diversity of *Syntormon pallipes* populations in Muğla province using ISSR markers	Ö. Yüzer, A. Tonguç, E. Doğaç
Review on phytochemical and antioxidant properties of passion fruits (*Passiflora* sp.)	M. A. Ndisanze, M. Ghelam, I. Koca
Current and potential distribution of *Aedes albopictus* and *Aedes aegypti* in Turkey	M. Öztürk, H. Bedir, B. Demirci, M. M. Akıner
Age structure of *Bufo verrucosissimus* (Pallas, 1814) males from Artvin, Turkey	N. Özdemir, C. Dursun, O.Ö.Berberoğlu
Aflatoxin B1 degradation by commercial enzymes	T. Söylemez

FULL TEXTS AND ABSTRACTS

Invited Speaker
Oral Presentation

The Contribution of Italian Research to Biodiversity Assessment and Conservation in Anatolia and Adjacent Areas

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ABSTRACT

An outline of the history of Italian zoologists in Anatolia, from the forerunners in the early 19th Century to the first decades of the 21st Century. The research and discoveries of prominent zoologists like Enrico Tortonese and Augusto Vigna Taglianti are discussed, as the decades long contribution of the Italian Natural History Museums and Universities and the Società Romana di Scienze Naturali.

Keywords: Italy, Turkey, zoology, history

INTRODUCTION

This paper is designed to highlight the considerable contribution, over time, made by Italian researchers to the knowledge of biodiversity in Turkey. This has been focused on the part of Turkey known as Anatolia which forms an extensive bridge between Europe and Asia (Figure 1). Anatolia has been visited by many European travellers from the time of Marco Polo's first Far Eastern journeys in the thirteenth century, and the richness of its biodiversity astonished the zoologists who began to explore it in the nineteenth century and more frequently in the twentieth century. Students of natural history have come from various countries- Italy, France, Russia, Germany, Austria, Switzerland and parts of Central Europe including Hungary and the Czech Republic- but Italian researchers have been particularly important because of their tendency to go East, towards what are seen as the sources of Mediterranean civilisation. Anatolia is of course more accessible today than in the past, joined to Europe by the iconic Bosphorus Bridge (dedicated to Mustafa Kemal Atatürk, founder of modern Turkey), so it is ever easier for Rome and our Italian homeland to feel a close connection with Istanbul and beyond it with Anatolia. Former and continuing research has resulted in an impressive number of papers, many appearing in authoritative journals, and in multitudes of preserved specimens in both private and public collections. All these confirm the friendly and fruitful collaboration between natural scientists of the two countries.

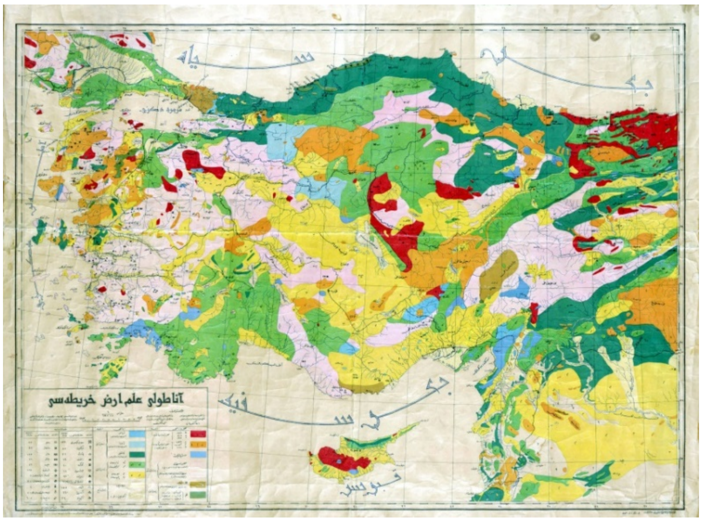

Figure 1. Geological Map of Anatolia in Ottoman Turkish (downloaded from: https://commons.wikimedia.org)

MATERIALS AND METHODS

A search for as many studies as possible, written by Italian authors on the fauna of Anatolia, has been carried out. However in spite of exhaustive efforts a search on this scale cannot be considered absolutely complete, and some authors and even important works may have been omitted. Most of the papers cited here has been reviewed, evaluated and given a brief description. The collaborative relationships shared by Turkish and Italian zoologists, which increased progressively during the last century, have been given particular attention.

History of Italy's contribution to knowledge of the fauna of Anatolia and the zoogeography of the Near and Middle East: the forerunners

The first expeditions to Anatolia were made by Italian, French and Middle European naturalists (for summary see Vigna Taglianti & Zapparoli, 1999), and early researchers were mostly entomologists. Giuseppe De Cristoforis (1803-1837) together with Giorgio Jan (1791-1866) a distinguished herpetologist and founder of the Milan Natural History Museum, described some new, showy and still valid species, such as Carabus chevrolati now Carabus (Procrustes) chevrolati chevrolati (Cristoforis & Jan, 1837) (Figure 2). Other interesting species of Carabus were collected in approximately the same decades (1837-1845) by Gaetano Osculati (1808-1898). Then in the second half of the nineteenth century, the zoologist Achille Costa (1823-1898) (Figure 3) visited the coast of Anatolia as part of a much more extensive trip to Eastern Mediterranean countries. However this situation changed considerably at the beginning of the twentieth century. Complex war developments opposed Italy to Turkey, and field trips by naturalists were therefore concentrated on the Dodecanese Islands rather than the mainland where the political situation was uncertain. Such visits include a significant first trip to Rhodes Island. Early collections were usually made by gentlemen keen on natural history and travel. The investigations made by Enrico Festa (1868-1939) and the most distinguished Italian zoologist of the first half of the century Alessandro Ghigi (1875-1970) were made in this context (Ghigi, 1928, 1929). The Dodecanese Islands were a favoured destination and repeatedly visited by many Italian naturalists including Raffaele Issel (1878-1936), Alessandro Brian

(1873-1969), and Prince Alessandro Dalla Torre e Tasso (1881-1937), owner and founder of the Entomological Museum "Pietro Rossi" in Duino near Trieste. Others included Arturo Schatzmayr (1880-1950), Alessandro Mochi (1920-1995), Carlo Menozzi (1892-1943), Giuseppe Jannone (1907-1971), Marcello Cerruti (1908-1978) and finally the Marquis Saverio Patrizi (1902-1957). All were entomologists but with different interests within the field, primarily beetles (see for example Baudi di Selve, 1870; Gridelli, 1919; Cerruti, 1977), but also ants and locusts. In this context the importance of a classic paper on beetles is notable, giving the results of a spring survey made in 1964 in mainland Greece and western Turkey by Franco Tassi (Tassi 1968), who was long time Director of the Abruzzi National Park (now Abruzzi, Latium and Molise National Park).

Figure 2. *Carabus chevrolati*, photo© by "pierrickb": https://www.inaturalist.org/observations/38371364

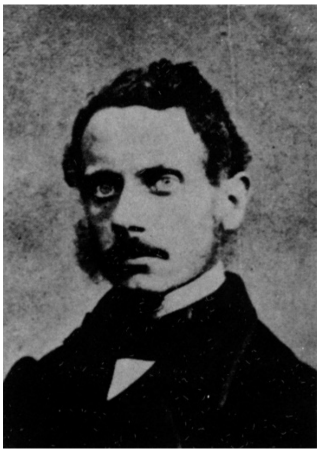

Figure 3. Achille Costa (from: Cesare Conci et Roberto Poggi (1996), Iconography of Italian Entomologists, with essential biographical data. Memorie della Società entomologica Italiana, 75 : 159-382. ISSN 0373-8747)

General investigations on marine biology, focused on the fishes of the Levant Sea, Bosporus and Black Sea, were made by Luigi Sanzo (1874-1940) and Emilio Cesare Ninni (1868-1945). Above all Enrico Tortonese (1911-1987) was the first Italian zoologist to promote a properly coordinated research program in Anatolia directed towards fishes of marine and inland waters. A long-time Director of the Museum of natural History "*G. Doria*" in Genoa Tortonese, from the beginning of his scientific career, had taken a deep interest in the fauna of the Middle East. The valuable results of his active research interests lie in records, observations and collections made between 1943 and 1981 in Turkey, Lebanon, Israel, Jordan, Saudi Arabia and Egypt. Of five trips to Anatolia two were made concurrently with a congress of the *Commission Internationale pour l'Exploration Scientifique de la Méditerranée* (CIESM). In a period of about 40 years Tortonese visited many sites in the western regions of Anatolia including the Menderes River, the city of Aydın, and the Akdağ massif bordering the Gulf of Antalya.

During these years this scientific field was dominated by the imposing figure of Curt Kosswig (1903-1982), known as the "father of Turkish zoology". He was Director of Hamburg Museum, and acquired important collections while he was in exile in Turkey (Glaubrecht, 2018; Omodeo & Rota, 2008). Enrico Tortonese, on the occasion of his most important journey (summer 1951), was probably the first Italian zoologist to be the guest of the Turkish University, Istanbul (at that time known as the Institute of Zoology). Tortonese was invited by Professor Cosswig to the *Symposium for the Biogeography of the Near and Middle East* which focused on the fauna of eastern Mediterranean landscapes. About 30 specialists participated, from countries including Turkey, Israel and Egypt. Before the conference Kosswig organised a trip to collect interesting fish species from the lakes Sapanca and Abant, the River Sakarya, the Tuz Gölü and Acı Göl Lakes, and some sites near Bursa. In a brief report on all these activities, Tortonese listed 45 papers together with various notes on environment and animal life. Special contributions deal with the freshwater fishes of Anatolia in the families Cobitidae and Salmonidae (Tortonese, 1948, 1951, 1952, 1954, 1985). He saw the endangered species *Cobitis bilseli* Battalgil in 1942 in Lake Beysehir near Isparta, and the beautiful butterfly *Parnassius apollo kosswigi* de Lattin, was encountered in 1941 on Uludağ Mountain near Bursa (Tortonese, 1985) (Figure 4). During these years we must also remember a few other Italian zoologists who made significant contributions. Marcello La Greca (1914-2001) and Pietro Omodeo (born 1919) worked on Polychaeta and Oligochaeta respectively (La Greca, 1949; Omodeo 1952 a, b, c). Notably La Greca provided the checklist (re-describing some species) of an interesting collection of Polychaeta from the Bosphorus which had been sent him by the University of Istanbul and in whose journal he published the report (La Greca, 1949; Baccetti & Ruffo, 2004; Buzzetti, 2004). Other actors appear on this stage as Turkey modernises year by year. The Turkish Republic is proclaimed in 1923 starting notable economic and social growth. The development of a modern road network after the second World War added a great bonus for naturalists wanting to explore the Anatolian landscape (Crucitti, 2005).

Figure 4. *Parnassius apollo* in Turkey, 2009, photo © by Chris van Swaay: https://www.inaturalist.org/observations/44625385

Zoological research in the Near East by the Universities of Rome

Beginning in the 1960s (the first expedition by Paolo Marcello Brignoli, Vezio Cottarelli and Giuseppe Osella was in 1968; Cottarelli personal correspondence VIII, 2020) numerous expeditions to countries bordering the Mediterranean took place in the framework of a joint zoological program developed by the Universities of Catania, Siena and Padua together with the Universities of Rome "Sapienza" and "Tor Vergata" (Omodeo & Rota, 2008). The introduction to the first list of research trips and resulting papers opens "*We felt that it was advisable to study Eastern Mediterranean fauna in order to gain a better understanding of the origins of Mediterranean fauna in general, and Italian fauna in particular*" (Sbordoni & Vigna Taglianti, 1989). The collation of this register was influenced by the many expeditions initiated by the Rome Universities after a first voyage to Lebanon in 1963. The main purpose of the initiative "Zoological Researches in the Near East by La Sapienza and Tor Vergata Universities of Rome" was to improve the knowledge of those areas south of the Aral-Pontus basin which form one of the faunal routes connecting Asia with Mediterranean Europe. The project was aimed to clarify dispersal and colonisation patterns which had occurred since the Miocene. Special attention was to be given to caves, deep soils and phreatic habitats for their richness in endemic and relict taxa. The limited knowledge of near East invertebrate fauna at the time made the clarification of taxonomical problems in this field a priority for the research.

The long series of Italian zoological missions to Turkey and neighbouring countries has gradually taken on an official character through the participation of the Rome Universities, mainly the Department of Animal and Human Biology (since 2010 the Department of Biology and Biotechnologies "Charles Darwin" of "Sapienza"). This was followed by the establishment of similar departments in the new university centres of Tor Vergata, Roma Tre and the University of Tuscia near Viterbo (Rome). Research is also produced by the Museo Civico di Storia Naturale di Verona and the Museo Civico di Storia Naturale "Giacomo Doria" di Genova, the civic museums of these cities (Sbordoni, 2000). Support used to come from the INE Instituto Nazionale di Entomologia (National Institute of Entomology) which has long since been suppressed, the Accademia Nazionale dei Lincei (National Academy of Lincei) and the CNR Consiglio Nazionale delle Ricerche (National Research Council of Italy). Other significant protagonists in this exciting arena have been the ARDE Associazione Romana di Entomologia (Rome Entomological Association) and the Museo Regionale di Scienze Naturali di Torino (Turin Regional Museum of Natural Sciences) both of which institutions with experienced specialists in several taxonomic groups. In the list of Sbordoni & Vigna Taglianti (1989) 61 research trips are listed of which 31 were in European Turkey and Anatolia, with others combining different countries (e.g. Turkey and Greece, or Turkey and Iran). This paper also lists 127 papers with other addenda and some unpublished titles. Many of these by Italian authors have been published in authoritative journals such as *Fragmenta Entomologica, Bollettino di Zoologia, Revue Suisse de Zoologie, Bollettino del Museo Civico di Storia Naturale di Verona* etc. Over 75 articles are devoted to Turkish taxa from planarians to amphibians, through to leeches, earthworms, spiders and other arachnids, tardigrades, insects (primarily beetles) and crustaceans; there are also a number of more general reports. Sbordoni (2000) brings the number of research trips up to the remarkable total of 109. Among these 11 were concerned with Anatolia in both north eastern and south eastern areas of the region (Vigna Taglianti & Zapparoli, 2000). The grand total of relevant papers eventually reaches 197, with no less than 30 papers on varied Turkish taxa from earthworms to reptiles, birds and mammals.

The contribution made by the Circolo Speleologico Romano

The extensive increase in research material gathered from the frequent and focused investigations carried out in the second half of the twentieth century provides a thorough analysis of various animal groups, some from very specialised habitats. Speleological knowledge of Turkey was largely incomplete till 1960, and caves of considerable size and depth were only discovered and explored in later years. Turkish speleologists coordinated by Dr Temuçin Aygen took part in this work as did others, France and Great Britain particularly (Agnoletti, 2015). Preliminary information gathered from earlier explorations by European zoologists, notably Weirather, Kosswig, Lindberg, Patrizi, Coiffat and Strinati had highlighted the great interest offered by the specialised cave fauna of Turkey, and made clear that much more in-depth studies were needed (Sbordoni, 1969, 2000). Research on the cave fauna of the Near and Middle East during the twentieth century benefited from the expeditions organised by the Circolo Speleologico Romano (CSR) (Speleological Circle of Rome), founded in Rome in 1904, when interest in Italian exploration of caves began to develop. Work carried out by CSR zoologists in Turkey, over more than 80 years, represents a significant contribution to bio-speleological knowledge of the Anatolian peninsula (Agnoletti, 1969, 2005; Agnoletti *et al.*, 1970; Marzolla, 1969; Sbordoni, 1969; Sbordoni & Latella, 2015). The first explorations of the karst area near Antalya go back to the first quarter of the last century when a preliminary field trip to In Dagh explored the impressive sacred cave at Döşemealtı in 1928. This cave, now know as Kocain Cave, was at that time titled "Ulisse Aldrovandi Cave" in honour of this great sixteenth century naturalist from Bologna. These early investigations uncovered a real "Pandora's box" of natural riches which would make it impossible ever to "put the lid on" this line of research again.

Among the numerous expeditions take abroad by the CSR between 1928 and 2008, a trip to the Taurus mountains is chronologically the starting point, followed by 12 more systematic explorations. One was for entomological collecting by Saverio Patrizi in the In Dagh karst, and is recorded in his 1956 diary (Patrizi, 2015). To honour this pioneer of cave biology, Carl Friedrich Roewer named a spider, a new species of *Araneidae* from the Pamphylia Taurus, as *Pholcus patrizii*, now *Hoplopholcus patrizii* (Roewer, 1962). However the first major organised expedition takes place in Turkey during 1969, with seven participants discovering 15 new caves on the Taurus massif near Konya and Isparta, 3 of them at Lake Beyşehir. In 1970 another CSR expedition to the Taurus examined many more caves - Asarini, İnögüini, Pozzo degli Italiani (-138 m), Gölcük Düdeni (=Gölcük Sinkhole), Ferzen Cave, Dibek Düdeni (=Dibek Sinkhole), Eksi Elma, Yer Köprü. Kayaönü Mağarası, caves near the village of Aladağ, Mağara Değirmenderesi, Cave 1 and Cave 2 of Bor Onu, Yağcı Köyü, Boraz Makka, Körükini and Değirmenini and a fossil branch of Tınaztepe. Then in 1973 in excess of 20 more caves were explored for bio-speleological research, mainly localised in the Taurus massif, with remarkable results. These expeditions focused on the careful collection of specialised animals (troglobitic fauna) and involved on-site stays of over a month and participation by many professional researchers. Major drawbacks could disrupt work in such difficult locations, for instance in 1967 when a vehicle was almost totally destroyed and valuable materials lost, but even re-examination of previously studied caves continued to add to the extremely interesting findings (Sbordoni, 1969).

The outline chronology of the CSR expeditions is as follows: 1956, Kocain Cave following the cruise-expedition of the research vessel "Vema" organised by the Lamont Geological Observatory, Columbia University; 1967, Konya, Isparta, Burdur, Antalya; 1968, Pontus Mountains and south-west coast of the Black Sea; 1969, Konya, Isparta, vicinity of Lake Beyşehir; 1970 and 1973, Çamlık, Tınaztepe and Haydin areas in the Taurus mountains; 1976, a large area extending up to Lake Van; 1982, north-eastern Anatolia; 1989, 1990, 1992, the Ayvaini Magarası near Bursa, Mersin, Western Anatolia; 1998, Taurus mountains of the Lycia and south-eastern Anatolia (Sbordoni & Gambari, 2015).

The abundant collections from these trips highlighted the numerous taxa discovered. Memorably these include Ascomycetes Laboulbeniaceae (*Laboulbenia vignai* Rossi, 1978), Annelida Oligochaeta (*Spermophodrilus vignai* Omodeo & Rota 1989; *Peloscolex arganoi* Pop, 1974), Hirudinea (*Dina vignai* Minelli, 1978), Crustacea Gammaridae and Hadziidae (*Gammaropisa arganoi* Ruffo & Vigna Taglianti, 1988; *Gammarus vignai* Pinkster & Karaman, 1978; *Parhadzia sbordonii* Vigna Taglianti, 1988), Arachnida Pseudoscorpiones and Araneae (*Neobisium agnolettii* Beier, 1973; *Neobisium sbordonii* Beier, 1973; *Harpactea sbordonii* Brignoli 1978; *Coelotes vignai* Brignoli, 1978; *Tegenaria agnolettii* Brignoli, 1978; *Tegenaria forestieroi* Brignoli, 1978; *Tegenaria vignai* Brignoli, 1978; *Coelotes arganoi* Brignoli 1978; *Harpactea diraoi* Brignoli, 1978; *Harpactea vignai* Brignoli, 1978; *Cataleptoneta sbordonii* (Brignoli, 1968); *Hoplopholcus patrizii* (Roewer, 1962)), Chilopoda (*Harpolithobius vignataglianti* Zapparoli, 1989), Orthoptera (*Dolichopoda sbordonii* Rampini & Di Russo, 2006) and finally Colepotera: Carabidae (*Calathus vignatagliantii* F.Battoni, 1986; *Carabus tenuitarsis vignatagliantii* Breuning & Ruspoli, 1977; *Laemostenus* (*Antisphodrus*) *agnolettii* Vigna Taglianti, 1999; *Laemostenus patrizii* Vigna Taglianti, 1999; *Sbordoniella* Vigna Taglianti, 1980 with the species *Sbordoniella indagi* Vigna Taglianti, 1980), Melolonthidae (*Maladera vignai* Sabatinelli, 1977), Pselaphidae (*Tychobythinus vignai* Besuchet, 1978) and Staphylinidae (*Vulda vignai* Bordoni, 1973). The list of genera and species named after members of the CSR is impressive evidence of the impact of their research activities. The names so featured include the late Saverio Patrizi, Marcello Cerruti, Paolo Marcello Brignoli, and Augusto Vigna Taglianti; Pietro Omodeo, Roberto Argano, Valerio Sbordoni, Vezio Cottarelli and Mauro Rampini, now retired; Marzio Zapparoli, Leonardo Latella and Saverio Forestiero, still active. Thirty-two other researchers have been involved (Sbordoni & Gambari, 2015; Sbordoni & Laetella, 2015; Vigna Taglianti & Zapparoli, 1999).

Augusto Vigna Taglianti and Anatolia

In the context of research in Anatolia is it important to acknowledge the outstanding contribution made by Professor Augusto Vigna Taglianti (1943-2019). A zoologist at the "Sapienza" University, whose contacts and leadership in this field extended to both amateurs and professionals in the world of natural history, managing to be a friend to all. He journeyed into various geopolitical landscapes as well as Anatolia, with the Balkans, the Middle East, North Africa and Somalia among other adventurous destinations. His collaborators included Paolo Audisio, Marco Alberto Bologna, Maurizio Biondi, Giuseppe Maria Carpaneto, Marzio Zapparoli and other professional entomologists specialising in different animal groups, for instance Sandro Bruschi, Achille Casale and Fabio Cassola (1938-2016), and with the charismatic evolutionary biologist Pietro Omodeo, a distinguished specialist in earthworms (Vigna Taglianti & Zapparoli, 1999; Poggi, 2019; Carpaneto *et al.*, 2019). Among Italian entomologists Vigna Taglianti was known to be deeply involved with Turkey, after his many surveys done in the Anatolian Peninsula. An impressive number of species or subspecies have been dedicated to him. Taxa named "*vignai*" or "*vignatagliantii*" are 75 in all, and 13 of these come from Anatolia (Carpaneto *et al.*, 2019). A major synthesis of faunal and ecological research is the subject of two volumes produced by the Società Italiana di Biogeografia (SIB) (Italkian Society of Biogeography) on "Biogeografia dell'Anatolia" (Biogeography of Anatolia) devotes a grand total of 1,050 pages to papers by some dozen Italian contributors, and Vigna Taglianti's work should be given credit in this context.

Part 1 of this SIB conference report (Vol. XX, 1999) consists of 12 articles (406 pages). The opening paper is dedicated to the Italian contribution to wildlife research in Anatolia during the nineteenth and twentieth centuries (Vigna Taglianti & Zapparoli, 1999). The second paper outlines a new proposal for the classification of Near East chorotypes using a methodological approach not unlike a previous contribution concerned with the chorotypes of the Western Palearctic fauna (Vigna Taglianti *et al.*, 1992, 1999). Both these papers are of outstanding zoogeographical importance. Further articles in the report are on terrestrial Oligochaeta, Scorpiones, supralittoral Amphipoda, Chilopoda, Orthoptera, Trichoptera, Lepidoptera, Coleoptera Cicindelidae. The concluding monograph, by Vigna Taglianti and Achille Casale, is on the Coleoptera Caraboidea (Cicindelidae/Cicindelinae excluded - see discussion in "**Selected groups studied by Italian authors**").

Part 2 of the SIB conference proceedings (Vol. XXI, 2000) contains 16 articles (657 pages) including the final remarks by Valerio Sbordoni (Sbordoni, 2000). The first seven papers are on faunal distribution patterns in Coleoptera (Cholevidae (now in Leiodidae), Hydrophilidae, Scarabaeoidea, Nitidulidae, Kateretidae and Tenebrionidae. These are followed by articles concerned with vertebrate fauna. A weighty paper gives a checklist and zoogeographical analysis of the reptiles of Anatolia. Further contributions deal with marine turtles, birds, small mammals, Pleistocene mammals of Cyprus. Final subjects primarily concern on mammals. These include large species of Carnivora and Artiodactyla and the paleobiogeography of the Cenozoic Anatolian fossil fauna of small mammals (Kotsakis & Barisone, 2000). The zoogeographical analysis is also extended to the Pleistocene mammal of some Greek islands and Cyprus (Hadjisterkotis, 2000); the introduction of wild boar Sus scrofa to Cyprus (Hadjisterkotis, 2000); wild cats (Mammalia, Carnivora) of Anatolia (Masseti, 2000a); the distribution of roe-deer *Capreolus capreolus* in the mountainous areas along the present border between south-east Turkey and northwest Syria (Masseti, 2000 b). Surveys have shown that the Anatolian Peninsula harbours a rich autochthonous fauna, but much remains to be discovered before the whole story is known.

The research of the Società Romana di Scienze Naturali

Following the groundwork of Augusto Vigna Taglianti and his colleagues and adherents, all united by their passion for scientific research, in the 1980s this Society became a new actor on the stage of Anatolian and related studies taking up the challenge left by these enthusiastic earlier zoologists many of whom by the beginning of the twenty first century had turned their interest substantially towards other countries (Africa, the Far East). The Società Romana di Scienze Naturali (SRSN) founded in Rome in 1967, is a non-profit institution which has become a centre for excellence in pure research. In the 1980s it launched an initiative, designing its own framework, for methodical work on "Zoocenoses of the Near and the Middle East; historical and ecological patterns" and this is still fully operational, and promotes research in ever more extensive landscapes.

At that time we were young zoologists looking for exciting research subjects. The program offered a choice of 32 planned expeditions, devoted to wildlife research, to be carried out from southern Albania to central Iran and eastern Iraq, and including Greece, Turkey and Georgia. The project began in 1982 with exploration of northern Greece and the Aegean Islands. During the first years (1982-1985) some districts of the Pindus Mountains were systematically explored, and as part of the same program research trips went to the Alonnisos and Samothrace islands in the northern Aegean, and to some Greek sites in Thrace, near Alexandroupoli and therefore close to the Turkish border. As these expeditions moved eastward, inevitably further field research suggested itself and a new cycle to allow for this began in July 1986.

This cycle followed two dedicated paths. 1 - focused mainly on the eastern and south-eastern parts of Turkey which are close to Georgia (previously in the USSR), Iran, Iraq and the Syrian border, all of which areas are comparatively less studied but presumably rich in Asiatic elements. 2 - research focused mainly on vertebrate fauna (amphibians, reptiles and small mammals, especially bats and rodents). Among invertebrates special interest was given to scorpions which were little known at that time. To this end samplings were taken at numerous localities and a few thousand specimens collected. Collections were also made from other taxonomic groups, e.g. Arachnids (Solifugae), and above all Insects (Odonata, Mantodea, Dermaptera, Orthoptera, Neuroptera, and Coleopotera of various families). All specimens were passed to qualified specialists for identification. Collecting was always restricted to the fewest specimens needed for identification, carefully respecting the conservation status of each species, and avoiding any taxa on the checklist of the CITES Convention. Nearly 20-30 days were spent on each mission, with the exception of the 2001 expedition which lasted 40 days in order to complete work on the scorpions of south-east Anatolia. 1-4 participants, all Italian, took part in each expedition. Travel was by air (rarely), ship, and own or local cars and minibuses. There were no major accidents and participants always enjoyed the friendly hospitality of the Turkish people. Nineteen expeditions have been made to the vast country of Turkey, which has been a favourite research destination for this program for as many years. "Mixed" expeditions have included Greece/Turkey (1987, 1988), Turkey/Iran (2000, 2002, 2003), Turkey/Iraq (2018). The hot summer months can be a handicap, but this is made easier by mountainous districts such as Ağrı Dağı (Mount Ararat) and Hakkâri.

The chronological order of the SRSN expeditions is as follows:

1986, from Bursa to Antalya, including exploration of the extensive marsh of Karamık Bataklığı (Swamp of Karamık) near Afyonkarahisar.

1987, the only expedition focused on Turkey-in-Europe. The site of Ereğli (or Erikli) near İbrice was visited, and caves along the coasts were explored allowing collection of the marine mollusc fauna, especially Poliplacophora and Gastropoda. These were two "tasting" journeys in order to get a better knowledge of the country and people.

Meanwhile the research project, as it matured, was working towards developing more ambitious undertakings, and the 1988 expedition followed a very long route into the eastern territories, from Gaziantep to Diyarbakır and the Gulf of İskenderun near Arsuz which allowed preliminary observations of the coastal marine fauna. Then Mount Ararat, Kars and up to Artvin, located in the heart of the Lesser Caucasus in the steep and arid Çoruh Valley, before returning west following the Black Sea coast.

1989, to the Gulf of İskenderun near Arsuz for further observations of the coastal marine fauna; to the Taurus Mountains near Mut and Mersin (İçel); to the Ceyhan river.

1996, into the Taurus Mountains from Ulukışla; in the vilayet (administrative division or province) of Niğde; to Gündoğmuş near Alanya.

1997, Hatay province: Kırıkhan, Dörtyol, and Belen (Berlen) about 33 km from Antakya which is renowned for its amazing biodiversity, e.g. eight families of Reptiles were found within an area of a few hundred square meters.

1998, Kahta and Sincik near Adıyaman, with neighbouring small towns and rural villages.

1999, Artvin and Yusufeli on the slopes of the Caucasus; the river Çoruh; Mount Ararat near Doğubayazıt; Kahta.

2000, Benekli Village and Tatvan near Lake Van; Mardin; Harran; Mount Ararat; Kahta.

2001, Ceylanpınar state farm - a visit to the restricted breeding site for the Persian gazelle *Gazella subgutturosa* Güdenstät (1780). Other destinations were Şanlıurfa, Harran, Mardin, Midyat and (for the last time) Kahta near Adıyaman.

2002 and 2003, Mount Ararat near Doğubayazıt; Topçatan Village.

2005, Bitlis; Tatvan.

2006, Sarıkamıs and Karakurt near Kars; the vicinity of Iğdır.

2008, the Nemrut Volcano near Tatvan with its crater lakes and rural villages.

2010, Korkuteli and Elmalı in the Akdağlar.

2014 and 2015, Hakkari; Zap River; Mount Cilo (Figure 5); Ördekli Koyu; Berçelan Plateau; Çukurca.

Figure 5. Prof. Crucitti and Mount Cilo during the 2014 expedition

2018, Şırnak, thanks to the kind hospitality of the local university (Şırnak Üniversitesi, Mehmet Emin Acar Kampüsü) where their *konuk evi* (guest house) was provided; Kasrik River near Cizre; the surroundings of Beytüşşebap; and finally the River Dicle near Güçlükonak.

Specimens collected were either placed in the SRSN collections or among one of the following institutions: the Zoological Museum of Biology and Biotechnology, Department "Charles Darwin" at the "Sapienza" University of Rome (one paratype specimen of *Acanthodactylus harranensis*); the Institute of Entomology (ex INE) of "Sapienza" (insects, mainly Coleoptera); the zoological section of the Natural History Museum "La Specola" at Florence University (Orthoptera Saginae, many Amphibians, Reptiles and small mammals together with all Vertebrates collected on the 2010 expedition; the World Biodiversity Association (WBA) of Verona (Mantodea); to some 20 expert specialists in various zoological groups, fellows of SRSN or independent researcher (Crucitti *et al.*, 2016, 2017; Lanza *et al.*, 2005, 2006; Lotti *et al.*, 2012). Aside from minor contributions with faunal reports, such as those on Chiroptera from Thracian caves in both Greece and Turkey, and on the vulnerable species *Rhinolophus mehelyi* Matschie (1901) and *Myotis capaccinii* Bonaparte (1837) observed in a cave on the coast near Ereğli/Erikli (Crucitti, 1988), the first major report dedicated entirely to Anatolian fauna deals with the discovery of a population of the "lessepsian" gastropod species, the Strombidae *Conomurex persicus* Swainson 1821, in a coastal site near Arsuz in the Gulf of İskenderun (Crucitti & Rotella, 1991), a species originally cited as *Strombus* (*Conomurex*) *decorus* (Röding, 1798). Biometrical and ecological observations (density, biomass) were added of this invasive species, probably introduced by ships coming from the Persian Gulf. It is now widely spread along the coasts of southern Turkey, Cyprus, Crete and the southern Peloponnese, as surmised in the predictive model of Crucitti & Rotella in 1991 (see also: Oliverio, 1995; Zenetos *et al.*, 2003 sub *Strombus decorus* Swainson, 1821).

Two contributions on scorpions followed: a checklist of the species of the Taurus Mountains based on collections made near the Mediterranean coast (Crucitti & Malori, 1998); and a detailed report of ecological and ethological observations regarding Scorpio maurus fuscus (Hemprich & Ehrenberg, 1829). A relatively common Scorpionidae in south-eastern Anatolia, this species has a Saharo-Sindian distribution and has also been studied in Hatay, the southernmost region of Turkey. This showy scorpion is generally found in deep burrows in arid habitat, but in moist habitats in Hatay (e.g. Belen) it can also be found under stones. Sexual dimorphism and sex ratio have been investigated together with the role of ecological factors, especially soil typology and hardness which can explain the micro-distribution of the species. Data on morphology, the depth of its burrows and shape of their entrances has also been collected and analysed (Crucitti, 1998a).

After ten years of field research it became possible to attempt a preliminary synthesis of the distribution patterns of Anatolian scorpions (consideration on the Euscorpiidae, genus *Euscorpius* are however now outdated). 14 species and subspecies from 4 families were included: Buthidae *Androctonus crassicauda* (Olivier 1897), which also had a later ecological report (Crucitti, 2003); *Compsobuthus matthiesseni* (Birula 1905) - the second record for Turkey; *Leiurus quinquestriatus* (Ehrenberg 1928) - now *L. abdullahbayrami* Yağmur, Koç & Kunt, 2009 (Yağmur et al,.2009; see also Lowe *et al.*, 2014); *Mesobuthus caucasicus* (Nordmann 1840) - now in the genus Olivierus, (Kovařik, 2019); *Mesobuthus eupeus* (Koch, 1839) which is now split into two species in Turkey, *M. eupeus* and *M. phillipsi* (Kovařik *et al.*, 2011) - this is a widespread taxon; and *Mesobuthus gibbosus* (Brullé, 1832, which is one of the most health-threatening scorpions in Turkey because of its wide distribution and local abundance, now in genus *Aegaeobuthus* (Kovařik, 2019). Euscorpiidae Laurie, 1896 (previously, the species of this family, at present all in the genus *Euscorpius*, have been placed in Chactidae Pocock, 1893, a Nearctic family) with the species complex "*Euscorpius carpathicus*", (subsequent revisions have identified new Mediterranean species which occur also in Turkey; see "**Selected groups studied by Italian authors**"), *E. italicus* (Herbst, 1800), *E. mingrelicus* (Kesseler,1874); Iuridae, with Calchas nordmanni Birula, 1899, an apparently uncommon species, and *Iurus asiaticus* Birula, 1903 (now carried to Protoiurus and divided into two species, *P. asiaticus* and *P. kraepelini* (Kovařík *et al.*, 2010; Soleglad *et al.*, 2012)) and finally, Scorpionidae with *Scorpio maurus* Linnaeus, 1758 (Turkish population was accepted as belonging to *S. kruglovi* (Ehrenberg, 1829): Talal *et al.*, 2015; Prendini & Loria, 2020). However biogeographical considerations are still valid for the recognition of the main grouping of chorotypes, European-Mediterranean taxa (Euscorpiidae), Central Asian and Saharo-Sindian taxa (Buthidae and Scorpionidae) and Aegean-Anatolian taxa (Iuridae) (Crucitti, 1999). Patterns in the ecology of the scorpions in the same area are briefly outlined in a following paper. This discusses the distribution and ecology of six species in the Mount Nemrut National Park, Adıyaman Province (Crucitti & Cicuzza, 2000, 2001a). The health and social aspects of poisoning by scorpion sting, first within the Adıyaman Province and then more widely in the whole of south-east Turkey, are dealt with in another three papers (Crucitti, 2000, 2001, 2002). In addition the ecology of the mid-sized yellow scorpion *Mesobuthus eupeus* Mount Ararat population has been examined (Crucitti & Cicuzza, 2001 b), and a further report has compared this with the ecological adaptations of the same taxon on the slopes of Mount Damavand in northern Iran (Crucitti & Vignoli, 2003). The most important contribution presents a thorough revision of the distribution and ecology of the scorpions of south-east Anatolia, with detailed reports on 11 species of which three (including two genera, all within Buthidae) were new to the fauna of Turkey. These are *Buthacus yotvatensis* Levy, Amitai & Shulov 1973 (now 'lumped' with *B. macrocentus* (Ehrenberg 1828): (Kovařík, 2005); *Hottentotta saulcyi* (Simon 1880); and *Mesobuthus nigrocinctus* (Ehrenberg 1928). The latter is now placed in the genus *Aegaeobuthus* (Kovařík, 2019). Remarkably *H. saulcyi* is probably the largest terrestrial invertebrate known in Turkey, reaching a total length of 120-130 mm. The first site where it was observed during recent research was at Deiryülzafaran Monastery near Mardin, where some huge specimens were seen climbing the outer walls. Most Buthidae, the scorpion family with the highest number of genera in Anatolia, are restricted to south-east Anatolia, so this bioclimatic region has the highest risk of scorpion poisoning in the whole of Turkey (Crucitti & Vignoli, 2002). In spite of our still incomplete knowledge of Turkish scorpions, and the remarkable surprises turning up as research proceeds (see **Selected groups studied by Italian authors**) we can already repeat that the "*the Anatolian Peninsula shows its nature of crossroads of different faunistic stocks as highlighted by its scorpion fauna too*" (Crucitti, 1999).

Unexpected discoveries about Turkey's herpetofauna have showed significant interest during the same time period. The snake genus *Eirenis* (Colubridae) has 18 known species described (Mahlow *et al.*, 2013) and at least 13 of these belong to the Anatolian fauna (Sindaco *et al.*, 2000). A new species, *Eirenis thospitis* Schmidtler & Lanza 1990, was found by Italian researchers near the city of Van, a short distance from the huge basin of Lake Van, during the 1988 expedition (Schmidtler & Lanza, 1990; Sindaco *et al.*, 2000; Venchi & Sindaco, 2006; Crucitti *et al.*, 2016, 2020).

Another exciting discovery was made during the 2001 expedition in the locality of Harran which has the ruins of the most ancient Islamic university in the world. In the same site here, where the scorpion *Buthacus yotvatensis* was found, a series of lizards in the genus *Acanthodactylus* (Lacertidae), adults and young, were collected. This genus has over 40 species in the Near and Middle East but only two were known in Anatolia, *A. boskianus* Daudin, 1802 and *A. schreiberi* Boulenger, 1878, both with only local distributions (Sindaco *et al.,* 2000). Some time before the Italian expedition specimens of the new species had been collected in the same site by Turkish zoologists coordinated by Professor Ibrahim Baran, the dean of Turkish herpetologist. They turned out to be a species new to science. The scientific description of this lizard was the result of a fruitful Italian-Turkish collaboration (Baran *et al.*, 2005) and it was given the name *Acanthodactylus harranensis* Baran, Kumlutaş, Lanza, Sindaco, Ilgaz, Avcı & Crucitti, 2005. The Harran Fringe-toed Lizard is a relatively large, stout-bodied *Acanthodactylus* with a tail more than 1.5 times the body length and a dorsal pattern consisting of irregular longitudinal dark and light stripes. Juveniles may have a series of spots. At present it is considered a critically endangered species (IUCN 3.1). In the same site, the ruins of the Castle of Harran, specimens of the local Phyllodactylidae gecko *Asaccus barani* Torki, Ahmadzadeh, Ilgaz, Avcı & Kumlutaş, 2011 were discovered (the species has only recently been split from *Asaccus elisae* F. Werner 1895) (Crucitti *et al.*, 2020).

During the 2000 expedition to Lake Van an astonishing abundance of the Spur-thighed Tortoise *Testudo graeca* Linnaeus, 1758 was observed round some villages in the vicinity of Benekli and Serinbahir Koyu, two sites with an outstanding rich biodiversity near the city of Tatvan by Lake Van, e.g. at least five species of Lacertidae were found here. A visit to the Nemrut Volcano during the 2005 expedition also revealed a huge density of this tortoise (with up to 10 adults seen moving at once in some places). The discovery suggested the advisability of planning research to focus on the morphology and ecology of this large population. The following expedition to the extinct Mount Nemrut volcano was the only expedition when no zoological voucher specimens were collected. Inside the Nemrut caldera, 305 tortoises, mainly adults, were measured, weighed and marked according to the two main habitat types - a bare shrubby steppe environment and denser scrub. Macro-habitat differences have been used to explain the remarkable observed morphometric differences in the context of the huge morphological plasticity of this wide-ranging taxon. This population of Testudo graeca on Mount Nemrut deserves close protection as it is one of the largest in the whole of Anatolia (Crucitti & Emiliani, 2012).

Biodiversity and endemism

The interest of the Anatolian Peninsula can be ascribed to complex paleogeographic elements as it incorporates *"…a large bridge between East and West along the eastern side of the Mediterranean Sea, and a natural door, in the past as well as in the present, for migrations of flora, fauna and humans from Asia to Europe and vice versa*" (Casale & Vigna Taglianti, 1999).

Turkey's animal population follows the geography in a surprising way, showing quotas of biogeographical influence roughly proportional to the extent of the borders which expose it to the Mediterranean and the three continents, that is, towards the other biota which influenced the physiognomy of its fauna (Sbordoni, 2000). Due to its orographic configuration Anatolia presents a suitable landscape for investigating the role played by various potential barriers to distribution at different time scales. In this context the "Anatolian Diagonal" exhibits its outstanding relevance. This is a theoretical dividing line which runs across central and eastern Turkey from the north-eastern corner of the Mediterranean Sea to the south-eastern corner of the Black Sea, cutting roughly across the upper course of the Euphrates River within the Turkish border. Italian zoologists have also made a significant contribution to these topics. A case of butterfly distribution (Rhopalocera) appears paradigmatic in this context, as it follows most suggestively two barriers - the Bitinia reliefs and the "Anatolian Diagonal" define two of the three areas characterized by very high species richness. A third biodiversity hotspot is located in the extreme south-east of Anatolia where the provinces of Van and Hakkari, together with the Zap River and the high alpine Cilo and Sat mountains are located (Sbordoni, 2000). The "Diagonal" as a geographical barrier makes it possible to interpret the distribution of certain groups, for example Arachnida **Scorpiones** (Crucitti, 1999, 2001) and Coleoptera Tenebrionidae Pimeliinae (Fattorini, 2000). Turkey's exceptional biological diversity is also highlighted by the number of endemic species among angiosperms, certain groups of arachnids and insects, amphibians, reptiles and rodents; and among all freshwater lampreys and fishes (384 species of which 208 (54.2%; Çiçek *et al.*, 2019). The rates of endemism among angiosperms and various groups of insects and reptiles are similar, at about 31%, and extremely high level compared with that in neighbouring countries or other large Mediterranean peninsulas. Moreover this reaches 100% in certain groups typical of cave environments such as Carabidae and Leiodidae, and among other beetles with highly specialised ecology, e.g. the aquatic hydraenids, reaches the remarkable level of 75% of endemic species (Sbordoni, 2000).

Selected groups studied by Italian authors

Annelida

Hirudinea. Minelli (1978) describes Dina vignai, a cavernicolous eyeless species, a leech (Erpobdellidae) from Turkey collected during the 1973 bio-speleological mission organised by the Institute of Zoology of the University of Rome. The specimens were collected in Çamlık Dalayman in the Province of Konya. At that time, of the 11 species of *Dina*, only two eyeless taxa were known, namely *D. absoloni* Johansson, 1913, from Yugoslavia, and *D. anoculata* Moore 1898 from the USA (Minelli, 1978).

Lumbricidae. Pietro Omodeo, following earlier discussions on the zoogeography of terricolous Oligochaeta, has stated since 1952 that some distribution patterns in the regions extending east of the Alpine arc as far as the Caucasus could be referred to the paleogeography of the Miocene. Information on the Oligochaeta of Turkey was limited and fragmentary, dating back, among Italian zoologists to some work by Daniele Rosa (1857-1944) (better known for his "hologenesis" - an orthogenetic theory of evolution) and by Luigi Cognetti De Martiis (1878-1931), a distinguished earthworm specialist. Pietro Omodeo was the first author who recognised, in his first discussions of the zoogeography of terricolous

Oligochaeta, the following patterns: 1. Alpine-Illyric-Carpathian, referable to the northern Aegeid; 2. Syrian-Anatolian-Aegean, referable to the southern Aegeid; 3. Mixed, referable to the period of maximum sea regression occurring towards the end of the Miocene. The Lumbricidae fauna of Turkey is therefore of particular interest as the country lies at the centre of these three distributional patterns (Omodeo, 1952, a, b). Outstanding contributions by Omodeo followed (Omodeo, 1952 a, b, c; 1955 a, b; 1988; 2000; Omodeo & Martinucci, 1987). He also worked in close cooperation with his collaborator Emilia Rota (Omodeo & Rota, 1989, 1991; Rota & Omodeo, 1992) who also researched this subject independently (Rota, 1994 a, b). Together these researches represent a synthesis of the faunal components of Turkey, with a speculative reconstruction of their history. Combining all available biogeographical knowledge (Omodeo & Rota, 2008) with that gathered by the two earlier Italian expeditions undertaken by Augusto Vigna Taglianti and Achille Casale, Omodeo and Rota were able to consider data from 62 Turkish localities (in 26 different vilayets), thus collating more than 3,000 oligochaete specimens. Small additional collections had been recorded by the distinguished Italian zoologists Emilio Balletto, Maria Grazia Filipucci, Marco Bologna, Saverio Forestiero, Mauro Giachino and Valerio Sbordoni (Omodeo & Rota, 1999). The 1987 and 1990 Turkish megadriles collections yielded 54 species and three subspecies (16 of them new to science) which increased the number of earthworms known from the country to 70 species and six subspecies (Omodeo & Rota, 1989, 1991, 1999, 2008). Additional data on molecular divergence (Cobolli et.al., 1987, 1992) has made it possible to assume that the speciation of Lumbricoidea may take more than 20 Myr to become detectable at phenotypic level. Recent surveys of terricolous oligochaetes in Turkey have led to the discovery of a taxon of Lumbricidae endemic to Anatolia, northern Greece and Epirus which undoubtedly deserves sub-familial rank. The establishment of the new Spermophorodrilinae family produced a more rational classification, particularly regarding the genus Bimastos, allowing the phylogenetic reconstruction of part of the suborder Lumbricina. Anatolia provides a variety of ecological niches for a widely colonizing, evolutionary dynamic earthworm fauna originally formed by the Spermophorodrilinae and a stock of the genus Dendrobaena. It is plausibly possible to date the indigenous stocks of Spermophorodrilinae and Dendrobaena to the Paleogene or earlier. During this period Turkey and the Rodopean area together formed an insular or semi-insular system. Isolation and absence of competition favoured diversification within these two taxa. The remote timing is considered appropriate for the Spermophorodrilinae because they are morphologically more archaic than the Sardo-Corsican Diporodrilinae, so should be contemporary with or older than these. According to Omodeo and Rota (1999) Turkey and Transcaucasia were indeed the major distribution centre for the genus *Dendrobaena*, and some species spread from there in eastward and north-western directions. For *D. attemsi* (Michaelsen, 1902) an accurate morphological and distributional study has made it possible to trace its supposed post-glacial migratory routes towards the western Alps, the British Isles and Sweden. Other interesting results come from some typical Carpatho-Balkan genera and species such as *Cernosvitovia*, *Fitzingeria*, *Allolobophora smaragdina* and *A. leoni*. These taxa penetrated into the northern or north-western Anatolian districts. The traditional subdivision of Turkish lumbricofaunal components into a northern and a southern Aegeid, as previously assumed, is not supported by modern paleogeographic reconstructions. Faunistic data confirms an unexpected absence of Holarctic species in Turkey, e.g. *Lumbricus terrestris, Dendrobaena octaedra, Allolobophora chlorotica, Octolasion cyaneum*. The southern limit of distribution of these species in the Mediterranean area needs to be somewhat re-interpreted. Significant differences in species composition between northern and southern zones are becoming clear, with strictly Mediterranean species seeming to be restricted to the south (Omodeo & Rota, 1999). Knowledge of the Anatolian megadrile fauna was still limited. Extensive surveys did reveal that the Anatolian Peninsula harbours a rich autochthonous fauna comprised of the subfamily Spermophorodrilinae with ten species exclusively found in Turkey and fourteen endemic species of *Dendrobaena* some of which may have originated by adaptive radiation. During the Pleistocene, other species of megadriles arrived in Anatolia from the Balkan Peninsula, but they remained confined to the northern coastal zone (Omodeo & Rota, 2008).

Arachnida

Altogether 41 species of scorpions, from 16 genera from four families (12 from Buthidae, 18 from Euscorpiidae, 10 from Iuridae and one from Scorpionidae) are currently known in Turkey's fauna. These are: *Aegaeobuthus gibbosus anatolicus* (Schenkel, 1947), *Aegaeobuthus nigrocinctus* (Ehrenberg, 1828), *Mesobuthus eupeus* (C. L. Koch, 1839), *Mesobuthus phillipsii* (Pocock, 1889), *Olivierus caucasicus* (Nordmann, 1840), *Leiurus abdullahbayrami* Yağmur, Koç & Kunt, 2009, *Hottentotta saulcyi* (Simon, 1880), *Buthacus macrocentrus* (Ehrenberg, 1828), *Compsobuthus matthiesseni* (Birula, 1905), *C. schmiedeknechti* Vachon, 1949, *Orthochirus fomichevi* Kovařík, Yağmur, Fet & Hussen, 2019 and finally *Androctonus crassicauda* (Olivier, 1807); *Alpiscorpius mingrelicus* (Kessler, 1874), *A. phrygius* (Bonacina, 1980), *A. uludagensis* (Lacroix, 1995), *Euscorpius arikani* Yağmur & Tropea, 2015, *E. avcii* Tropea, Yağmur, Koç, Yeşilyurt & Rossi, 2012, *E. tauricus* (C. L. Koch, 1837), *E. italicus* (Herbst, 1800), *E. lycius* Yağmur, Tropea & Yeşilyurt, 2013, *E. gocmeni* Tropea, Yağmur & Yeşilyurt, 2014, *E. ciliciensis* Birula, 1898, *E. koci* Tropea & Yagmur, 2015, *E. eskisehirensis* Tropea & Yagmur, 2015, *E. sultanensis* Tropea & Yagmur, 2015, *E. honazicus* Tropea, Yağmur, Karampatsou, Parmakelis & Yesilyurt, 2016, *E. alanyaensis* Tropea, Yağmur, Parmakelis & Kunt, 2016, *E. harikani* Tropea & Yağmur, 2016, *E. aladaglarensis* Tropea & Yağmur, 2016 and finally E. idaeus Yağmur & Tropea, 2017; *Calchas anlasi* Yağmur, Soleglad, Fet & Kovařík, 2013, *C. birulai* Fet, Soleglad & Kovařík, 2009, *C. kosswigi* Yağmur, Soleglad, Fet & Kovařík, 2013, *C. nordmanni* Birula, 1899, *Neocalchas gruberi* (Fet, Soleglad & Kovařík, 2009), *Iurus kinzelbachi* Kovařík, Fet, Soleglad & Yağmur, 2010, *Protoiurus asiaticus* (Birula, 1903), *P. kadleci* (Kovařík, Fet, Soleglad & Yağmur, 2010), *P. kraepelini* (von Ubisch, 1922) and finally *P. kumlutasi* Yağmur, Soleglad, Fet & Kovařík, 2015; *Scorpio kruglovi* Birula, 1910. The distribution patterns of scorpions, a rather mobile group of arachnids, deserves attention (Crucitti, 1999; Crucitti & Cicuzza, 2001 b). The genus *Euscorpius* Thorell, 1876 is about the commonest scorpion genus in southern Europe and Anatolia, with species which occupy diverse habitats from sea level up to over 2,700 m asl. It is one of the most studied groups of scorpions. Extensive research on *Euscorpius* has been undertaken by the independent Italian researcher Gioele Tropea who described many species new to science, working in close cooperation with Turkish scientists (Tropea & Yağmur, 2015, 2016 a, b; Tropea *et al.*, 2012, 2014, 2015, 2016 a, b, 2017; Yağmur & Tropea, 2013, 2015, 2017; Yağmur *et al.*, 2013). These new species are *Euscorpius aladaglarensis* from Niğde Province, *E. arikani* from Antalya Province, *E. eskisehirensis* from Eskişehir Province, *E. honazicus* from Denzili Province, *E. sultanensis* from the Sultan Mountains (Sultan Dağları) near the border between Afyonkarahisar and Konya provinces, and finally *E. idaeus* from Balıkesir and Çanakkale provinces. Of the number of *Euscorpius* species currently known in Turkey - raised since 2012 from three to 18 (Yağmur & Tropea, 2017) - 11 are related to the sub-genus *Alpiscorpius* Gantenbein *et al.*, 1999 (recently raised to genus level) on which Fet *et al.*, published a phylogeny of the populations. In comparison, in Italy the genus Euscorpius at present has 12 known species. All the species recently described in Turkey are endemic. The distribution of Euscorpius s.l. is seen to be circumscribed by the Taurus Mountains, the Pontus Mountains, and central Anatolia - all sites west of the "Anatolian Diagonal" (for distribution of the sub-genus *Alpiscorpius* see Yağmur & Tropea, 2017). Consequently, using the simplest total, the highest concentration is observed west to the "Anatolian Diagonal, a result strictly defined by the number of species from the genus *Euscorpius*. Conversely, if the number of genera are considered, the situation appears dramatically different, as seen in Table 1. West to this effective barrier we find many genera, e.g. *Euscorpius*, *Iurus*, and *Mesobuthus*, all of which have distributions in Mediterranean Europe. The distribution of *Iurus dufoureius* Brullè, 1832, at first divided into the subspecies *I. d. dufoureius* and *I. d. asiaticus* is now identified as belonging to two genera and five species: *Iurus kinzelbachi* Kovařík, Fet, Soleglad & Yağmur, 2010; *Protoiurus asiaticus* (Birula, 1903); *Protoiurus kadleci*

(Kovařík, Fet, Soleglad & Yağmur, 2010); *Protoiurus kraepelini* (von Ubisch, 1922; *Protoiurus* kumlutasi Yağmur, Soleglad, Fet & Kovařík, 2015. The approximate distribution of these is between the south-west Peloponnese and the Mediterranean coast of Turkey (a narrow stripe between Izmir and Adana, passing through some large islands in the Aegean Sea: see also Crucitti, 1995 a, b; 1998 b; Parmakelis *et al.*, 2006). East of the barrier of the "Anatolian Diagonal" most of the genera present are strictly of Saharo-Sindian distribution. The Buthid genera Orthochirus is at present the last genus of this family to be discovered within Turkey (in Hakkari Province, Çukurca District, 2 km west of Çukurca town). The species discovered was previously named as *O. zagrosensis* Kovařík, 2004 (Yağmur, 2010) but has been reassigned to *O. fomichevi* Kovařík, Yağmur, Fet & Hussen, 2019 (Kovařík *et al.*, 2019).

Table 1. The distribution of scorpion genera in Turkey with respect to the Anatolian Diagonal

Localization with respect to the Anatolian Diagonal	Genera
Western	*Alpiscorpius*, *Euscorpius*, *Neocalchas*, *Iurus*, *Protoiurus*, *Aegaeobuthus*, *Mesobuthus*
Eastern	*Androctonus*, *Buthacus*, *Compsobuthus*, *Hottentotta*, *Leiurus*, *Mesobuthus*, *Olivierus*, *Orthochirus*, *Calchas*, *Scorpio*

Araneae

A useful historical contribution on this subject dates back to the Italian arachnologist Pietro Pavesi (Pavesi, 1876). Lodovico Di Caporiacco (Caporiacco, 1935) is also drawn on with, remembering however that the works of this author are not always adequately accurate. A new troglophile species in the Dysderidae family, *Harpactea dobati* Alicata, 1974 was described by Pietro Alicata, full professor of Zoology at the University of Catania, Sicily (Alicata, 1974). He retired in 2010. *Harpactea* is one of the most speciose dysderid genera in Turkey, with 29 endemics (Bayram *et al.,* 2010) of which at least six are dedicated to Italian zoologists: *Harpactea alanyana* Özkütük *et al.,* 2015, *H. agnolettii* Brignoli, 1978, *H. arnedoi* Kunt *et.al.,* 2011, *H. babori* (Nosek, 1905), *H. ballarini* Kunt, Özkütük & Elverici, 2013, *H. christodeltshevi* Bayram, Kunt & Yağmur, 2009, *H. clementi* Bosmans, 2009, *H. colchidis* Brignoli, 1978, *H. diraoi* Brignoli, 1978, *H. dobati* Alicata, 1974, *H. forceps* Varol & Danışman, 2018, *H. galatica* Brignoli, 1978, *H. isaurica* Brignoli, 1978, *H. karaschkhan* Kunt *et al.,* 2016, *H. kencei* Kunt *et al.,* 2011, *H. korgei* Brignoli, 1979, *H. lazonum* Brignoli, 1978, *H. lyciae* Brignoli, 1978, *H. medeae* Brignoli, 1978, *H. mithridatis* Brignoli, 1979, *H. osellai* Brignoli, 1978, *H. pisidica* Brignoli, 1978, *H. pugio* Varol & Akpınar, 2016, *H. sanctaeinsulae* Brignoli, 1978, *H. sbordonii* Brignoli, 1978, *H. strandjica* Dimitrov, 1997, *H. sturanyi* (Nosek, 1905) *H. terveli* Lazarov, 2009 and finally *Harpactea vignai* Brignoli, 1978. Four contributions from the independent researcher Fabio Gasparo are noteworthy (Gasparo, 2002, 2008, 2011, 2014). The late Professor Paolo Marcello Brignoli (1942-1986) is a charismatic figure among arachnologists of the past century, one of the few specialists to study spiders from all over the world. Author of over 210 scientific papers, Brignoli described more than 370 new species and 25 new genera from materials collected not only in the Mediterranean region and the Near East but in Equatorial and East Africa, Central and South America, and in Indonesian and Indo-Australian regions too (Vigna Taglianti, 1986; Osella, 1987). In the 1960s Brignoli began to study mostly cave spiders (and occasionally epigean species) collected primarily in historical regions of Anatolia (Bitinia, Pisidia, Pamphylia). He described many species new to science: *Paraleptoneta sbordonii* Brignoli, 1968 and *P. aesculapii* Brignoli, 1968, the first from the Insuyu cave near Burdur in central-western Anatolia, the second from the Damlataş cave near Alanya (Brignoli, 1968); *Diplocephalus turcicus* Brignoli, 1972 from Burdur, Isparta and Konya (this is considered a widely distributed species in Anatolia); *Tegenaria melbae* Brignoli, 1972 from the Korkha cave near Diyarbakır, *T. anhela* Brignoli, 1972 from Karain cave near Antalya and *T.*

pericuriosa Brignoli, 1972 from Zından cave near Isparta. He also produced short summaries on Turkey's cave spiders from which a preliminary catalogue was published with over 60 taxa considered at the genus/species level (Brignoli, 1972). To the new species above must be added those described during the field trips sponsored by the Roman Speleological Circle (see **"The contribution of the Circolo Speleologico Romano"**) thus bringing the number of species of cave spiders described by this author over about a decade which were new to science (and Anatolia) to the impressive total of 15 (Brignoli, 1968, 1971 a, b, 1972, 1978 a, b, 1979). The cave spider fauna of Anatolia shows a certain similarity with the Caucasian fauna, perhaps showing most affinity with the alpine and Romanian faunas than that of the Mediterranean caves (Brignoli, 1972). Of some interest is the apparent absence of Nesticidae (usually with many abundant, easily-collected species found in caves). This family is also unknown in Lebanese caves. Brignoli (1972) suggests that the complex biogeography of the Middle East should be well worth additional study. Unfortunately Professor Brignoli died prematurely before he could carry out further research on the cave araneofauna of Anatolia.

Myriapoda

Chilopoda. Before modern attempts to identify distribution patterns and conduct zoogeographical analysis of the centipedes of Turkey, only about 20 papers on such topics were published between the second half of the nineteenth century and the end of the twentieth (Zapparoli, 1999). The Rumanian specialist Zachiu Matic studied specimens collected during the zoological expeditions of the Italian Museum of Natural History of Verona and the Institute of Zoology of "La Sapienza" University of Rome. He published his findings sometimes in Italian journals and in Italian (Matic, 1970, 1973, 1976, 1977, 1980, 1983). Since its first numbers the Italian magazine *Fragmenta Entomologica* has accepted contributions on the fauna of Turkey by both Italian and non-Italian authors (*e.g.* Pardo-Alcaide, 1972, Magnano, 1977). However, the greatest revision of our knowledge of the centipede fauna of Anatolia comes from professor Marzio Zapparoli of the Department of Plant Protection at the University of Tuscia (Viterbo, Italy). After about 15 years of intensive research Zapparoli was able to make a synthesis of available knowledge on the centipede fauna of Anatolia from both faunistic and biogeographical viewpoints (Zapparoli, 1986, 1988, 1989 a, b, 1990, 1992, 1993 a, b, 1994 a, b, 1995 a, b, 1999; Zaparolli & Minelli, 1993). Within current Turkish political boundaries 123 species have been recorded from the whole of Anatolia (c. 756,850 sq. km). Because of faunistic affinities this also includes the Greek islands of the southern Sporades. The total represents 2 Scutigeromorpha (two genera), 73 Lithobiomorpha (seven genera), 13 Scolopendromorpha (two genera), and 35 Geophilomorpha (15 genera). These values are provisional because of some still unresolved taxonomic problems needing clarification (*e.g.* for Geophilomorpha) combined with incomplete faunistic knowledge. Thirty-eight species (approximately 31% of the whole group) which are endemics of the Near East occur in Anatolia with the highest endemic rate in the north of the region, especially in the Eastern Pontus which has about 38% of the regional fauna. The rate of endemism in SE Anatolia is very low (5%) but this is because of lack of knowledge of this area's fauna. The main chorological categories represented are as follows: 17 species are widespread in the Holarctic Region (1 W-Palearctic, 1 Sibero-European, 2 Centralasiatic-European, 2 Turano-European-Mediterranean, 2 Turano-Mediterranean, 1 European-Mediterranean, 8 SW-Asiatic); 23 species are more or less widespread in the Mediterranean countries (9 Mediterranean and 11 E-Mediterranean); 2 species, one Saharo-Turano-Sindian and one NE-African-Sindian, are widespread in the Palearctic Region but occur in small peripheral areas of the Western Palearctic region too. Zapparoli (1999) produced an annotated checklist of the species of centipedes in Turkey as well as an analysis of their local distribution both in terms of the natural regions and the administrative provinces. New species and subspecies of the Lithobiidae have been described, *e.g.* a new cave species of the genus *Harpolithobius* Verhoeff, 1904 (Zapparoli, 1989 b); also *Lithobius (Lithobius) antonellae* Zapparoli, 1999, *L.* (*L.*) *biondii* Zapparoli, 1999, *L.* (*Sigibius*) *dogubayazitensis* Zapparoli, 1999, *L.* (*Monotarsobius*) *manicastrii* Zapparoli, 1999, all from east; *L.* (*L.*) *ispartensis* Zapparoli, 1999, and the subspecies *L.* (*L.*) *plesius antalyanus* Zapparoli, 1999, and *L.* (*L.*) *plesius* *audisioi* Zapparoli, 1999, all from south Anatolia (Mediterranean region); finally *L.* (*L.*) *rizensis* Zapparoli, 1999, from East Pontus, with the addition of some new synonyms (Zapparoli, 1999).

Hexapoda

Orthoptera. The first scientist we must honour for his role in this area of research is Marcello La Greca (1914-2001) of the University of Catania. "*A strong and benevolent giant, well placed in the Temple of Science*" he has been described as the world's foremost orthopterologist living in the past 50 years. He described 70 new taxa, species and subspecies, mainly in Orthoptera and Mantodea, putting them into systematic order to enable deeper biogeographical analysis (Baccetti & Ruffo, 2004; Fontana & Massa, 2004). It is not a mere coincidence that a recent group set up to define the biogeography of Anatolia (Çıplak, 2004) acknowledge in their work two landmark publications by Marcello La Greca (La Greca, 1999 a, b) as well as some contributions by Bruno Massa, a distinguished Italian orthopterologist still very active (Massa, 1995, 1999; Katbeh Bader & Massa, 2001). Knowledge of the Anatolian Orthoptera was considered quite good by La Greca (today we would say very good) in his acknowledgement of the work of pioneer researchers, especially German and Russian scientists, including Sir Boris Petrovič Uvarov who was a native Russian naturalised in Britain (*e.g.* Uvarov, 1949). According to La Greca the Anatolian Orthoptera include elements deriving from stocks with different origins and from different surrounding areas. In this context four main biogeographical categories are recognised: Angarian elements which arrived in Anatolia during the Pleistocene, from Siberian cold steppe habitats; Middle Asian xerothermic elements which arrived in the Pliocene and during the Interglacials; palaeomediterranean elements going back to Miocene stocks (with some taxa experiencing a spectacular evolutionary explosion; other palaeomediterranean or middle-asiatic elements with remote origins in Gondwanaland. To this last group belong the genera *Isophya*, *Poecilimon*, and allied genrea such as *Kurdia*, *Micromon*, *Parapoecilimon*, *Poecilimonella*, and final *Saga.* The subfamilies Akicerinae and Pamphaginae of the family Pamphagidae, which also have a great number of endemic genera and species, may have similar origins. The elements of the Gondwanian component, a group of ancient Orthoptera, arrived in west Asia from more than one eastern source from the Iranian-Anatolian plate which breached off the African Plate, crossed the Tethys and drifted to fuse with the southern and eastern margins of Eurasia perhaps as early as the Palaeocene. The Pamphaginae arrived in SW Europe by means of a NW African terrain called Alborana, and probably spread eastward to the rest of Europe in the Middle Miocene, going round the Prealpine Channel and Paratethys and colonizing Anatolia from the Iranian-Anatolian Plate (La Greca, 1999). According to Çiplak (2004), Anatolia biogeographically includes Levant, western Iran and northern Iraq in addition to Asian Turkey (Kosswig, 1955; De Jong, 1998). Following the same author (Çıplak, 2004) some distribution patterns among Orthoptera possibly reflect tectonic and climatic changes in Anatolia. The genera *Eupholidoptera* and *Poecilimon* are assumed to be derivatives of some stocks present in the Aegean Plate in the Miocene. The distribution of the genera *Poecilimon, Psorodonotus* and *Parapholidoptera* support the hypothesis that rapid spread in Anatolian Orthoptera occurred recently in the Pliocene and Pleistocene, especially when affected by glacial periods. The distribution of *Parapholidoptera, Psorodonotus* and *Chorthippus* shows that faunal contact between east Anatolia/Caucasus and the Balkans occurred via mountain ranges into Anatolia (Çıplak, 2004). Research on cave Orthoptera of the Anatolian Peninsula have benefited from investigations by a group of Italian researchers from the University of Rome ("Sapienza" and "Tor Vergata") on the systematic biochemical and evolutionary relationships between populations and species of the genus *Troglophilus* Krauss, 1879 in the Rhaphidophoridae family. This family is one of the most primitive taxon among the Orthoptera Ensiferi and is currently divided into five subfamilies. The primitive features of the Rhaphidophoridae are highlighted both in geographical distribution patterns and in morphology (lack of wings, a symplesiomorphy that must have originated from the oldest Rhaphidophoridae); this condition strongly influenced dispersion possibilities, limiting it to continuous emerged land (Cobolli *et al.,* 1999). At present the representatives of this family are essentially confined to the temperate zones of both hemispheres (New Zealand, Australia, Africa, America, Eurasia) and their presence in tropical areas of the Far East can be interpreted as the result of rather recent colonization events. In the Mediterranean area only the genera *Dolichopoda* Bolívar, 1878 and *Troglophilus* Krauss, 1879, exist, whose species are generally found in subterranean environments. Cobolli *et al.* (1999), using allozyme markers to investigate the levels of genetic differentiation and the evolutionary relationships among several cave populations from the Taurus mountains between Isparta and Adana towns in the Anatolian Peninsula, have been able to highlight allozymic polymorphisms. This work made it possible to recognise four distinct gene pools, including the nominal species *Troglophilus adamovici* Us, 1974 and *T. gajaci* Us, 1974 plus two genetically well-differentiated forms (Cobolli *et al.,* 1999). In a later paper, thanks to fruitful Italian-Turkish cooperation (Taylan *et al.,* 2012) the authors were able to describe four new species of *Troglophilus* from western and southern Anatolian caves, namely *T. alanyaensis, T. fethiyensis, T. ozeli* and *T. ferzenensis*. Considering the other five species already documented from Anatolia, this brings the total to nine recorded species of *Troglophilus* known from the caves and epigean habitats of Turkey. The best character for distinguishing these groups is the shape of the ovipositor. Of particular interest was the finding of the new species *T. ferzenensis* in the Ferzene cave. This differs from all other known Turkish species in the different spinulation of the legs, making it close to the Aegean species from Crete *T. spinulosus* Chopard, 1921, and *T. marinae* Rampini & Di Russo, 2003 from Santorini island (Taylan *et.al.,* 2012). Further contributions by Italian authors concern the distribution of *Prionostenus güleni* Karabag, 1956 in a small area of Turkey south of Antakya (Massa & Fontana, 2004), and an improved description and distribution data, based on examined material from Syria and Turkey (Massa, 2009) for *Orchamus davisi* Uvarov, 1949 (type locality: Antalya).

Trichoptera. A balanced summary, updated to 1998, was carried out by Fernanda Cianficconi and Francesco Tucciarelli, covering the Anatolian trichopteran fauna and including the zoogeographical point of view. They were followers of the doyen of all Italian trichopterologists, the late professor Giampaolo Moretti (1910-1997). Cianficconi and Tucciarelli examined the European faunal components using lists updated by themselves and others (Moretti & Cianficconi, 1995; Cianficconi *et al.,* 1997). Based on current knowledge the composition of the Anatolian Trichoptera consists of 306 species belonging to 20 families and 74 genera, compared to the European one which includes 1,217 species belonging to 22 families and 137 genera (Cianficconi & Tucciarelli, 1999). The similarities between Anatolia and the other geographical regions of Limnofauna Europaea were assessed by means of the widely-used Sorensen index. A marked affinity between Anatolia and neighbouring regions emerged: Eastern Balkans have a 47% affinity, Western Balkans 42%, Caucasus 40%, Hungarian Lowlands 39% with a lesser affinity between Anatolia and North Africa at 11% (Cianficconi & Tucciarelli, 1999).

Coleoptera *Caraboidea.* According to Fabio Cassola (1938-2016), a distinguished figure in entomology and wildlife conservation, the Cicindelinae (tiger beetles) of Anatolia incorporate 38 taxa, species and subspecies, 11 of which are strictly Anatolian endemics, thus confirming this region as an important centre of endemic speciation. The following genera are listed; *Homodela, Lophyra* and *Megacephala* with one species each; *Myriochile* with two species; *Cephalota* with four species; *Cylindera* and *Lophyridia* with five species each and finally *Cicindela* with seven species. There are therefore 26 species in all, two of which appear to be strict Anatolian endemics (Cassola, 1999). Many Italian entomologists have focused their field research on the Carabidae of Anatolia (see *e.g.* Cavazzutti, 1984 a; Straneo, 1984). Cavazzutti carried out 13 entomological research trips in Anatolia between 1972 and 1983, sometimes in collaboration with the Civic Museum of Natural History of Carmagnola (Turin) (Cavazutti, 1984 b). There are many Italian experts among the numerous coleopterists from other European countries who specialise in the Turkish Carabinae, above all the genus *Carabus.* The main authors are Silvano Battoni, Sandro Bruschi, Achille Casale, Pierfranco Cavazzuti, Achille Costa, Giuseppe De Cristoforis, Stefano Dacatra, Alessandro Dalla Torre, Piermauro Giachino, Giorgio Jan, Paolo Mazzi, Gaetano Osculati, Giuseppe Osella, Maurizio Pavesi, Ivan Rapuzzi, Mario Ruspoli, Arturo Schatzmayr, Enrico and Mario Sturani, Franco Tassi and finally Augusto Vigna Taglianti (Avgin & Cavazzuti, 2011). Among the Carabidae a concentration of studies on the subfamily Carabinae is essentially for the following reasons: their importance in biological control and their large size making them easier to examine together with their elegance of shape and colour attracting attention (Avgin & Cavazzuti, 2011). Vezio Cottarelli, Paolo Marcello Brignoli and Giuseppe Osella all collected useful specimens (Breuning & Ruspoli, 1970, 1971, 1974, 1976, 1977, 1979). Their reports were widely circulated in the carabidological publications of the period and they undertook long expeditions to Anatolia. Among the many new taxa they described are *Carabus* (*Tomocarabus*) *rumelicus zaraensis* in 1970, *C. cribratus haramburae* and *C. cribratus schubertianus* in 1974. Other taxa described in the same period were *Carabus* (*Lamprostus*) *rabaroni enricoi* Battoni & Blumenthal, 1972 and *C.* (*L.*) *erenlierensis karadagensis* Battoni & Blumenthal, 1973 (Battoni & Blumenthal, 1972, 1973). Battoni (1982) working alone described *C.* (*Oreocarabus*) *staneki yaraligozi.* Achille Casali, also working by himself, described a new species of *Carabus* from Anatolia (Casale, 1973) and in collaboration with Cavazzuti a new *Carabus* of the subgenus *Sphodristocarabus* (Casale & Cavazzuti, 1976). The most notable contributions came from the activities of Pierfranco Cavazzuti, who together with Achille Casale, visited Anatolia several times between 1973 and 1991; *e.g.* the description of some new species of the genera *Ischnocarabus, Lamprostus, Pachystus, Tomocarabus, Tribax,* and especially *Sphodristocarabus,* the revision of *Procerus* Dejean, 1821 making it treated as a distinct genus, and the description of *Cychrus anatolicus ziyathi* (2003) a unique taxon of *Cychrus anatolicus* present in north-east Anatolia, and finally a more detailed study on the Turkish Carabinae (Cavazzuti, 2003, 2006). In the monograph by Avgin & Cavazzuti (2011) readers will find a bibliography of Pierfranco Cavazzuti's *oeuvre,* 32 items including notes, articles, monographs and books, some published in collaboration with Casale, Dacatra, Ghiretti and Rapuzzi. New subspecies of the subgenera *Chaetomelas*, *Ischnocarabus*, *Lamprostus*, *Pachystus*, *Procrustes* and *Tomocarabus* have been described (Rapuzzi, 1991, 1995, 1997; Cavazzuti & Rapuzzi, 1998; Rapuzzi & Kleinfeld, 2000). *Carabus (Sphodristocarabus) keltepensis,* a new species collected in the mountains near Lake Sapanca has been described by Vigna Taglianti & Bruschi (1976) . During the months of June and July, 1973, a research initiative in Asia Minor made by Augusto Vigna Taglianti, Luigi Boitani, Paolo Marcello Brignoli and Giuseppe Osella enabled collection of the new species *Troglocimmerites pasquinii* (type location Borçka in the vilayet of Artvin, on the eastern side of the Pontic Chain). This is a new endogean Trechinae, though not truly cave-dwelling (Vigna Taglianti, 1977).

The following summary of the knowledge of the Anatolian carabid fauna is based on the literature to date (see for example Casale & Vigna Taglianti, 1984; Casale & Giachino, 1989; Vigna Taglianti, 1980) and the abundant materials collected and/or examined by Augusto Vigna Taglianti and Achille Casale and published in a masterwork on the faunal composition and distribution in Anatolia (Casale & Vigna Taglianti, 1999). Compared with other regions of the Mediterranean, the Anatolian carabid fauna can be interpreted as the result of interactions between historical (paleogeographic and paleoclimatic) and recent ecological events. Ancient phyletic lines of carabid beetles colonised the area from the beginning to the end of the Tertiary period. The survival of some Oligocene-Miocene age lines, partially of Gondwanian origin, only marginally extended to the neighbouring regions (Balkans, Caucasus, Syrian and Iranian regions) can be interpreted in the light of this fact. The total number of carabid species known from Turkey is about 1.100 species according to Casale & Vigna Taglianti (1999), but as many as 1,200 according to Avgin & Cavazzuti (2011). Even if much smaller Italy has more than 1,300 species, but it's characterized by a more favourable position in the Mediterranean stretching between southern Europe and North Africa. Further examples from the 1999 data give 1,050 species for the Iberian Peninsula, 350 for the British Isles, 400 for the Scandinavian Peninsula, all the result of a long process extending from the Oligocene to the present (Casale & Vigna Taglianti, 1999). The history and evolution of Anatolia's carabid fauna is the result of numerous events which include various interruptions in ancient connections between Anatolia and the Balkan Peninsula, with Europe and with the Afro-Arab regions which allowed the immigration of phyletic lines with a preference for forest habitats, and the ancestors represented today by endemic species most of which are found in the Mesozoic carbonate massifs of western and southern Anatolia, the establishment of new vegetation types and new connections between taxa. Other significant elements have been Mio-Pliocene connections with the Caucasus, the salinity crisis of the Mediterranean, new land elevations, the tendency towards marked aridity in Anatolia. All these influenced wildlife movements, cladogenetic events and a consequent increase in diversity, as did massive penetrations of phyletic lines of Caucasian and Balkan origin coming into the Pontic area, and vice versa, dispersing phyletic lines from Anatolia to the Caucasus and Europe, and from the Turano-Caspian regions to Anatolia. All these movements had isolation phases and consequent speciation. The climatic fluctuations of the Pleistocene, with the availability of shelter in caves and forests during glacial and interglacial phases, the extension of steppe areas, the establishment of new vegetation types and new connections between emergent land areas, have influenced variable sea levels both in the Mediterranean and in the Black Sea, and determined some patterns in Anatolia's carabid fauna. During the Pleistocene cladogenetic events occurred modifying numerous patterns of distribution and causing the phenomena of adaptive speciation to different environments, with immigration of mesophilic or hygrophilous elements from the Balkans to the Caucasus, characteristic of this period of the current post-glacial. In the latter context the actions of man have favoured species of open areas thanks to the extensive development of agriculture. In entomological research, several new species were described such as *Duvalius bruschii* Vigna Taglianti, 1999*, Laemostenus patrizii* Vigna Taglianti, 1999*, L. zoiai* Casale & Vigna Taglianti, 1999*, L. agnolettii* Vigna Taglianti, 1999*,* or re-described, such as *Laemostenus longicornis* Casale, 1988, *L. guzelolukensis* Lassalle, 1997*, L. sciakyi* Casale & Vigna Taglianti, 1999*,* and the extraordinary *Sbordoniella indagi* Vigna Taglianti, 1980, a new genus of highly specialised Trechinae showing highly adaptive morphological modifications to the cave environment. It is close to the genus *Kosswigia* Jeannel, 1947 in its general body shape, but has very elongate antennae and legs, a sub-cylindrical head, narrow pronotum and narrow pear-shaped elytra, vanishing shoulders, a stout and short median lobe of aedeagus, great copulatory organ, sinuate and vertically placed (Casale & Vigna Tagliati, 1999).

Coleoptera *Curculionoidea.* There is an important tradition of Italian studies on this enormous group which is the largest superfamily in the entire animal kingdom, with at least 62,000 species. Over 3,000 of these are known to be in Turkey, though the exact number is unknown (Avgin & Colonnelli, 2011 b). For studies of the Palaearctic Region the "stars of greatest magnitude" among Italian entomologists are Giuseppe ("Beppe") Osella, now retired, who started his career at the Museum of Verona and later worked at the University of L'Aquila; and the independent researchers Roberto Caldara and Enzo Colonnelli. Caldara alone produced 32 publication, 16 on his own and 16 in collaboration (Caldara 1975, 1977, 1978 a, b, c, 1979, 1985 a, b, 1986, 1987, 1990, 2007, 2008 a, b, 2010, 2014; Caldara & Fremuth, 1992, Caldara & Karasyov, 1995, Caldara & O'Brien, 1998, Caldara *et al.,* 2008 a, b, Caldara & Korotyaev, 2010, Caldara *et al.,* 2012, Caldara & Fogato, 2013, Caldara & Legalov, 2016, Caldara & Podlussàni, 2018, Caldara & Toševski, 2019, Toševski *et al.,* 2011, 2014, 2015, Weill & Caldara, 2017, Košt'ál & Caldara, 2019) describing new species of the genera *Echinodera* and *Rhinusa*: even in publications with a strictly ecological or biogeographical "footprint", for example Osella, 1979, Osella & Zuppa, 1993, 1998, Morrone *et al*., 2001. In 1970, Osella published a revision of the genera *Caulomorphus* Faust, 1886, with the description of five new species from Turkey; *Caulomorphus besucheti* from coastal regions of the Black Sea, *C. bithynicus* and *C.* sp. prope *bithynicus* n. sp. in the vicinity of Bolu, *C. giocoae* coming from the surroundings of Artvin and *C. amaseianus* from Akdağ (vil. of Amasya) (Osella, 1970). In a later work, Osella describes two new species of *Horridorhinus* of the group *phrygius* from Anatolia: *H. meurguesae* from Uludağ and *H. bithynicus* from Abant Gölü, vil. Bolu; besides, two new species of *Pararhytirhinus: P. margaritae* of Ilgaz Dağları, vil. Kastamonu and *P. olympicus* from Uludağ (Osella, 1973). Following contribution of Osella focus on the new or little known species of the genera *Myllocerus* and *Ptochus*: *Myllocerus damascenus* Miller, 1861, a widespread species in the Near East, *M. curtipennis* Pic, 1903 from Adana, Osmaniye, Mersin, Isparta and Denizli, *M. cinereidorsum* Desbrochers des Loges, 1903 from Tokat, *M. lodosi* n. sp. from Osmaniye, vil. Adana, *Ptochus anatolicus* n. sp. from Adapazarı and *P. armeniacus* n. sp. from Eleşkirt, vil. Ağrı (Osella, 1977). The presence of the genus *Ocladius* Schönherr, 1825 inside Asia Minor is postulated (Osella & Meregalli, 1986). The revision of the genera *Minyops* and *Paraminyops* is the subject of a substantial monograph of Osella & Bellò (2010). *Minyops* includes 31 *taxa* from Albania, Macedonia, Greece, Turkey and Iran among which the following are described for the first time: *M. klapperichi* (Mt. Uludağ), *M. behnei* (Burdur), *M. setulosus* (Kayseri), *M. phrygius* (Eskişehir) and *M. lodosi* (Sivrihisar); *Paraminyops* gen. nov. includes 11 *taxa* from south Austria, North Italy, Istria, Dalmatia, Corfu, Albania, Greece and Turkey among which the following species/subspecies are of new description: *P.*

pseudoescherichi (Mt. Olympus of Bitinia and Balıkesir) and *P. opulentus isauricus* (Taurus) (Osella & Bellò, 2010).

The first publication of Enzo Colonnelli on the Coleoptera Curculionidae of Turkey dates back to 1978 and this author in the context of his comprehensive contribution to the study of the family (over 200 articles) continued his work on the Turkish fauna until very recently (for example, Colonnelli, 1978, 2011; Magnano & Colonnelli, 2005; Gültekin & Colonnelli, 2006; Avgin & Colonnelli, 2011 a, b; Korotyaev *et al.*, 2017; Hacet & Colonnelli, 2019). Avgin & Colonnelli (2011 b) give a checklist of Curculionoidea from southern Turkey (Adana, Osmaniye and Hatay provinces). The known localities and ecological notes on each of them were based on literature records and on recently collected material. *Lixus farinifer* Reitter, 1892 is newly recorded from Turkey, and 35 species (2 Rhynchitidae, 5 Apionidae and 28 Curculionidae) were listed for the first time from the investigated area of southern Turkey (Avgin & Colonnelli, 2011 b).

Coleoptera *Hydrophilidae.* The Coleoptera Hydrophilidae of the genus *Laccobius* Erichson, 1837 with over 80 species are the subject of a monograph by Elio Gentili (2000) who recognised 21 species in Anatolia. He proposed treating the species known here in three biogeographical groups: Mediterranean, Euro-siberian, Irano-turanian. Only three Anatolian species are partly Oriental, making it possible to conclude that Anatolia must be considered a pure Palearctic region (Gentili, 2000).

Coleoptera *Leiodidae (ex Cholevidae).* Cholevidae, a group now considered by many authorities to be a subfamily of Leiodidae, are Staphylinoidea beetles of small to medium size (usually between 0.8 and 6 mm) (Giachino *et al.,* 2013). Although the central part of the Anatolian Plateau has unfavourable conditions for them, this does not seem to be an insuperable barrier (at least for not strictly cave-dwelling taxa). The central xeric highlands prove easily avoidable by some taxa in both eastern and western areas where there are mountain ranges with favourable climatic characteristics (Giachino & Vailati, 2000). It is very difficult to understand the Anatolian population patterns of the Cholevidae without looking at the neighbouring key areas such as the Caucasus, Iran or Syria where numerous taxa closely related to Anatolian species exist. Many new species among these have been described by Giachino & Vailati (2000); they belong to the genera *Eocatops* (3 species, all from Turkey - Kars, Sivas and Erzincan), *Nargus* (14 species, 10 of them from Turkey - Manisa, Yeniköy, Samsun, Antakya, 2 in Artvin, Mersin, Kastamonu, Kars, Polatlı), *Choleva* (5 species, all from Turkey - Antakya, Antalya, Istanbul, Adana, Bursa), *Catopsimorphus* (4 species, 3 from Turkey - Çanakkale, Ankara, Antalya), *Catops* (4 species, 1 from Turkey - Antalya), *Fissocatops* (1 species, from Turkey - Rize). Finally, Giachino *et al.,* (2013) described two new species of *Anemadus* from the Near East: *Anemadus lucarellii* from south-western Anatolia which belongs to the *Anemadus pellitus* Ritter, 1884, species-group, and *A. kadleci* from north-western Syria which belongs to the *Anemadus strigosus* (Kraatz, 1852) species-group (*sensu* Giachino & Vailati, 1993).

Coleoptera *Meloidae.* Professor Marco Alberto Bologna of the University Roma Tre, Italian expert on Coleoptera Meloidae, made considerable contributions to the systematics and distribution of the world's blister beetles including taxa from the Near and Middle East. He also described the larvae of numerous genera. The Meloidae are a family with about 120 genera and some 3,000 species, mostly tropical or subtropical, related to open habitats and widely distributed as to be almost cosmopolitan. Members of this family are morphologically very heterogeneous, but adults are well characterised by a head clearly separated from the pronotum by a "neck", and by bilobed claws. Adults are mostly diurnal and phytophagous, feeding on the flowers and/or leaves of several plant families. The larvae are predaceous, feeding on the food stores and immature stages of various aculeate Hymenoptera (mostly Apoidea) or on Acridoidea egg pods. Blister beetles are mostly known because of their importance in the biological control of grasshoppers and for their uses in pharmacology and for veterinary and agricultural problems, as well as for their distinctive biology (hypermetamorphic development, parasitoid larval habits, defensive attributes, and diverse courtship behaviours). Bologna (1986) examined the taxonomic problems of the Coleoptera Meloidae fauna of the Syrian-Palestinian region which is a typical transition zone among Central Palearctic (Turanian), Palaeoremic (Saharo-Sindian) and Afrotropical regions and subregions. He highlighted the puzzling differences between the Syro-Palestinian population with that of Turkey, considering the level of genera, the absence of the genera *Sitaris* (with a distribution mainly Mediterranean-Saharan) and *Epicauta* which is widespread in the Palearctic region but only marginally present in southern arid areas. Moreover the genus *Ctenopus,* relatively widespread in Anatolia and above all Iranian-Turanic, is absent in Syria and Palestine.

The main differences with the Turkish blister beetles fauna are however ascribed to the presence in Palestine of some typically eremic genera such as *Croscherichia*, *Diaphorocera*, *Lyttolydulus*, *Lyttonyx*, *Sitarobrachys*, represented here by widespread or endemic species, and by the mainly afrotropical genera *Ceroctis*, *Cylindrothorax* and *Zonitoschema*. Of the 22 genera found in Turkey, 19 are in common with the 27 genera of Syria and Palestine (Bologna, 1986). Bologna *et al.* (2002) described the first instar larva of *Stenodera puncticollis* (Chevrolat, 1834) collected with adult specimens near Adana and provide the key to the adults of the genus *Stenodera* which includes the following species: *S. caucasica* (Pallas, 1781) from many sites of Central and Eastern Turkey, *S. anatolica* (Frivaldszky, 1884) from northern and south-eastern Anatolia, *S. coeruleiceps* (Fairmaire, 1892) from Antalya and Içel and *S. puncticollis* (Chevrolat, 1834) from the Taurus of Cilicia, Adana and Hatay. Afterwards Bologna & Di Giulio (2006) revised the genus *Teratolytta*; two main sections of this genus - one including five groups of species and three groups the other - are tentatively defined. Four new species from eastern and southern Anatolia are described; *T. carlae*, *T. dvoraki*, *T. monticola* and *T. taurica*; besides, a key to the 17 recognized species is proposed. A further revision of the same authors concern the genus *Trichomeloe* (Reitter, 1911) which includes eight species, mostly from the Near East. Based on abundant material, a review and newly definition on the basis of larval and adult characters is proposed and the following species from Turkey are re-described: *Trichomeloe chrysocomus* (Miller, 1861) from Adana, Hatay, Adıyaman, Mardin and Şanlıurfa; *T. conicicollis* (Reitter, 1907) from Muğla, Antalya and Adana; *T. deflexus* (Reitter, 1889) from Gaziantep, Adıyaman, Hatay and Kahramanmaraş; *T. seriçellus* (Reiche and Saulcy, 1857) from Hatay; *T. ottomanus* (Pliginskji, 1914) from Elazığ. Further data on the genus *Teratolytta* are given by Bologna & Di Giulio (2016) and the new species *Teratolytta krejciki* from Munzur range (East Turkey) is described; new records of *T. gentilis* (J. Frivaldsky 1877) from southern Turkey are also provided. Bologna (2016) recorded for the first time in Turkey *Sitarobrachys thoracica* (Kraatz, 1862), a species belonging to a monotypic Mediterranean-Macaronesian genus of Meloidae Nemognathinae widely distributed around the Mediterranean Basin and in the eastern Canary Islands. Bologna *et al.* (2008) proposed a thorough revision of the Mylabrini genus *Actenodia* (Laporte de Castelnau, 1840); the Mylabrini (as defined by Bologna & Pinto, 2002) is the most speciose tribe of the Meloidae, including approximately 750 described *taxa*. The genus *Actenodia* includes 18 species distributed in the Mediterranean and Saharo-Arabian regions, eastern and southern Africa; adults occur in temperate and tropical dry habitats during the blooming periods. Only two species of *Actenodia* are known for Turkey: *Actenodia confluens* (Reiche, 1866) from the vicinity of Istanbul, Izmir, Ankara and Antalya and *Actenodia peyroni* (Reiche, 1866) from Içel. Di Giulio & Bologna (2007) described the first instar larva, or triungulin, of *Euzonitis rubida* (Menetries, 1832) from southern Anatolia (Vilayet Içel near Mut). Di Giulio *et al.* (2013) in their revision of the first instar larvae of *Meloe*, subgenera *Eurymeloe* and *Coelomeloe*, described the larva of *Meloe* (*Eurymeloe*) *glazunovi* Plignskji, 1910 with adults from Turkey (Akseki). The discovery of some specimens of a new first instar larval type in blister beetles, collected in Iran on *Anthophora* bees, confirms the existence of repetitive and parallel trends in morphological specialization to phoresy in distinct lineages of Meloidae and in particular in the subfamily Meloinae. In this context the larval morphology of *Meloe* (*Lampromeloe*) *variegatus* Donovan, 1793, in the vicinity of Simav, Karaman, Adana and Malatya is described (Di Giulio *et al.*, 2014). Pan & Bologna (2014) revising the species of the genus *Mylabris* (of the nominotypical subgenus) list the following *taxa* from Turkey; *Mylabris apicenigra* Sumakov, 1915, *M. ciliciensis* (Escherich, 1899), *M. concolor* Marseul, 1870, *M. emiliae* (Escherich, 1899), *M. olivieri* Billberg, 1813, *M. quadripunctata* (Linnaeus, 1767), *M. tauricola* Marseul, 1870 and *M. variabilis* (Pallas, 1782); in addition they described the new species *M. cernyi* from the Mediterranean Turkey (Çanakkale and the vicinity of Adana). Turco & Bologna (2005) analysing the sexual behaviour of Littyni include in their observations *Muzimes tauricus* (Maran, 1941) from Sivas. Turco *et al.* (2006), and describing the first-instar larval morphology in the subtribe Lydina (Meloidae Lyttini) include in their analysis *Alosimus chalybaeus*

(Tauscher, 1812) from Mersin and Mut. Turco & Bologna (2011) mention numerous species from Turkey while using a canonical morphological approach to revise the taxonomy of the Palaearctic genus *Cerocoma*: *Cerocoma* (*Cerocoma*) *prochaskana* Reitter, 1896 from Hatay, *C.* (*C.*) *schaefferi* (Linnaeus, 1758) with a wide distribution (= w.d.), *C.* (*C.*) *simplicicornis* Reitter, 1913 from Aras river, NE Turkey, *C.* (*Meloides*) *adamovichiana* (Piller & Mitterparker, 1783) (w.d., also in Thrace), *C.* (*Meloides*) *albopilosa* Dvořák, 1993 from South Turkey, *C.* (*M.*) *barthelemyi* Baudi, 1878 (w.d.), *C.* (*M.*) *malatyensis* Kaszab, 1951 from Malatya (Caucasus too?), *C.* (*M.*) *muehlfeldi* Gyllenhal, 1817 (w.d.), *C.* (*M.*) *turcica* Pardo Alcaide, 1977 from Bingol, *C.* (*M.*) *gloriosa* Mulsant, 1857 from Turkey (general), *C.* (*M.*) *kunzei* Frivaldsky, 1835 (w.d.), *C.* (*M.*) *macedonica* Mařan, 1944 from W and central Turkey, *C.* (*M.*) *marginiventris* Reitter, 1899 from the Aras River valley, *C.* (*Mesocerocoma*) *scovitzi* Falderman, 1837 (w.d.), *C.* (*Metacerocoma*) *ephesica* Reitter, 1885 from European and Asiatic Turkey, *C.* (*Metacerocoma*) *festiva* Faldermann, 1837 from Turkey (general), *C.* (*Metacerocoma*) *schreberi* Fabricius, 1781 (w.d.); they describe also the new species *C.* (*Meloides*) *confusa* from Izmir (Altınova), *C.* (*Meloides*) *longiseta* from Ankara (Gordion) and *C.* (*Metacerocoma*) *martae* from Pamukkale and Söke (Menderes, Lake Bafa).

Coleoptera *Nitidulae* and *Kateretidae.* The monograph produced by Professors Paolo Audisio and Alessio De Biase (Department of Biology and Biotechnology at "Sapienza" University of Rome) together with the distinguished Czech expert Josef Jelinek (Audisio *et al.,* 2000) synthesises a great number of analytical publications (about forty by Audisio as single author; *e.g.* the description of *Meligethes zapparolii* from vil. Muş, east side of the Buglan Geçidi, Audisio, 1989) dating from 1976 to 1999 on these two groups of beetles. Audisio *et al.*, (2000) summarises the accumulated knowledge of these families as they occur in Anatolia (including all of Turkey and the Greek Eastern Aegean islands), in the Caucasus region (including the Turkish and Russian Caucasus, Georgia, Armenia, NW Iran, Azerbaijan) and in the Middle East (including Hatay (Turkey), Cyprus, Syria, Lebanon, Israel, Palestine, Jordan, Sinai, N Iraq). As many as 30 studied collections provided material for the data processing contributing to this classic monograph by Audisio *et al.,* (2000).

The fauna of the whole area includes 205 Nitidulidae and 27 Kateretidae for a grand total of 232 species, nearly 24% are endemics. Among Nitidulidae, we must remember the genera *Carpophilus* Stephens, 1830 (16 species), *Epuraea* Linnaeus, 1758 (30 species), *Meligethes* Stephens, 1830 (at least 112 species); among Kateretidae, the genus *Anamartus* Jelinek, 1976 (8 species). The percentage of endemic *taxa* follows the ecological requirements of the genera. About 32% of the species of the more or less specialized phytophagous genera, such as *Meligethes* in the Nitidulidae or *Anamartus* in the Kateretidae, are endemic or subendemic to the Anatolian, Caucasian and Middle East areas, while most of the other non-phytophagous species such as *Epuraea* and *Carpophilus* (Nitidulidae) are usually widespread Palaearctic, Asiatic-European, Siberian-European or European taxa (Audisio *et al.*, 2000). Pie charts significantly show the following percentages; among phytophagous (*s.l.*) species, endemics are 32% while a mere 9% among non-phitophagous species (Audisio *et al.*, 2000). Among the species new to science discovered in Turkey, all Nitidulidae, we must remember: *Urophorus colonnellii* Audisio & Kirejtshuk, 1989 from the vicinity of Adana, Ankara, Eskişehir and Nevşehir; *U. yakushenkoi* Audisio & Kirejtshuk, 1989 from Adana and Izmir; *Meligethes amei* Audisio & Kirejtshuk, 1988 from Giresun; *M. armeniacus* Audisio, Jelínek & Stepanovic, 1999 from the vicinity of Ağrı, Erzincan, Gümüşhane, and Kars; *M. biondii* Audisio, 1988 from Ağrı; *M. bithynicus* Audisio, 1988 (*species propria*) from Bolu; *M. bolognai* Audisio, 1977 from Artvin, Erzincan, Erzurum, Giresun, Kars, Kastamonu, Sivas and Yozgat; *M. bucciarellii* Audisio, 1976 widespread in central and eastern Turkey; two species of the group *M. coracinus* Sturm, 1845, "species 1" widespread in Turkey, "species 2" from Sivas; *M. dieckmanni* Audisio & Jelínek, 1984 from Artvin, Bursa, Erzurum, Gümüşhane, Kars and Rize; *M. jelineki* Audisio, 1976 from Artvin; *M. kirejtshuki* Audisio, 1979 from Erzurum, Gümüşhane, Kars and Kastamonu; *M. matronalis* Audisio & Spornraft, 1990 from Artvin, Giresun and Rize; *M. osellai* Audisio & Jelínek from Yozgat (in the same paper); *M. saxatilis* Audisio, 1988 from Adana, Bingöl, Gaziantep, Hakkari, Içel and Tunceli; *M. wittmeri* Jelínek & Audisio, 1977 from Erzincan, Erzurum, Gümüşhane and Sivas; *M. zapparolii* Audisio, 1989 from Antalya, Artvin, Erzincan, Erzurum, Kars, Muş and Sivas (Audisio *et al.*, 2000).

Coleoptera *Scarabaeoidea.* Based on 887 specimens of flower-eating Scarabaeoidea and Lucanidae collected in Turkey during the Zoological Institute of Rome University expeditions made between 1966 and 1975, Sabatinelli was able to identify two species new to science, *Maladera* (*Macroserica*) *vignai* and *Triodonta brignolii* (Sabatinelli, 1977 a). In a following paper the same author describes two new species of the Meolonthinae genus *Maladera, M.* (*Aserica*) *bruschii and M.* (*Aserica*) *cerrutii* from Antakya and Cyprus respectively (Sabatinelli, 1977 b). Professor Giuseppe Maria Carpaneto of the University Roma Tre, a leading figure in faunistic and systematic research on scarab beetles, described two new species of the genus *Aphodius* from Turkey, and gave new information about the distribution of various taxa (Carpaneto, 1973, 1976 a, b; Carpaneto & Piattella, 1989). Pittino (1982) described two new species of *Onthophagus* from Turkey, one of which is *O.* (*Paleonthophagus*) *carpanetoi* (Pittino, 1982). Finally, Carpaneto and his colleagues Emanuele Piattella and Riccardo Pittino provided a comprehensive overview of Turkey's Coleoptera Scarabaeoidea. A total number of 625 species of scarab beetle (281 Laparosticti and 344 Pleurosticti) were recorded in the literature as being in Turkey. These species belong to 99 genera and 14 families (Carpaneto *et al.,* 2000). Laparosticti are mainly dung- or detritus-feeders, Pleurosticti are mainly plant-feeders. This high percentage of Pleurosticti (55%) among other Mediterranean scarab beetle faunas can be explained by the large amount of wilderness and the high degree of habitat diversity in Turkish territories, including large areas of woodland and natural steppe, their presence supported by a flourishing vegetation cover of wild herbs, shrubs and trees. Conversely, any abundance of Pleurosticti species notably decreases whenever land use is dominated by intensive agriculture or grazing (Carpaneto *et al.*, 2000).

Two chorotypes are dominant: the SW-Asiatic (15%) and the E-Mediterranean (12%). The number of endemic species appears very high, 234 species that is 37.4% of the whole scarab fauna of Turkey; the Pleurosticti represent 75% of the endemics. The endemic Laparosticti are about 20% of the total number of species occurring in Turkey, whereas the endemic Pleurosticti exceed 51% of their total number. Most endemics occur in southern Anatolia, the scenario of an adaptive radiation for some genera probably due to the high floristic and habitat diversity; especially within the families Glaphyridae, Melolonthidae and Rutelidae. The highest number of endemic species is attributable to a S-Anatolian or Taurian pattern of distribution as observed in 87 species (14%), while the second pattern is shown by the species widely spread throughout Anatolia (10.6%) and those restricted to the Armenian and Armeno-Caucasian areas (4.5%). The scarab beetles of Turkey belong to the family Trogidae, Glaresidae, Geotrupidae, Hybosoridae, Orphnidae, Ochodaeidae, Aphodiidae (with the genus *Aphodius*, 123 species), Scarabaeidae, Glaphyridae, Melolonthidae, Euchiridae, Rutelidae, Dynastidae and Cetoniidae (Carpaneto *et al.*, 2000).

Coleoptera *Staphylinidae.* Relevant contributions on Turkey's Staphylinidae were produced by Arnaldo Bordoni, an independent researcher. He published 27 notes and monographs, always working alone. He started research in the 1970s (Bordoni, 1971), continuing his work until it culminated in a weighty monograph 40 years later. "*In 1971 I began to study the few specimens of Staphylinidae from Turkey who came from the collections made by colleagues, in particular of the Museum of Zoology of Rome University "Sapienza" and of the Museums of Natural History of Verona and Genoa". Since then, I started to prepare a Catalogue of the species of that region"* (Bordoni, 2010; see also Bordoni, 2013). Noteworthy is the description of two new species from Turkey, preserved in the Natural History Museum of Verona, *Lathrobium* (*Lobathrium*) *prapezuntis* and *Quedius* (*Sauridus*) *osellai* both from Sumela (Trabzon) and, on the same volume of Fragmenta Entomologica, the description of two new species of the genus *Vulda* subgen. *Typhlodes* the first known for Asian Turkey of these rare hypogean staphilinids characterized by showy dimensions and almost unknown behaviour; *Vulda* (*Typhlodes*) *vignai* and *V.* (*Typhlodes*) *brignolii*, the first from Abant, vil. Bolu, the second from Boraby gölü, vil. Amasya (Bordoni, 1973 a, b). Many other works followed (Bordoni, 1973 c, 1976 a, b, 1978, 1979, 1980 a, b, c, 1984, 1986 a, b, 1994, 1999 a, b, 2000, 2003 a, b, 2004, 2005, 2007 a, b, 2009). The same Author also gives the description of *Deliphrosoma lothari* Bordoni, 2000 from Kopdağı Pass in north-east Turkey (Bordoni, 1999, 2000) and *Achenium propontiacum* Bordoni, 2009 from the European Turkey (Bordoni, 2009). In the last paper known to us, the Author made observations and proposes new synonymies on Palaearctic Xantholinini (Bordoni, 2013). Other Italian authors who have made noteworthy contributions to the study of Turkey's Staphylinidae have been Roberto Pace (especially the genera *Leptusa*, *Geostiba* and *Atheta*) (Pace, 1982, 1983 a, b, 1989, 1996 a, b, 2002, 2004) and Adriano Zanetti (Zanetti, 1993, 2002).

Coleoptera *Tenebrionidae.* Our knowledge of the distribution of this family in Turkey comes from three significant monographs by Simone Fattorini, at the time a fellow of the Department of Animal and Human Biology of "Sapienza" University of Rome, and collaborators (Fattorini, 2000; Leo & Fattorini, 2000; Fattorini *et al.*, 2000); and from two earlier contributions by the same authors (Fattorini *et al.*, 1998, 1999). Tenebrionidae, one of the largest families of the Coleoptera comprising over 18,000 known species, exhibit superficial morpho-diversity at a level where they are sometimes considered to belong to other families of Coleoptera (Carabidae, Chrisomelidae, Curculionidae). Adult characters (abdominal defensive glands, ovipositor, tentorium, wing venation etc.) have been used in reconstructing phylogenetic relationships inside the family because larvae, relatively simple in structure, present few characters which can be used by taxonomists. Both adults and larvae are primarily saprophagous, feeding on a huge variety of dead plant and animal matter (humus, leaf litter etc.). According to the major habitat of their larvae, tenebrionids can be divided into two groups: xilophilous, which occur in rotten wood and associated cambium and subcortical spaces; geophilous, which occur in soil and leaf litter. Many species are well-adapted to steppes and deserts and tenebrionids are effectively a conspicuous element of most arid and semi-arid environments. This is shown by their numerous morphological, physiological and behavioural adaptations. Pimeliinae are the most important geophilous tenebrionid group in arid and semi-arid regions. The distribution of the Tenebrionidae family in Anatolia is based on our knowledge of the subfamily Pimeliinae, the largest of all the Tenebrionidae and considered a sister group to all the other components of the family. Although Tenebrionidae occur in all major zoogeographical regions they are most numerous in tropical and subtropical areas as opposed to cool-temperate climates (a pivotal comparison between Italy with 281 species and the British Isles with only 27 demonstrates this). In spite of to the amount of biogeographical information on Pimeliini available in numerous papers, including those by the distinguished Italian entomologist Edoardo Gridelli (1895-1958), few deal with Anatolian Tenebrionidae. According to Fattorini (2000) the tenebrionid fauna of Anatolia probably includes more than 200 known species but the exact distribution and taxonomic status of many are uncertain. At least 78 species of Pimeliinae are definitely known to be present in the Anatolian Peninsula (Fattorini, 2000). Cluster analysis shows a clear faunal breakdown between north-eastern and west-central Anatolia. Among Pimeliini, eastern areas are mainly characterized by elements with "Irano-Turanian" distribution or by endemic species that, according to their phylogenetic relationships, can be referred to such distribution. If we analyze and compare the phytogeographical and climatic divisions of the Middle East, recognizing the following ecological provinces: Eurosiberian, Mediterranean, Saharo-Sindian, Irano-Turanian and Sudano-Deccanian (Ethiopian), one can conclude that three of these, Mediterranean, Eurosiberian and Irano-Turanian occur in the Anatolian peninsula. Lush forests (Eurosiberian province) flourish in the north side of the Anatolian peninsula characterized by heavy rainfall often throughout the year; Mediterranean climate predominates in the west and south with its cool damp winters and hot dry summers; the Central Plateau is dominated by severe conditions with very hot arid summers and cold winters. Post-Pleistocene aridification due to climatic changes and human occupation and disturbance possibly play a basic role in determining present distribution of Irano-Turanian elements in Central Anatolia. Kosswig (1972) suggested that the majority of so-called "Irano-Turanian" species are actually those which have made additional adaptations to man-influenced habitats such as secondary steppe, while true elements of an eremic fauna, Irano-Turanian or Saharo-Sindian, are late incomers to Anatolia and are mostly restricted to its eastern territories. From a general viewpoint, there is a congruence among vertical distribution, general distribution and chorotypes. Species referable to the East Mediterranean chorotypes or to the southern part of the Irano-Anatolian distribution type of the SW Asiatic chorotypes, such as *Pimelia villosa*, *P. subglobosa*-group, *P. akbesiana*, *P. timarchoides* and *P. bajula*, are mainly distributed within the Mediterranean province under 2000 m, while "Irano-Turanian" species, such as *P. dubia* and *P. musiva*, are distributed in the Irano-Turanian province about over 2000 m. This congruence supports the hypothesis that the east Anatolian mountain areas provide a filter which connects the east Anatolian fauna with the Irano-Turanian fauna while the Central Anatolian plateau seems to have a transitional character between an Irano-Turanian and a more typical Mediterranean fauna (Fattorini, 2000). Comparing distribution patterns of Pimeliini with the so called "Anatolian Diagonal" some interesting patterns emerge: most of the Anatolian Pimeliini have been apparently affected by this biogeographical break; West Anatolian species are *Pimelia villosa*, *P. subglobosa*-group, *P. timarchoides*, *P. akbesiana*, *P. werneri* and *Graecopachys quadricollis*; East Anatolian species are *Trachyderma setosa*, *P. musiva*, *P. repleta* and *P. dubia*. Few species are distributed on both sides of the "Diagonal" namely *P. bajula*, *P. robusta* and partly *Trachyderma philistina*. As the "Diagonal" is an old event, these distribution patterns suggest possible different biogeographical scenarios, mainly some taxa at the subgenus level (for example *Camphonota*) are subdivided into eastern and western species as a possible result of a vicariance event (Fattorini, 2000). Anatolian Pimeliini are very poorly known: of the 15 species from Anatolian peninsula and Cyprus, one belongs to the genera *Sternoplax* (*S. nicomedia* from Amasya), at least three species to *Trachyderma* (*T. setosa* from Ararat and Van, *T. lima* from Nevsehir and Mersin and *T. philistina* from Konya), *Pachyscelis* with two species (*P. musiva* from Bitlis and Van and *P. villosa* (w.d.), *Graecopachys* with *G. quadricollis* from Aydın, Denizli, Pamukkale, Efes, Kuşadası, Kayseri, Konya and Marmaris. Finally the genus *Pimelia* with eight species: *P. akbesiana* (w.d.); *P. repleta* between Bayburt and Erzincan; *P. subglobosa* (w.d.); *P. timarchoides* from Amasya, Çorum, Boğazkale, Kayseri, Sivas and Yozgat; *P. werneri* from Kayseri, Malatya, Maras and Niğde; *P. bajula* from Adana, Antakya, Balıkesir, Hatay, Gaziantep, Içel and Kahramanmaraş; *P. dubia* from Ağrı and Hakkari; *P. robusta* from Amasya, Erzurum and Mardin (Leo & Fattorini, 2000). Following Huggett (1998) who distinguished endemic and microendemic species, the Italian authors were able to attribute to the first category *P. timarchoides* and *P. akbesiana*, *P. werneri* and *P. robusta* and to the second category *P. repleta* and *S. nicomedia* (Leo & Fattorini, 2000).

Crustacea*. General remarks.* A report on the summer zooplanktonic cenosis of Lake Abant by professor Fiorenza Margaritora and professor Vezio Cottarelli (both retired, though the latter is still very active), associates of the distinguished Italian hydrobiologist professor Emilia Stella of "Sapienza" University, Rome (1909-1994) is noteworthy (Margaritora & Cottarelli, 1970). Lake Abant, an ellipsoidal basin with a perimeter of 7 km, is located 35 km from the city of Bolu in north-west Turkey, at an altitude of 1,448 m asl. Zooplankton organisms were collected at four stations, and for each station Copepods, Rotifers and Cladocerans were counted and percentage ratios calculated. The summer planktonic biocoenosis of Lake Abant are similar to those known from some high altitude alpine lakes and include many cosmopolitan forms which prefer cold waters. The following species found in the lakes were new to Turkish fauna: among Rotifera, *Kellicottia longispina* (Kellicott) and *Conochilus unicornis* Rousselet; among Cladocera, *Sida crystallina* (O. F. Müller), *Polyphemus pediculus* (L.), *Ceriodaphnia bicuspidata* Weltner, *Scapholeberis mucronata* (O. F. Müller) and *Daphnia hyalina lacustris* Sars (Margaritora & Cottarelli, 1970). The preliminary results of two expeditions (1970, 1971) in Anatolia aimed at collecting phreatic fauna based on materials from 62 stations during 33 days and 7,000 km covered, have been described in Argano *et al.*, 1972.

Crustacea*. Amphipoda.* Like all Peracarids, Talithrids lack planktonic larval phases. Their dispersal over medium-large distances occurs through chance transport of individuals on drift material. They usually disperse from their original beach to other sites, particularly during heavy storms. In the eastern Mediterranean the geographical area between the Greek and Anatolian coasts is ideal for analysing the degree of genetic structuring in different species of sublittoral Talithrids, and in verifying the hypothesis that surface sea currents may play an important role in determining heterogeneity patterns (De Matthaeis *et al.,* 1994, 1995, 1996, 1998). Data on the level of gene flow and degree of genetic structuring were collected for this work from four species of Talithrid Amphipods (*Orchestia montagui, O. stephensi, Platorchestia platensis, Talitrus saltator*) sampled between the Sporades islands, the Cyclades islands and the coast of Anatolia. The role played by surface sea currents in influencing probable migration between populations appeared evident for all species (De Matthaeis *et al.,* 1999).

Crustacea*. Branchiopoda* and *Copepoda.* The Anostraca is a section of the Crustacea which (together with Notostraca and Spinicaudata) constitutes the informal group of the so-called "*large branchiopods"*. Among these *"fairy shrimps"* we must acknowledge the genera *Artemia* and *Chirocephalus* for their distribution, ecology and practical importance. Professor Vezio Cottarelli, a distinguished carcinologist and specialist on both Branchiopoda and Copepoda Harpacticoida, produced numerous publications, sometimes in collaboration with the late professor Graziella Mura (1940-2016). Firstly it is appropriate to remember that the genus *Chirocephalus* contains 51 species, 10 of which are described by Italian authors, eight by Cottarelli and Mura themselves, individually or in collaboration (see **"Sitography"**). This series of papers began with the description of a new species *Chirocephalus paphlagonicus* Cottarelli, 1971, found in a pond near the village of Kastamonu on the Black Sea coast, at the same site where another species new to Turkey: *Cyzicus tetracerus* (Krynicki, 1830) *fide* Auduoin, 1837 (*sensu* Alonso, 1996) had been found (Cottarelli, 1971). The series continues with an annotated list of a number of species, among which are *Branchinecta ferox* (Milne-Edwards, 1940) from a site near Karabahace (Urfa) which had small and adult specimens of different ages, the cosmopolitan species *Artemia salina* Linnaeus, 1758 from Tuz Gölü with *Phallocryptus spinosa* (Milne-Edwards, 1840) from the same site, *Branchipus laevicornis* Daday, 1913 collected in the vicinity of Nevşehir - this was redescribed as it had no collections or published reports since it was first named - and finally *Chirocephalus diaphanus carinatus* (Daday, 1910) from Kula (Manisa) whose male cercopoda were illustrated. This last species seems to be a Palaearctic form with an oriental distribution (Cottarelli & Mura, 1974). In the study of this group collaboration between Italian and Turkish researchers paid off. The results begin with the description of two new Anatolian species of Turkish *Chirocephalus: C. anatolicus* and *C. cupreus* Cottarelli, Mura and Özkütük, 2007, two new fairy shrimp species collected from temporary pools on the Anatolian Plateau (Cottarelli *et al.,* 2007). Fruitful collaborations continue with the detailed re-description of *Chirocephalus tauricus* Pesta, 1921 together with the description and discussion of two new fairy shrimp taxa, *C. algidus* and *C. brteki* Cottarelli, Aygen and Mura, 2010. These new species were collected respectively inside Alagöl, a temporary pool close to the glacial Lake Karagöl on Mount Bolkar (Taurus mountains, 3.100 m asl, Nidge Province), and from Lake Alan Gölü, 600 m asl, a shallow basin on the border of Izmir Province close to the village of Bozalan (Cottarelli *et al.,* 2010). In recognition of Graziella Mura's contribution to knowledge of the biology of the Branchiopoda Anostraca, Brtek and Cottarelli dedicated to her the new species *Chirocephalus murae*, an interesting fairy shrimp discovered in astatic water bodies of the Anatolian Plateau in the Turkish Province or "vilayet" of Eskişehir (Brtek & Cottarelli, 2006). Incidentally Brtek himself discovered a new Turkish species: *Chirocephalus vornatscheri* (Brtek, 1968) and was the co-author, with Graziella Mura, of a revised key to families and genera of Anostraca (Brtek & Mura, 2000). To date, the presence of at least five species new to science has been documented for the Anatolian altiplano (Mura *et al.*, 2005). Further research has enabled 10 species belonging to the "*diaphanus*" and "*bairdi*" groups to be attributed to the genus *Chirocephalus*, with representatives of other genera which include *Branchinecta ferox*, *B. orientalis*, *Phallocryptus spinosa* and *Branchipus laevicornis*; while the presence of *Branchinectella media* Schmankewitsch, 1873, *Chirocephalus reiseri* Marcus, 1913 and *Streptocephalus auritus* Koch, 1841 need confirmation (Mura *et al.*, 2011). Some years later an important new record emerges. *Chirocephalus sarpedonis* Cottarelli, Mura, Ippolito and Marrone, 2017 sp. nov. was collected in a temporary pond in Lycia (Turkey), described and its affinities to other species of this genus, based both on morphology and mtDNA cytochrome oxidase subunit I (COI) sequences were investigated (Cottarelli *et al.,* 2017). Male and female morphology suggests its major affinity is with species of the *bairdi*-group although its morphological peculiarities make it difficult to ascribe *C. sarpendonis* to any of the *Chirocephalus* species-groups which are currently in use in the systematics of the genus. Finally three new species of *Kinnecaris* (Copepoda: Harpacticoida: Parastenocarididae) are described: *Kinnecaris xanthi* sp.nov., *Kinnecaris draconis* sp.nov., and *Kinnecaris iulianae* sp.nov. (Bruno & Cottarelli, 2015). These were first record for both Thailand and Turkey. The first two species were collected in Anatolian Turkey, respectively from the hyporheic zone of the Karamenderes River near the ruins of ancient Troy in Çanakkale Province, and in the hyporheic zone of the Anamur and Dalaman rivers in Mersin and Muğla Provinces (Bruno & Cottarelli, 2015).

Crustacea*. Isopoda.* Professor Roberto Argano ("Sapienza" University) and Professor Giuseppe Lucio Pesce (University of L'Aquila, Abruzzi, Central Italy) now both retired, focused a short monograph on the Asellidae of Turkey with particular attention to the genera *Asellus* and *Proasellus* (Argano & Pesce, 1979). Following researches on the fauna of phreatic waters in the Near and Middle East (Argano & Pesce, 1980), the first Cirolanid from Turkish subterranean waters was discovered. *Turcolana cariae*, a new species and genus (Argano & Pesce, 1980). The ability to roll into a ball is shown in only three genera of the Cirolanid family: the Mexican genus *Creaseriella* Rioja, 1953, the European genus *Faucheria* Dollfus & Viré, 1905, and the African genus *Skotobaena* Ferrara and Monod, 1972. All these are freshwater subterranean forms which achieved this ability independently, using very different morphological features. *Turcolana*, belonging to a new genus (the first from Turkey) provides further evidence of the existence, in subterranean aquatic environments, of ecological conditions favourable to the adaptive success of this behavioural feature. The description of this eyeless and depigmented Cirolanid is based on a single specimen, a female from a freshwater well (4 m deep) near Cetibeli (Muğla vilayet) on the road between Ula and Koycegiz, at an altitude of 200 m asl. It is rather unusual to work on a single specimen when reporting on particular environments such as subterranean or abyssal ones. However the morphological characters of this Cirolanid are remarkable and can definitely confirm its generic identity. The extraordinary modification of the uropods and the complex adaptation enabling the body to be rolled into a perfect ball are the most peculiar characteristics of the genus *Turcolana.* The convexity of the body of the related *Typhlocirolana* Racovitza, 1905, which is unable to roll up, the structure of its pleopods, the shape of the first pleonite together with the general features of the uropods, enabled the authors to suggest the derivation of the very specialised genus *Turcolana* from *Typhlocirolana* (Argano & Pesce, 1980).

Vertebrata

Amphibia and ***Reptilia.*** We are not aware of an overall publication on the Amphibians of Turkey written by any Italian author. However in the Italian private or public collections there are many amphibian (and reptile) voucher specimens from Anatolia. For example the Natural History Museum of Florence University has many specimens donated by the late Professor Benedetto Lanza (1924-2016) (Lanza *et al.,* 2005, 2006; Lotti *et al.,* 2012), and there's similar material in the zoological collections of the Società Romana di Scienze Naturali (Crucitti *et al.,* 2020).

A paper on intraspecific variation in the common toad *Bufo bufo* in Turkey (especially north-eastern Anatolia), Greece and southern Italy, based on 16S Ribosomal RNA sequences does not support the existence of genetically differentiated entities (Kutrup *et al.,* 2006). A second fruitful Italian Turkish collaboration (with an author from Russia as well) led to arranging the systematics of the green toad (genus *Bufotes*) in Turkey using combined mitochondrial genes (D-loop and 12S ribosomal RNA), and applying demographic analysis to clarify its evolutionary history. D-loop variation in toads from 46 localities were examined and three haplotype groups were found: one for *Bufo viridis*, and two lineages for *Bufotes variabilis* with only one of the latter present in Turkey. Population genetic analyses are consistent with a range expansion of the *Bufotes variabilis* group covering western Turkey. Mitochondrial DNA haplotype groups may reflect historical divisions within *B.variabilis* and indicate, as a whole, that the allopatric distribution of *B.variabilis* within Anatolia occurred because of climatic shifts during the Pliocene and that this shows that Anatolia is likely to have been the setting for vicariant species formation (Özdemir *et al.,* 2014).

Short notes, some full papers and a concluding monograph (up to June 2000) represent the main contributions by Italian authors to the study of the distribution, systematics and ecology of the reptiles of Anatolia and adjacent countries. Venchi & Bologna (1996) collected one male *Lacerta parva* Boulenger, 1887, in the Thracian locality of Emirali in the vilayet of Tekirdağ. The record is interesting for two reasons: the altitude, which is 250 m asl while Anatolian localities are between 950 and 1,700 m asl; and the now-known presence of this species in Europe when it was previously only known from Caucasian records. Till this time *Lacerta parva* was believed to be endemic to the Anatolian Peninsula and Transcaucasica (Venchi & Bologna, 1996).

Italian-Turkish cooperation led Aureggi *et al.* (2000) to dedicate five years of research to the main nesting site of the green turtle *Chelonia mydas* (Linnaeus, 1758) in the Mediterranean. This is the Akyatan beach located in the Çukurova region of the south-east coast of Turkey, where the green turtle was always the predominant species while the loggerhead turtle *Caretta caretta* (Linnaeus, 1758) is not a significant part of the turtle population when compared with other nesting beaches in the Mediterranean. The Akyatan beach, 19.7 km long, is composed of fine sand and at this time was still unaffected by human disturbance. Observations included the total number of marine turtle nests where eggs were laid, the spatial nest distribution within each kilometre along the beach, and the number of predated nests. The main nest predator here was the red fox *Vulpes vulpes* Linnaeus, 1758 (Aureggi *et al.*, 2000).

In the context of Italian contributions to checklists and zoogeographical analysis of reptiles in Anatolia there is a notable paper by Sindaco *et al.* (2000) which is a fundamental study of the geographical distribution of reptiles in Anatolia compared with other Near East areas. Incidentally, Roberto Sindaco (now at the Carmagnola Natural History Museum near Turin) is the main author of two monographs on the reptiles of the Western Palearctic (Sindaco *et al.*, 2008, 2013). Roberto Sindaco, Alberto Venchi, Giuseppe Maria Carpaneto and Marco Alberto Bologna were all included in this work on the Asiatic regions of Turkey. The monograph is an updated checklist of 109 species of indigenous reptiles belonging to 48 genera and 19 families; 8 Turtles, 1 Amphisbaenian, 55 Lizards and 46 Snakes for each of these the general distribution, the distribution in Anatolia, the main chorotype and notice on its affinities, the subspecies occurring in Anatolia, a map with both bibliographic and unpublished records for indigenous species only, are reported. The conditions of “endemic” and “near endemic” species are considered. The highest number of endemic taxa, 10 (26% of the reptile fauna) which usually includes species inhabiting mountains or highlands, is referable to an “Armenian” pattern of distribution. These species generally are usually found in north-eastern Anatolia and, more or less marginally, also in Transcaucasia, and adapted to steppe or rocky habitats. The other main chorotypes are as follows; the SW-Asiatic (23%), the E-Mediterranean (18%), the Turano-Mediterranean (9%) and the Mediterranean (5%). Six larger divisions corresponding to main geographic regions of Anatolia were obtained by the similarity dendrogram and finally compared with 13 selected geographic areas outside Anatolia in order to check their faunistic affinities (Sindaco *et al.*, 2000).

An Italian-Spanish collaboration produced a systematic review of the genus *Anatololacerta*, applying various phylogenetic methods to work out relationships within this genus and to assess the taxonomy of this morphologically diverse group of lizards endemic to western and southern Anatolia and some neighbouring Aegean islands (Bellati *et al.*, 2015). By selecting both mitochondrial and nuclear markers, Bellati *et al.* (2015) tested the effectiveness of the classic “gene tree” (i.e. Bayesian Inference) versus the innovative (i.e. coalescent-based) “species tree” as methods of resolving the *Anatololacerta* taxonomic enigma. According to the results, the gene tree method failed to clarify phylogenetic relationships among clades, whereas the multi-locus species tree approach, coupled with species delimitation methods, enabled the identification of four clearly distinct species, the north-western taxon *A. anatolica*, the south-western taxon *A. pelasgiana stat.novo*, the south-eastern taxon *A. budaki stat. novo*, and the easternmost *A. danfordi.* These species probably diversified in different allopatric refugia located in south and west Anatolia, where isolated populations may have persisted during Pleistocene glacial cycles (Bellati *et al.,* 2015).

An international team of scientists (from Greece, Slovakia, Turkey, Israel, Russia, Czech Republic, Italy, USA) gave their collaboration to resolving the systematic and biogeographic dilemma posed by Kotschy’s Gecko (Kotsakiozi *et al.,* 2018). *Mediodactylus kotschyi* is a small gecko native to south-east Europe and the Levant, which displays great morphological variation and has a large number of morphologically recognised subspecies. It was reasonable to suppose that it constituted a complex of several as yet unrecognised species. The international group used multi-locus sequence data (three mitochondrial and three nuclear gene fragments) to estimate the phylogenetic relationships of 174 specimens from 129 sampling localities covering a substantial part of the distribution range of the species. Results revealed high genetic diversity among *M. kotschyi* populations and contributed to our understanding of the phylogenetic relationships and ability to estimate the divergence times between them. Within *M. kotschyi* diversification began approximately 15 million years ago (Mya) in the Middle Miocene, whereas diversification within most of the major clades has occurred in the last 5 Mya. Tentative proposals were made for recognition of the following five species: *Mediodactylus kotschyi* (mainland Balkans, most Aegean islands, Italy), *M. orientalis* (Levant, Cyprus, southern Anatolia, the south-eastern Aegean islands), *M. danilewskii* (Black Sea region and south-west Anatolia), *M. bartoni* (Crete), and *M. oertzeni* (southern Dodecanese islands) (Kotsakiozi *et al.*, 2018). The conclusion looks significant "*This newly recognised diversity underlines the complex biogeographical history of the Eastern Mediterranean region"* (Kotsakiozi *et al.,* 2018).

Aves. The Anatolian wetlands have important wintering and breeding sites for waterfowl resident in the Palearctic region, and the checklist of these key sites of international importance is of paramount relevance for waterfowl and waders. Surveys related to bird census were carried out in 40 sites. All waterfowl and waders present during their breeding seasons were recorded by Domenico Fulgione and Mario Milone from the Dipartimento di Zoologia, Università Federico II di Napoli. The authors identified 97 Anatolian wetland sites with high numbers of birds including several vulnerable species, among which only eight are protected. Twenty-eight unprotected areas (for example the Çukurova delta) harbour threatened waterbird species. The highest diversity, with 44 bird species, is the delta of the Evros River because of its geographic position. The reservoir of Lake Kuş has 27 species and the artificial Lake Sarıyar has 24 species. The chorological groups most strongly represented are the Palearctic, Oloarctic and Orientals (Fulgione & Milone, 2000). For appropriate conservation planning, wetlands need to be managed as a network and not as separately individual sites. Consequently "*…we think the Anatolian peninsula is worthy of a specific conservation program to preserve their biodiversity"* (Fulgione & Milone, 2000).

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Sitography

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Oral Presentation
Wednesday
Diversity of Animal Species, Systematics, and Phylogeny-1

Range Extension of *Squalius fellowesii* (Günther, 1868) in Anatolia (Teleostei: Leuciscidae)

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ABSTRACT

The survey was conducted between 2014-2019 to assess the distribution of *Squalius fellowesii*. Fish samples were caught at 20 different sampling sites in the western part of Anatolia. Fish were caught by pulsed DC electrofishing equipment and killed by over anaesthetization, fixed and stored in formaldehyde. As a result, new locations have been added to the known distribution area of the species.

Keywords: Chub, Turkey, freshwater fish, ichthyofauna.

INTRODUCTION

The *Squalius* species (Bonaparte, 1837) was considered to be a member of the family of Cyprinidae, which was in the Cypriniformes order for a long time (Stout *et al.*, 2016). Some studies conducted after the 1980s, and reported that the Cyprinidae family had two main subfamilies (Cyprininae and Leuciscinae), these emerged at different times of the Oligocene period (Chen *et al.*, 1984; Cavender and Coburn, 1992; Zardoya and Doadrio, 1998; Sanjur *et al.*, 2003). Stout *et al.* (2016) revealed that this subfamily is a separate family called Leuciscidae, which also includes the genus *Squalius*. Members of the genus *Squalius* inhabit an area which ranges from Europe to the Middle East, especially in the Mediterranean Basin. Recently, it has been reported that 49 species belong to this genus and it is represented by 21 species (Table 1) in Turkey (Sanjur *et al.*, 2003; Stoumboudi *et al.*, 2006; Kottelat and Economidis, 2006; Doadrio and Carmona, 1998; Kottelat and Freyhof, 2007; Zupancic, 2008; Bogutskaya and Zupancic, 2010; Özuluğ and Freyhof, 2011; Turan *et al.*, 2009; 2013; 2017; Bayçelebi, 2019).

MATERIALS AND METHODS

Fish were caught by pulsed DC electrofishing equipment and killed by over anaesthetization, fixed in 10 % formaldehyde and stored in 4 % formaldehyde. Material examined is deposited in Recep Tayyip Erdoğan University Zoology Museum of the Faculty of Fisheries, Rize (FFR). The map was created using the Qgis v. 3.8.3-Zanzibar software available at http://diva-gis.org. Occurrence data in the map (Fig. 1) are based on our own material.

Abbreviations used: SL, standard length.

We follow Stout *et al.* (2016) and authors cited in this publication and treat the cyprinid subfamily Leuciscinae as an own family: Leuciscidae. Authors of species names are listed in Table 1.

Table1. Species names mentioned in this study, and their authors

Squalius adanaensis Turan, Kottelat & Doğan, 2013
Squalius agdamicus Kamensky, 1901
Squalius anatolicus (Bogutskaya, 1997)
Squalius aristotelis Özuluğ & Freyhof, 2011
Squalius berak Heckel, 1843
Squalius cappadocicus Özuluğ & Freyhof, 2011
Squalius carinus Özuluğ & Freyhof, 2011
Squalius cephaloides (Battalgil, 1942)
Squalius cephalus (Linnaeus, 1758)
Squalius cii (Richardson, 1857)
Squalius fellowesii (Günther, 1868)
Squalius kosswigi (Karaman, 1972)
Squalius kottelati Turan, Yılmaz & Kaya, 2009
Squalius lepidus Heckel, 1843
Squalius orientalis Heckel, 1847
Squalius orpheus Kottelat & Economidis, 2006
Squalius pursakensis (Hanko, 1925)
Squalius recurvirostris Özuluğ & Freyhof, 2011
Squalius semae Turan, Kottelat & Bayçelebi, 2017
Squalius seyhanensis Turan, Kottelat & Doğan, 2013
Squalius turcicus De Filippi, 1865

Figure 1. Distribution of *Squalius fellowesii* in western Anatolia.

RESULTS

Squalius fellowesii (Günther, 1868) *Leuciscus fellowesii* Günther, 1868: 224 (Type locality: Turkey: Xanthus). Figure 2-3.

Figure 2. *Squalius fellowesii***,** Not preserved, about 100 mm SL; stream Bakırçay; Not preserved, about 90 mm SL; Büyükmenderes River.

Common name. Aegean chub / Ege tatlı su kefali.

Synonyms. *Leuciscus cephalus* (Linnaeus, 1758); *Squalius cephalus* (Linnaeus, 1758).

Material Examined. FFR00785, 8, 66-93 mm SL; Aydın: Çine, stream Kayırlı, 37.426 28.137. —FFR00790, 25, 69-153 mm SL; Uşak: Gediz River, 38.776 29.21. —FFR00797, 22, 66-145 mm SL; Muğla: Ören, stream Eşen, 36.705 29.404. —FFR03820, 10, 85-151 mm SL; Muğla: Seydikemer, stream Eşen, 36.632 29.360. —FFR06201, 26, 107-161 mm SL; Muğla: Seydikemer, stream Eşen, 36.713 29.369. —FFR06204, 25, 90-145 mm SL; Aydın: Boğazyurt, Akçay, Büyük Menderes River, 37.749 28.339. —FFR06208, 25, 68-140 mm SL; Denizli: Honaz, stream Akçay, 37.789 29.261. —FFR06210, 52, 42-150 mm SL; Antalya: Korkuteli, stream Korkuteli, 37.019 30.264. —FFR06211, 8, 85-150 mm SL; Uşak: Çivril, Büyük Menderes River, 38.155 29.637. —FFR06212, 35, 78-172 mm SL; Antalya: stream Kovada, 37.575 30.817. —FFR06213, 29, 42-157 mm SL; Uşak: Sivaslı, stream Banaz, 38.550 29.620. —FFR06217, 29, 42-157 mm SL; Muğla: Dalaman, Dalaman River, 36.834 28.795. —FFR06290, 8, 77-137 mm SL; İzmir: Bergama, Bakırçay River, 39.129 27.372.

Additional Records. 39.156 29.142, 38.214 27.102, 39.083 27.211, 39.129 27.373, 38.229 27.548, 36.632 29.3605, 39.129 27.372.

Distribution. *Squalius fellowesii* is widespread in the western part of Anatolia. It is known from the River Dalaman, Büyük Menderes, Gediz, Bakır, Madra, drainages and also stream Eşen. Here, it was recorded first from streams Aksu, Korkuteli and Kovada (see Figure 1.). More studies are needed to determine whether the species is distributed in the island of Lesbos (Özuluğ and Freyhof, 2011).

Figure 3. *Squalius fellowesii***,** from top: FFR 06201 165 mm SL; stream Eşen; FFR 06212 154 mm SL; stream Aksu.

DISCUSSION

Durand *et al.* (2000) claimed that, as a result of their genetic study, the genus of *Squalius* from Eşen was related to chub distributed in Büyük Menderes, Bakırçay and Gediz rivers but genetically belonged to different groups. With this study, 302 samples from different rivers and streams flowing into the Aegean Sea and the Western Mediterranean were analyzed and all of them were described as *S. fellowsii* (except for Tahtalı drainage, İzmir).

CONCLUSIONS

Pollution, climate change, drought and water withdrawal are the chief threats. Species that form an important part of the distribution of Büyükmenderes and Gediz rivers are contaminated so intensely that the species only live in the tributaries (IUCN, 2015).

ACKNOWLEDGEMENTS

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Oral Presentation
Wednesday
Biodiversity, Landscape, Tourism-1

Determination of the Recreational Potential of Erzurum Palandoken Urban Forest by the Gulez Method

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ABSTRACT

Recreation is defined as a recreation of the activities that take place in the free time by the individual's own will, which allows them to be renewed physically and spiritually, depending on the social, economic, cultural opportunities and the structure of the society in which they live. The purpose of this research; to determine the recreational potential of the Palandoken City Forest in Erzurum. Gulez in Research, which is developed in accordance with the conditions in Turkey and used to determine the potential of the recreation area, offering practical solutions for local managers and practitioners Gulez method is used. In order to determine the recreation potential of Palandoken City Forest, landscape value, climate value, accessibility, recreational facilities and negative factors have been determined. As a result of the research, the recreation potential of Palandoken City Forest was found to be 58%. According to the classification in the Gulez Method, this value corresponds to the middle level. This result reveals that although Palandoken City Forest is located on the slopes of an important winter tourism center, it does not meet, and improve the expected services, and functions. Palandoken City Forest, which was closed to transportation at the start of the winter season, should be used more effectively in this city, which constitutes the basic building blocks of winter tourism. The link with the city center should be supported by cable car works, and it should be envisaged that the middle-income people living in the city and the real owners of the city will benefit from these opportunities. Observation terraces should highlight the beauty of the city and should be designed to dominate the city's scenery.

Keywords: Palandoken City Forest, recreation potential, Gulez Method, Erzurum

INTRODUCTION

The concept of urban forestry has become one of the elements that succeeded in gaining a place in urban planning and management that emerged with the need of society (Bayram, 2004; Yılmaz *et al.*, 2006). Forests established on natural forest formation and favorable lands, located in or around cities, protected or reforested, at a distance that the city people can directly or indirectly benefit from, broadly capable of sustaining the existing ecosystem are called urban forests (Aslanboğa, 2004; Korkut and Çilek, 2004; Yılmaz *et al.*, 2006).

Today, the development of technology and industrialization have led to the introduction of machines instead of manpower. Less need for manpower has improved working conditions. As a result, the free time that people can spare for recreation and entertainment has increased. These free times have become the basic need for individuals to provide mental and physical relaxation. In this period time, the activities performed by individuals to get rid of the stress and monotony of daily life, to rest and to have a good time have revealed the concept of recreation (Çidam, 2007; Çakır and Çakır, 2012; Surat, 2017).

Recreation is the activities that individuals carry out in their free time with the aim of physical and spiritual regeneration (Koç, 1991; Akten, 2003). The purpose of these activities is to rest and gather energy (Gülez, 1989; Akten, 2003).

Individuals who need physical and mental renewal due to stress, monotony and environmental problems in cities are increasingly demanding recreation areas where they can carry out their social, cultural, economic and physiological activities in their leisure time (Gülez, 2000; Öztürk, 2005; Surat, 2017).

Individuals who want to get away from cities that have become a concrete pile and struggle with environmental problems, are turning to outdoor recreational resources. Forest areas are one of the most preferred outdoor recreational resources due to their natural, cultural and visual values (Akten, 2003).

Various human activities take place in forest areas. Among these activities; picnic, horse-horse-pedestrian walks, guided tours, various sports activities, view viewing and so on. (Aslanboğa and Gül, 1999; Akten, 2003).

The aim of this research; to determine the recreation potential of Palandöken City Forest located on the skirts of Palandöken Mountain in Erzurum city by using the Gülez Method developed to determine the potential of recreational areas in the forest and to make suggestions for its development.

MATERIALS AND METHODS

The material of the research is the Palandöken City Forest located on the slopes of Palandöken Ski Center in Erzurum. Palandöken forest, located in the southwest of Erzurum and 5 km from the city center, has been rearranged as an urban forest. In the urban forest woody like scotch pine, birch, willow, rosehip, mountain medlar; Herbaceous plants such as yarrow, wormwood, sage, mullein, agave, nettle, and centaury are included. Among the wild animals, there are pigs, foxes, hedgehogs, mole, rabbit, and squirrel. Among the natural and artificial resources of the urban forest; There is a viewing terrace, a pond, a football field, a volleyball court, a volleyball court, a rain shelter, a watchtower, a control, and promotion cabin, a parking lot, a fountain, a children's playground, a stream and a waterfall (URL-1).

In this study; Gülez (1990), which is developed and is utilized for Turkey conditions and methods that allow for easy identification of the potential of a forest outdoor recreation area. This method is expressed by a simple mathematical formula shown below.

$$\% RP = L + C + A + RC + NF$$

Gülez (1990) scored the items in the formula as seen in Table 1.

Table 1. Gülez's scoring chart

Symbol	Meaning	Maximum Score (Item's Weight Score)
L	Landscape Value	35
C	Climate Value	25
A	Accessibility	20
RC	Recreational Convenience	20
NF	Negative Factors	0 (Minimum-10)
%RP	Recreation Potential	100

In-forest recreation potential evaluation form created by Gülez (1990) is given in Table 2.

Table 2. In-Forest Recreation Potential Assessment Form (From Gülez, 1990)

<table>
<tr><th>Items in the Formula</th><th>Item Properties</th><th>Maximum Point</th><th colspan="2">Descriptions</th></tr>
<tr><td rowspan="18">Landscape Value (L)</td><td rowspan="4">Size of Area</td><td rowspan="4">4</td><td>Greater than 10 ha</td><td>4</td></tr>
<tr><td>5-10 ha</td><td>3</td></tr>
<tr><td>1-5 ha</td><td>2</td></tr>
<tr><td>0.5-1 ha</td><td>1</td></tr>
<tr><td rowspan="8">Flora</td><td rowspan="8">8</td><td>Woodland, bush, meadow</td><td>7-8</td></tr>
<tr><td>Lonely woodland and meadow</td><td>6-7</td></tr>
<tr><td>Thicket, meadow, sparsely wooded</td><td>5-6</td></tr>
<tr><td>Meadow, sparse woodland</td><td>4-5</td></tr>
<tr><td>Lonely meadow and bush</td><td>3-4</td></tr>
<tr><td>Thicket, sparsely wooded</td><td>3-4</td></tr>
<tr><td>Meadow, sparse bush</td><td>2-3</td></tr>
<tr><td>Lonely meadow</td><td>1-3</td></tr>
<tr><td rowspan="4">Sea, Lake, Streams</td><td rowspan="4">8</td><td>Seashore</td><td>7-8</td></tr>
<tr><td>Lakeside</td><td>6-7</td></tr>
<tr><td>River bank</td><td>4-5</td></tr>
<tr><td>Creeks</td><td>1-4</td></tr>
<tr><td rowspan="2">Superficial Condition</td><td rowspan="2">5</td><td>Flat area</td><td>5</td></tr>
<tr><td>Slightly wavy</td><td>4</td></tr>
</table>

			Low slope, some flatness	3
			Less hilly	2
			Medium hilly	1
	Visual Quality	4	Panoramic views	3-4
			Nice views and vistas	2-3
			General visual aesthetic value of the area	1-3
	Other Features	6	For example, natural monument, waterfall, cave, historical and cultural values; wild animals, birds etc.	1-6
Climate Value (I)	Temperature	10	16-17, 18-19, 20-21, 22-23, 24-25, 34-33, 32-31, 30-29, 28-27, 26-25	
			Score: 1, 2,3, 4, 5, 6, 7, 8, 9, 10	
	Precipitation	8	Summer months (June, July, August) totals mm- 50, 100, 150, 200, 250, 300, 350, 400	
			Score: 8, 7, 6, 5, 4, 3, 2, 1	
	Sunbathing	5	Average cloudiness in summer months: 0-2, 2-4, 4-6, 6-8, 8-9	
			Score: 5, 4, 3, 2, 1	
	Windiness	2	Less than 1 m/sec	2
			1-3 m/sec	1
Availability (A)	Region where it is located tourist importance	4	Mediterranean, Aegean, Marmara coastal band	3-4
			Black Sea coastline	2-3
			Important highway routes, priority regions in tourism	1-3
	Having a city with a population of at least 100,000 in its region	5	Distance up to 20 km	4-5
			Distance up to 50 km	3-4
			Distance up to 100 km	2-3
			Distance up to 200 km	1-2
	Time span reached (from a nearby city with at least 5,000 inhabitants)	4	Up to 1 hour on foot or 0-30 minutes by vehicle	4
			0.30-1 hour by vehicle	3
			1 -2 hours by vehicle	2
			2-3 hours by vehicle	1
	Transportation (taxi and private car outside)	4	Walking or anytime finding a vehicle	3-4
			Finding vehicles at certain times	1-3
	Other in transport facilities	3	For example, being a cable car, from the sea	1-3
Recreational Convenience (RC)	Picnic facilities	4	Fixed picnic table, stove etc.	1-4 (attributes by)
	Water situation	3	Drinking and utility water facilities	1-3 (attributes

				by)
	Overnight facilities	2	Fixed overnight facilities	2
			Camping with or without a tent Possibilities to install	1-2
	WCs	2	According to the qualifications	1-2
	Car park	2	According to the qualifications	1-2
	Country casino, sales buffet	2	According to the qualifications	1-2
	Watchmen and attendants	2	Permanent guard/attendant	2
			On duty at weekends	1
	Other conveniences	3	For example beach, cabin and shower facilities, boat rental facilities, ball, etc. playgrounds and sports fields, facilities etc. (according to qualifications)	1-3
Negative Factors (NF)	Air pollution	-3	According to the degree of pollution	-1 -3
	Not Insecure	-2	According to the assurance status	-1 -2
	Water pollution	-1	For sea, lake and rivers	-1
	Neglect	-1	Insufficient maintenance in the area	-1
	Noise	-1	Traffic, crowd, etc. noises	-1
	Other Negative Factors	-2	For example, factory and construction ruins, stone and gravel quarries, etc	-1 -2
Overall Score or In-Forest Recreation Potential (%):				100

Table 2 shows the sub-parameters of the landscape value constituting 35% of the recreation potential, the climate value constituting 25%, the accessibility that constitutes 20%, the recreational facilities constituting 20%, and the score range they should take. The parameters that constitute the negative factors get points between 0 and -10. The climate value, which constitutes a maximum of 25 points, consists of 10 points of temperature, 8 points of precipitation, 5 points of sunbathing, and 2 points of the wind. In temperature, one of the parameters of climate value, the averages of the summer months of June, July, and August are taken. This value corresponds to 10 points since the ideal temperature for recreational activities is thought to be 25^0 C.

Since rainfall is a climate value that negatively affects recreation, the places with 50 mm and below rainfall in the summer months are given a maximum of 8mpuan. Points decrease as the amount of rain increases. The sunbathing parameter was evaluated as 5 weighted points. The open-air is shown with 5 points. As the cloudiness increases, the score approaches 1. One of the important climatic values is wind. In summer, 1 point is given to a place with an average wind speed of 2-3 m/sec, and 2 points to a place with less than 1/sec. Likewise, the parameters that constitute values such as accessibility, recreational convenience, and negative factors, and the score ranges they receive are also shown in the table.

Recession Potential (RP%) after applying the Gülez (1990) method; If less than 30% is very low, 30% - 45% is low, 46% - 60% is medium, 61% - 75% is high, more than 75% is very high.

DISCUSSION

Palandöken Urban Forest, which has the feature of a C-type forest, has a total area of 80 hectares and a usage area of 100 decares. In Palandöken Urban Forest; There are 10 picnic tables, a set of playgroups, 1 watchtower, 1 wooden bridge, 2 toilets, 1 rain shelter, and 1 parking lot for 30 cars on the left at the entrance to the promenade area for those who can reach the promenade by car. There are 4 fountains in the area, 3 of which are idle and only 1 is active. Within the Palandöken Urban Forest, there are 3 viewing terraces, taking into account the landscape feature of the city and also the visual quality that makes its mark in winter. Due to the roughness of the land and its location, it is not possible to reach it by vehicle, but it can be reached on foot.

In Figure 1, general views of Palandöken Urban Forest are given.

According to the "Gülez Method", the current recreational potential of Erzurum Palandöken City Forest has been determined. The current potential of the field has been determined with the data obtained from public institutions and organizations. According to the information obtained, this area cannot go beyond being active during the picnic season.

Palandöken Urban Forest is most popular during the picnic season. With its proximity to the city square, it is possible to reach the place, which has a great chance, in a short time as walking distance. With its biodiversity, it has been a habitat for many creatures. The area is close to the Palandöken Mountain, which is the center of attention by athletes, with the mountain air and the high oxygen, and it is as close to the Palandöken Mountain and has the opportunity to participate in all kinds of recreation, eating and drinking, sports activities in winter and hiking with the unique view of the mountain in summer.

Palandöken City Forest, which is located in a place where people can stay away from stressful lives by evaluating the organizations in the hotels in its vicinity, has an important position with its proximity to the city. The sports activity fields on the right before coming to the city forest and the fields observed as another activity to be evaluated have also hosted important teams.

Since Palandöken City Forest is the junction point of both the city center and the ski center, it is not unnoticed that the weather conditions of the city are open only during the summer months. Palandöken City Forest, which is generally used as a picnic area in summer, caused great noise during these times. Although the panoramic view of the area is also the focus of attention, those who enter the area by vehicle experience difficulties. There is no camping option in the area. But there was a chance to stay in nearby hotels and this made the urban forest even more valuable. The recreational potential of Palandöken Urban Forest has been determined according to Table 3.

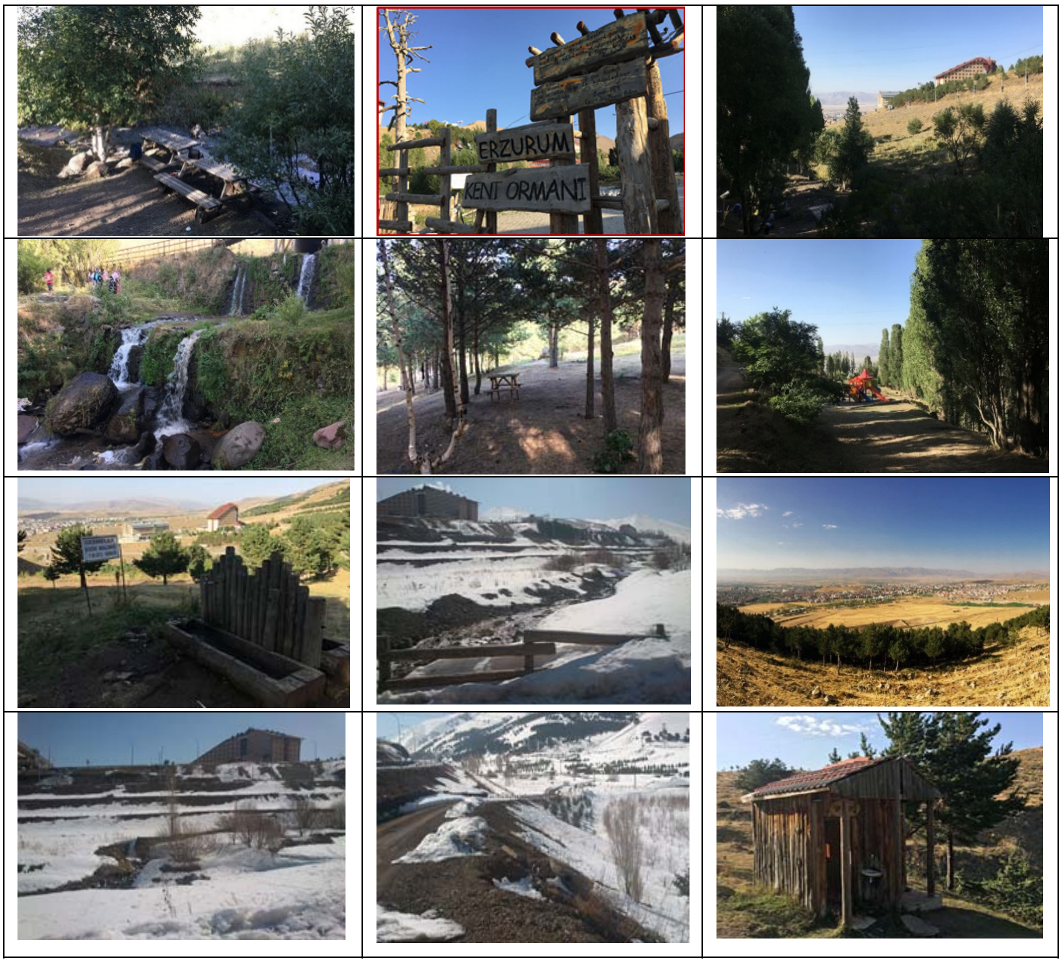

Figure 1. General images from Palandöken Urban Forest

Table 3. Palandöken Urban Forest Recreation Potential

Items in the Formula	Item Properties	Maximum Point	Descriptions	
Landscape Value (L)	Size of Area	4	Greater than 10 ha	4
			5-10 ha	
			1-5 ha	
			0.5-1 ha	
	Flora	8	Woodland, bush, meadow	
			Lonely woodland and meadow	

			Thicket, meadow, sparsely wooded	6
			Meadow, sparse woodland	
			Lonely meadow and bush	
			Thicket, sparsely wooded	
			Meadow, sparse bush	
			Lonely meadow	
	Sea, Lake, Streams	8	Seashore	
			Lakeside	
			River bank	
			Creeks	4
	Superficial Condition	5	Flat area	
			Slightly wavy	
			Low slope, some flatness	3
			Less hilly	
			Medium hilly	
	Visual Quality	4	Panoramic views	4
			Nice views and vistas	
			General visual aesthetic value of the area	
	Other Features	6	For example, natural monument, waterfall, cave, historical and cultural values; wild animals, birds etc.	6
Climate Value (I)	Temperature	10	16-17, 18-19, 20-21, 22-23, 24-25, 34-33, 32-31, 30-29, 28-27, 26-25	8
			Score: 1, 2,3, 4, 5, 6, 7, 8, 9, 10	
	Precipitation	8	Summer months (June, July, August) totals mm- 50, 100, 150, 200, 250, 300, 350, 400	7
			Score: 8, 7, 6, 5, 4, 3, 2, 1	
	Sunbathing	5	Average cloudiness in summer months: 0-2, 2-4, 4-6, 6-8, 8-9	4
			Score: 5, 4, 3, 2, 1	
	Windiness	2	Less than 1 m / sec	
			1-3 m/sec	1
Availability (A)	Region where it is located tourist importance	4	Mediterranean, Aegean, Marmara coastal band	
			Black Sea coastline	
			Important highway routes, priority regions in tourism	3
	Having a city with a	5	Distance up to 20 km	5
			Distance up to 50 km	

	population of at least 100,000 in its region		Distance up to 100 km	
			Distance up to 200 km	
	Time span reached (from a nearby city with at least 5,000 inhabitants)	4	Up to 1 hour on foot or 0-30 minutes by vehicle	4
			0.30-1 hour by vehicle	
			1-2 hours by vehicle	
			2-3 hours by vehicle	
	Transportation (taxi and private car outside)	4	Walking or anytime finding a vehicle	4
			Finding vehicles at certain times	
	Other in transport facilities	3	For example, being a cable car, from the sea	
Recreational Convenience (RC)	Picnic facilities	4	Fixed picnic table, stove etc.	4
	Water situation	3	Drinking and utility water facilities	2
	Overnight facilities	2	Fixed overnight facilities	2
			Camping with or without a tent Possibilities to install	1
	WCs	2	According to the qualifications	2
	Car park	2	According to the qualifications	2
	Country casino, sales buffet	2	According to the qualifications	1
	Watchmen and attendants	2	Permanent guard/attendant	
			On duty at weekends	1
	Other conveniences	3	For example beach, cabin and shower facilities, boat rental facilities, ball, etc. playgrounds and sports fields, facilities etc. (according to qualifications)	1
Negative Factors (NF)	Air pollution	-3	According to the degree of pollution	0
	Not Insecure	-2	According to the assurance status	-1
	Water pollution	-1	For sea, lake and rivers	0
	Neglect	-1	Insufficient maintenance in the area	-1
	Noise	-1	Traffic, crowd, etc. noises	-1
	Other Negative Factors	-2	For example, factory and construction ruins, stone and gravel quarries, etc	0
Overall Score or In-Forest Recreation Potential (%):				73

% RP = L+ C + A + RC + NF

% RP=27+20+16+13+(-3) =73

According to the classification of Gülez (1990), the values taken between 61% and 75% indicate a high degree of recreational potential. The recreational potential of Palandöken City Forest is 73%, so it is considered high.

CONCLUSIONS

It is seen that Palandöken Urban Forest, which is one of the open-air recreation resources of Erzurum city, is sufficient in quality and quantity and meets the recreational needs of the city people.

Nowadays, to create a modern and healthy city, it is only possible with a rational, consistent, continuous and participatory approach, and the implementation of planning, supervision processes in integrity. However, what can be seen here is that security was provided with only one security guard even during the contract summer months. In today's world, although the safety factor is of high importance, it should be handled with a higher security system for the urban forest, which has a high recreational potential.

Although Palandöken City Forest and its surroundings have significant recreational potential, these recreational areas cannot be used effectively except during the summer months. In terms of rational use of natural resources, it should be aimed to develop the infrastructure and superstructure of the existing recreational areas in the city and its immediate surroundings, and to diversify and increase the recreational activities. In this way, the potential of the existing recreation areas will be increased and the services expected from it will be provided.

The reason why forest recreation resources are most preferred is their natural and visual values. For this reason, the infrastructure and superstructure work to be carried out and the recreational activities to be carried out should be in a way that does not disturb and negatively affect the structure of the environment. Also, with an intensive written and verbal warning work to be carried out in forest recreation areas, all kinds of pollution, including noise pollution, that occur during the use of the areas by the users should be prevented. It should be paid attention that garbage bins are abundant, especially in picnic and camping areas. These bins should be in color and size that will not spoil the natural appearance of the area, but attract attention.

Inactive terraces, which are difficult to access, should be developed and further contribution should be made to tourism. Instead of insufficient tables and game groups, they should be overhauled with materials suitable for the Urban forest. Palandöken City Forest, which was closed to transportation with the start of the winter season, should be used more effectively in this city, which constitutes the basic building blocks of winter tourism. Its connection with the city should be supported by ropeway works and it should be foreseen that the people living in the city benefit from these opportunities. View terraces with a view of the city should be designed.

The scarcity of tree diversity has been observed in Palandöken City Forest. It is necessary to contribute to this area by planting trees without disturbing the natural structure. Therefore, the creation and implementation of functional, aesthetic and managerial new approaches as soon as possible by ensuring the participation of the public in the planning and management practices of forest recreation areas and other recreational resources is important for the city of Erzurum, which is the most important city of winter tourism and our country.

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Oral Presentation
Wednesday
Diversity of Plant Species, Systematics, and Phylogeny-1

Determination of Genetic Diversity of *Liquidambar orientalis* Mill. var *integriloba* Fiori Populations in Muğla Province Using ISSR Markers

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ABSTRACT

Liquidambar orientalis in *Altingiaceae* family is a relict endemic species that spread south west of Turkey. This species has two varieties, *Liquidambar orientalis* Mill. var. *integriloba* Fiori and *Liquidambar orientalis* Mill. var. *orientalis*. Since the beginning of the 20th century, the natural distribution of this species has decreased to a great extent. Therefore, studies on the genetic diversity of the species are important for the protection of the species. In this study, 5 polymorphic ISSR markers were studied to assess the genetic variability within and among 5 *Liquidambar orientalis* populations. Analysis of data was carried out by POPGENE ver. 1.32 and GenAlex ver. 6.05 software programs. A total of 145 loci were resulted in the analysis of 5 primers. For all populations the mean number of observed alleles was found as and the mean number of effective alleles was found as 1.93 ± 0.25, 1.55 ± 0.33, respectively. The proportion of polymorphic loci for all populations ranged from 12,41 % (Köyceğiz Toparlar) to 25,52 % (Marmaris National Park) and Nei's gene diversity value ranged from 0,05 ± 0.14 (Köyceğiz Toparlar) to 0.10 ± 0.17 (Marmaris National Park). The level of gene flow was 0.16 per generation. Nei's genetic distance coefficient ranged between 0,33 (Ula Kızılyaka and Marmaris Çetibeli) and 0,54 (Köyceğiz Zeytinalanı and Marmaris National Park) among all possible population pairs. According to the Analysis of Molecular Variance (AMOVA), the main contribution to genetic variance (% 81) was due to variation among populations.

Keywords: *Liquidambar orientalis*, ISSR Marker, Genetic Diversity, Polymorphism, Muğla.

INTRODUCTION

Biological diversity means the diversity of living creatures and life styles on Earth, and includes 4 elements: genetic diversity, species diversity, ecosystem diversity and diversity of ecological functions (Işık, 1998). Turkey is located in the temperate zone and called Minor Asia by some authors. The reason for this is that it includes a wide variety of ecosystems and is one of the rare countries that show continental characteristics. There are lots of plant and animal species, which are mostly endemic, living in the ecosystem diversity in our country with the different races of these species, different gene pools and different evolutionary units. For this reason, Turkey is one of the world's most important gene centers and has a great biodiversity (Demirayak, 2002). One of these species *Liquidambar orientalis*, which is a relict and endemic to our country, is a good sample for this biodiversity.

The genus *Liquidambar*, which belongs to the *Altingiaceae* family, is represented by four different species found in approximately the same latitudes on Earth. These species are distributed on three continents in the Northern Hemisphere, America, Southeast Europe, and Asia (Figure 1). These species are *L. acalycina* (Chang sweetgum tree), *L. formosana* (Chinese sweetgum tree), *L. styraciflua* (American sweetgum tree), *L. orientalis* (Anatolian sweetgum tree) (Ickert-Bond *et al.*, 2005). The genus *Liquidambar* is thought to have existed for 65 million years. Because of this situation, the species in the *Liquidambar* genus are called relict species (Akman *et al.*, 1992).

Figure 1. Distribution of *Liquidambar* genus on Earth (Ickert-Bond *et al.*, 2005)

Relict endemic *L. orientalis* species is distributed in South-West Anatolia. While this species mostly distributed in Köyceğiz, Marmaris, Fethiye, Ula, and Dalaman districts within the Muğla province, rarely distributed in Aydın, Denizli, Antalya, Burdur and Isparta provinces (Figure 2) (Acatay, 1963; Atay, 1985; Efe, 1987; Günal, 1994; Istek and Hafızoğlu, 2004; Alan and Kaya, 2003; Velioğlu *et al.*, 2008; Aydıngöz and Bulut, 2014). According to Davis (1972), there are two varieties of *L. orientalis*. These are *Liquidambar orientalis* Mill. var. *orientalis* and *Liquidambar orientalis* Mill. var. *integriloba* Fiori.

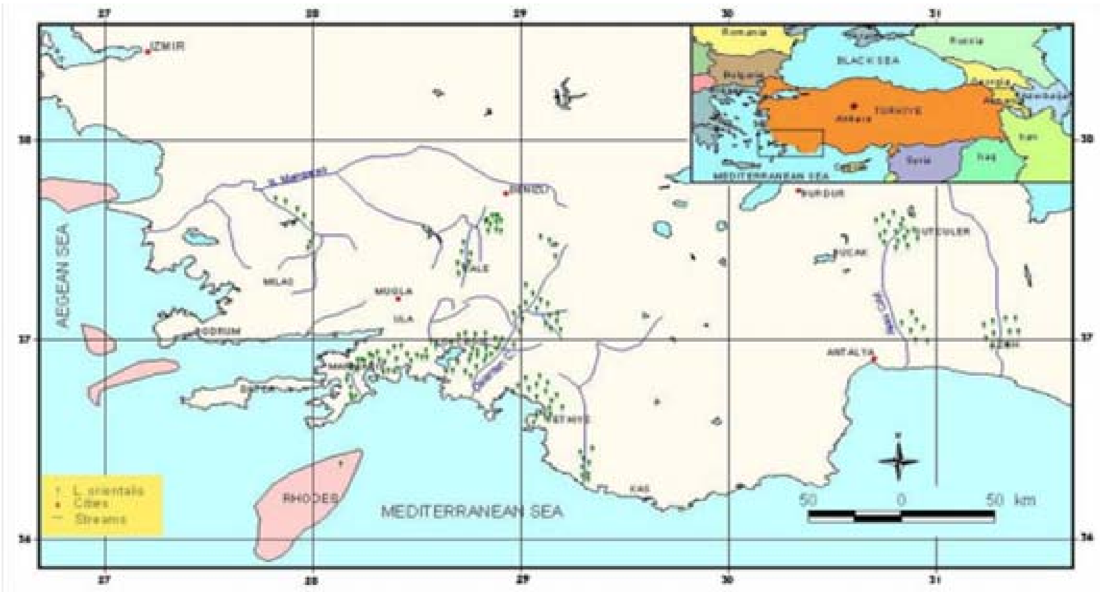

Figure 2. Distribution of *L. orientalis* in Turkey (Arslan and Şahin, 2016)

L. orientalis is generally known as the "sweetgum tree" among the people (Arslan ve Şahin, 2016). The sweetgum tree, which is thought to date back 65 million years, is approximately 20-25 meters tall in terms of its general structure. Its similarity with the plane tree is quite high and it can live for approximately 200 - 300 years (Günal, 2006). It is a deciduous tree in winter and although its leaves are generally seen as 5 lobes, it can rarely be found as 3 and 7 lobes. Leaves have an aromatic scent (Efe, 1987; Günal, 1994). Sweetgum tree is an important species that has economic value as well as ecological value. From past to present sweetgum trees are used in many different fields such as perfume, medicine, pharmacy, and furniture. (Acatay, 1963; Atay, 1985; Bozkurt *et al.*, 1989).

Determination of the diversity of this species is very important. According to Tanksley *et al.* (1989), Restricted Fragment Length Polymorphism (RFLP) is the first DNA marker used to reveal genetic relationships in plants. The cost and slowness of the RFLP method have led to the development of PCR-based molecular markers. Some of these methods are RAPD (Random Amplified Polymorphic DNA), AFLP (Amplified Fragment Length Polymorphism), SSR (Simple Sequence Repeats), and ISSR (Inter Simple Sequence Repeats). Among these techniques, RAPD, AFLP, SSR, and ISSR markers are used extensively to detect the genetic diversity in plants (Özcan *et al.* 2004).

The study aimed to determine the genetic diversity of *integriloba* Fiori varieties belonging to *Liquidambar orientalis* species by using ISSR primers. To better understand the population genetic structure of this species, allozyme (Hoey and Parks, 1991; Öztürk, 2008), chloroplast DNA (cpDNA) (Or, 2007; Özdilek 2007) and randomly amplified polymorphic DNA (RAPD) (Doğaç, 2008; Velioglu *et al.*, 2008) studies have been conducted. However, to the best of our knowledge, no studies are using inter simple sequence repeat (ISSR) markers. Therefore, the study is the first attempt to determine the genetic diversity of South-West Anatolian *L. orientalis* populations by using ISSR markers.

MATERIALS AND METHODS

Plant Materials

In the process of collecting samples in field studies, the natural sweetgum forests were determined first; however, the field study was not carried out later in the forests that were created by planting. In the determined natural forests, the population's general distribution area where the field study would be conducted was determined first. Then, using the transect method, the sampling was done to be the most homogeneous within the population. These transects were formed in a straight line with approximately 50-100 meters between each individual. Different numbers of transects were determined in different populations to obtain 10 individuals, and the direction and number of transects varied according to the population size, the slope of the land, and the topography. Information on the locations where individuals were collected for the study are given in Table 1.

Table 1. *L. orientalis* sampling locations.

	Location	Variety information	Number of Individuals
1	Marmaris - Cetibeli	*L. orientalis* Mill. var *integriloba* Fiori	10
2	Ula – Kızılyaka	*L. orientalis* Mill. var *integriloba* Fiori	10
3	Marmaris – National Park	*L. orientalis* Mill. var *integriloba* Fiori	10
4	Koycegiz – Toparlar	*L. orientalis* Mill. var *integriloba* Fiori	10
5	Koycegiz – Zeytinalanı	*L. orientalis* Mill. var *integriloba* Fiori	10

Genomic DNA Extraction

From each location, ten individual trees (total 50) were used in DNA extraction and amplification. 0.03 grams of sweetgum leaves crushed with approximately 5 ml of liquid nitrogen was used for DNA extraction. Total cellular DNA was extracted from the collected specimens according to Soltis Lab DNA CTAB extraction protocol (Doyle and Doyle, 1987; Cullings, 1992) with little modifications. This method was a standard protocol for DNA extraction with phenol-chloroform. DNA samples were checked in terms of quantity and purity for the best PCR amplification. DNA samples were used either in PCR reaction or stored at −20 °C.

Polymerase Chain Reaction Amplification

Each reaction tube for the PCR amplification process was prepared to contain 10.5 μl Thermo Scientific DreamTaq PCR Master Mix (2X), 12.3 μl dH2O, 1 μl primer, 0.2 μl Tween®-20, and 1 μl DNA. The thermocycler parameters included an initial denaturation at 95°C for 3 min, followed by 35 cycles of denaturation at 95°C for 15 sec, annealing at 55°C for 30 sec, extension at 68°C for 3 min, and then a final extension at 72°C for 10 min. DNA was amplified using five ISSR primers: (ACC)6CC, CCA(TG)7T, GCA(AC)7, GGG(AC)7, and (GA)8GG as provided by Baysal et. al., 2011. PCR products were electrophoresed for 3 hours in a 1% agarose gel prepared using 1X TBE and ethidium bromide.

Analysis of data

The gel images obtained by screening 50 different individuals with 5 primers were scored according to the Thermo Scientific ™ GeneRuler 1 kb DNA Ladder. This scoring was performed according to the band profile formed by the marker, as 1 if there is band formation and 0 if there is no band formation. Scores processed on Microsoft Excel were analyzed using POPGENE 1.32 and GenAlex 6.05 computer software. Allele number (Nei, 1987), effective allele number (Kimura and Crow, 1978), polymorphic locus rate, and genetic distance (Nei, 1987) were also calculated using appropriate formulas.

RESULTS

The genetic diversity of 50 individuals from five different populations belonging to Muğla province was investigated using five different ISSR primers. As a result of the screening of the 5 primers used, 145 loci were detected. Information on the number of loci detected by the primers used of the studied populations are given in Table 2. Accordingly, it was determined that primer number 3 constitutes the most band formation and primer number 5 constitutes the least band formation.

Table 2. Band numbers formed by primers and populations

Primer No	No:1 (ACC)6CC	No:2 CCA(TG)7T	No:3 GCA(AC)7	No:4 GGG(AC)7	No:5 (GA)8GG
Number of total bands	26	30	38	34	17

According to the analysis results obtained using the POPGENE Version 1.32 program, the average number of alleles for all populations was found to be 1.93 ± 0.25, and the average number of effective alleles among populations was found to be 1.55 ± 0.33 (Table 3). Nei's genetic diversity and Shannon constant were found to be 0.32 ± 0.15 and 0.48 ± 0.21, respectively.

Table 3. Average genetic diversity values for all populations

	Na	***Ne***	***h***	***I***
Average of All Populatıons	1,93 ± 0,25	1,55 ± 0,33	0,32 ± 0,15	0,48 ± 0,21
Na: Observed number of alleles, ne: Effective number of alleles, h: Nei's gene diversity, I: Shannon's Information index				

As shown in Table 4, when the analysis results are examined based on each population used in the study, the location with the highest observed average number of alleles and average effective allele values is Marmaris National Park, respectively 1,25 ± 0,43 and 1,17 ± 0,31. The location with the lowest values is Köyceğiz Toparlar location, respectively 1,12 ± 0,33 and 1,09 ± 0,26. Likewise, the locations where Nei's genetic diversity value and Shannon values are determined the highest and lowest are Marmaris National Park and Köyceğiz Toparlar locations, respectively.

The number of polymorphic loci detected as the result of POPGENE 1.32 analysis ranges between 18 (Köyceğiz Toparlar) and 37 (Marmaris National Park) as seen in Table 4. The percentage polymorphism rate varies between 12.41% (Köyceğiz Toparlar) and 25.52% (Marmaris National Park). For the number of polymorphic loci and percentage polymorphism ratio values, the lowest and highest values were respectively in Köyceğiz Toparlar and Marmaris National Park locations.

Table 4. Average genetic variation values of studied *L. orientalis* population.

	Na	***Ne***	***h***	***I***	**% Polymorphism (P%)**	**Number of Polymorphic Loci**
Marmaris Çetibeli	1,23 ± 0,42	1,14 ± 0,30	0,08 ± 0,16	0,12 ± 0,23	23,45	34
Ula Kızılyaka	1,23 ± 0,42	1,16 ± 0,33	0,09 ± 0,17	0,13 ± 0,25	23,45	34
Marmaris Natıonal Park	1,25 ± 0,43	1,17 ± 0,31	0,10 ± 0,17	0,14 ± 0,25	25,52	37
Köycegiz Toparlar	1,12 ± 0,33	1,09 ± 0,26	0,05 ± 0,14	0,07 ± 0,20	12,41	18
Köycegiz Zeytinalanı	1,20 ± 0,40	1,13 ± 0,29	0,07 ± 0,16	0,11 ± 0,23	20,69	30
Na: Observed number of alleles, *Ne:* Effective number of alleles, *h:* Nei's gene diversity, *I:* Shannon's Information index						

When the genetic diversity values for all studied populations were examined, the total genetic diversity value (*Ht*) was found to be 0.32 ± 0.02. While the total genetic diversity constitutes the genetic diversity (*Hs*) within the populations with a value of 0.08 ± 0.006, the genetic diversity (D_{st}) among the populations was determined as 0.24.

It was determined from the value (*Hs*) = 0.08 ± 0.006 that 25% of the genetic diversity originates within the populations. It was found from D_{st} = 0.24 that 75% of the genetic diversity originates among the populations (Table 5).

As seen in table 5, the genetic differentiation value (G_{ST}) and gene flow value (*Nm*) were found to be 0.75 and 0.16, respectively.

Table 5. Total genetic diversity, G_{ST} and Nm values for all populations.

	H_t	H_s	D_{st}	Gst	Nm
Average Of All Populatıons	0,32 ± 0,02	0,08 ± 0,006	0,24	0,75	0,16
H_t: Total genetic diversity, H_s: Within-population genetic diversity, D_{st}: Among-population genetic diversity, *Gst*: Relative level of genetic differentiation, *Nm*: estimate of gene flow from *Gst* or *Gcs*. E.g., Nm = 0.5(1 - Gst)/Gst					

Genetic distance (D_N) values calculated over 145 loci according to the calculation of Nei's Original Measures of Genetic Identity and Genetic distance are given in Table 6.

Table 6. Genetic distance (D_N) values of 5 *L. orientalis* populations.

	Marmaris Çetibeli	Ula Kızılyaka	Marmaris National Park	Köyceğiz Toparlar	Köyceğiz Zeytinalanı
Marmaris -Çetibeli	*				
Ula - Kızılyaka	0,3384	*			
Marmaris -National Park	0,4235	0,4462	*		
Köyceğiz -Toparlar	0,3617	0,3606	0,3884	*	
Köyceğiz - Zeytinalanı	0,3897	0,3394	0,5493	0,4767	*

The tree branching structure for the populations examined using the among-population genetic distance (D_N) values is presented in figure 3.

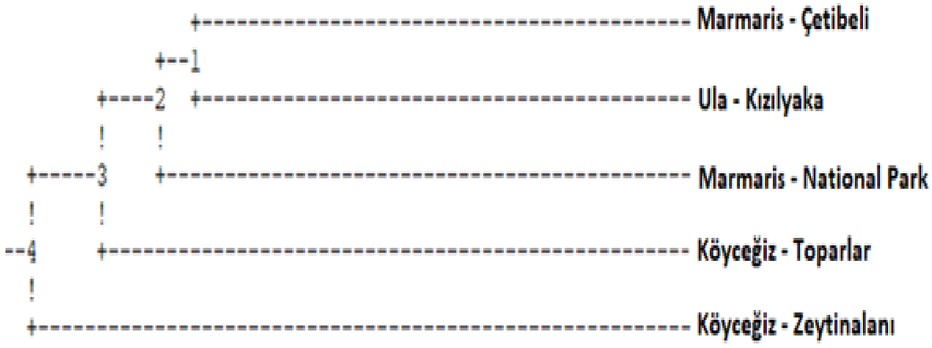

Figure 3. Dendogram of genetic distances with ISSR markers between 5 *L. orientalis* populations.

According to the Molecular Analysis of Variance (AMOVA), the main contribution (81%) to genetic variance is due to variation among populations (Figure 4).

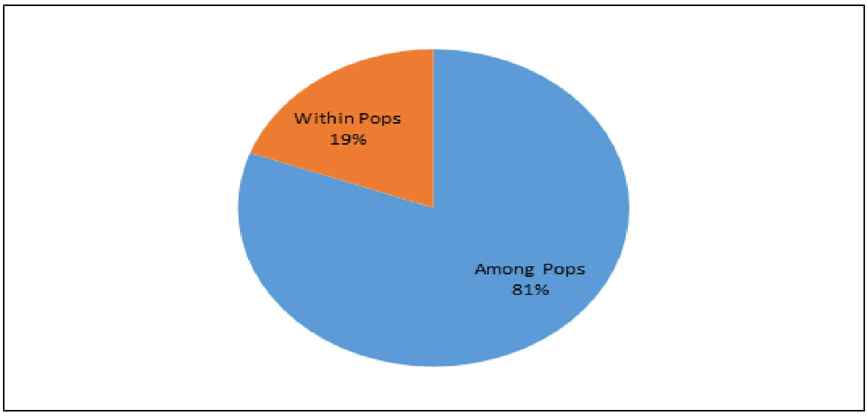

Figure 4. Percentages of Molecular Analysis of Variance (AMOVA)

DISCUSSION

L. orientalis, which is a relict endemic species, is one of the most important and remarkable species of our country in terms of biodiversity. Therefore, it is very important to take *L. orientalis* under preservation and to take due precautions in this context. It is also very important to investigate the molecular origin of the species and to determine the genetic variation of the species to protect the species. That's why it is essential to compare the results obtained from different methods in order to determine the polymorphism of the species. The reason for using ISSR markers in this study was their simplicity of application, inter-laboratory compatibility, rapid results, and low implementation cost, and also the fact that ISSR markers were not used before in determining genetic diversity in *L. orientalis*. However, contrary to these advantages, since ISSR markers are dominant markers, it was not possible to distinguish heterozygous characters.

In the study conducted by Doğaç (2008), RAPD markers were used to determine the genetic diversity of *L. orientalis*. The four populations are the same in the study performed by Doğaç (2008) and in this study conducted by us. When the results of the two studies carried out for these four populations were compared, it was seen that the genetic diversity values such as the average number of observed alleles, the average number of effective alleles, etc., were lower. This is because the number of individuals in the same four populations and the number of primers used in the study conducted by Doğaç (2008) were higher than in this study. When the average number of loci detected for all primers used in both studies were compared, the average number of loci detected for each primer used in this study was higher (While an average of 15 loci per primer was determined with RAPD primers, an average of 29 loci per primer were determined using ISSR primers.).

Velioğlu *et al.* (2008) performed a study with 450 individuals and 10 RAPD primers to determine genetic diversity. All the values of genetic diversity they obtained are lower than the values of our study.

Although the number of primers and individuals used in the study conducted by Velioğlu *et al.* (2008) was high, the obtained genetic diversity values were lower, and the average number of loci detected for each primer in Doğaç (2008)'s study was lower. For these reasons, we think that ISSR markers will give better results than RAPD markers to determine the genetic diversity of *L. orientalis* species.

When the genetic diversity values of Nei were examined in the analysis results of this study, the total genetic diversity (Ht) in terms of 145 loci detected for all populations was found to be 0.32 ± 0.02. The value of (H_S) (0.08 ± 0.006) showed that 25% percent of the genetic diversity originated from within the population. D_{ST} value (0.24), showed that 75% percent of the genetic diversity originated from among the populations. As a result of molecular variance analysis (AMOVA), while 19% percent of the genetic variation was caused by within the population, 81% percent of it was caused by among populations. These two results have shown that genetic diversity occurs mostly among populations.

G_{ST} is one of the values that reveal genetic differentiation. This value ranges from 0 to 1 and refers to the level of genetic differentiation. As stated by Yeh *et al.* (1999), if the G_{ST} value is 0.05 or less, genetic differentiation between populations can be neglected. If this value is more than 0.25, the level of genetic differentiation is high. In this study, the G_{ST} value was found to be 0.75. So, the genetic differentiation among the studied populations is quite high.

Gene flow between populations is calculated using the G_{ST} value. In the study, the gene flow level (Nm) was found as 0.16. It was stated by Hamrick (1989) that the critical Nm value for populations is 0.50, and values above this value will prevent genetic drift. In this study, the gene flow level is very low. The GST and Nm values indicate that the studied populations may be subject to genetic drift.

CONCLUSIONS

As a result of the study, it was determined that the genetic differentiation value of *L. orientalis* Mill var *integriloba* Fiori populations was quite high and the gene flow value was very low. Therefore, populations are likely to be subject to genetic drift.

Among the studied populations, Marmaris National Park location is a population under protection. When the results of the study are examined, it appears as the location with the highest genetic diversity values. Likewise, protecting the other populations studied is also important for preserving the genetic diversity of these populations. After this study, we suggest that the current conservation strategies should be maintained, and in-situ and ex-situ conservation strategies should be developed. The existing research is the first to be realized using ISSR molecular markers in sweetgum populations in Turkey. However, further studies using other genetic markers are desirable to enrich our understanding of the genetic structure of this species and important for developing effective conservation strategies.

ACKNOWLEDGEMENTS

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Oral Presentation
Wednesday
Environmental Toxicology-1 & Microbial Diversity-1

Accumulation of Heavy Metals in Olive Grown Under Different Soils

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ABSTRACT

The current study aimed to determine the lead (Pb), chromium (Cr), copper (Cu), iron (Fe), zinc (Zn) and manganese (Mn) concentrations in olive fruits and to identify how the traffic factor effect on olive fruits. This research was conducted in Kahramanmaraş province, located in the east of the Mediterranean region of Turkey. Two sampling areas were set at "polluted area (Kahramanmaraş center)" where there is near the main traffic roads and "non-polluted area (Yenidemir village)" is far from the main traffic roads with a relatively low anthropogenic impact. All olive samples were prepared for analysis and measurements were performed by the ICP-OES. There were no significant differences for all heavy metals among the localities. Results show that heavy metal concentrations of olive grown in traffic-based areas were higher than non-polluted areas. The heavy metal values obtained from this study are below the normal level for all the elements considered. Therefore, there is no heavy metal pollution in olive fruits grown in the research area.

Keywords: Heavy metal, Kahramanmaraş, Olive, Traffic.

INTRODUCTION

Pollution of the biosphere with heavy metals due to man-made activities constitute a significant environmental and human health problem (Leyval *et al.*, 1997). Heavy metals are important environmental pollutants, and their toxicity is a problem of increasing importance for ecological, evolutionary, nutritional and environmental reasons (Nagajyoti el al., 2010). In recent years, traffic-related pollution has become one of the main problems, especially in parallel with the population growth in urban areas (Karavin and Ural, 2016). According to WHO (2006), in many urban areas of the world, traffic pollution is an important source of air pollution, contributing 57-75 % of total emissions. With the increase in the number of motor vehicles, toxic gases and many substances are released into the environment. Metals are one of the most dangerous substances caused by auto exhaust pollution (Çali and Karavin, 2020). The polluted environment causes many negativities, especially product loss, especially in plants that do not have the ability to act actively (Munzuroğlu and Gür, 2000). Certain heavy metals, such as Fe (iron), Cu (copper), Co (cobalt), Ni (nickel), Mn (manganese), Mo (molybdenum) and Zn (zinc) are essential elements required for the normal growth of plants. Others, such as As (arsenic), Pb (lead), Cd (cadmium), Hg (mercury) or Se (selenium) are not essential elements that can be toxic to plants, animals and human beings even at very low concentrations (Rascio and Navari-Izzo, 2011). Many researchers stated that there is a close relationship between heavy metal concentrations and traffic emissions (El-Hasan *et al.*, 2002; Demirayak *et al.*, 2011).

A native of the Mediterranean basin and parts of Asia, olive tree (*Olea europaea* L.) is now widely grown in many parts of the world for olive oil and table olive production (Ghanbari *et al.*, 2012). The average composition of olive fruit contains water (50%), protein (1.6%), oil (22%), carbohydrate (19.1%), cellulose (5.8%), inorganic substances (1.5%) and phenolic compounds (1-3%). Other important compounds in olive fruit are pectin, organic acids and pigments (Boskou, 1996). Olives play an important role in the uptake of a number of nutritional trace elements and biologically active compounds in human beings. Therefore, the determination of the heavy metals in olive which has an economical importance for Turkey has a great of important. The current study aimed to determine the Pb, Cr, Cu, Fe, Zn and Mn concentrations in olive fruits and to identify how the traffic factor effect on olive samples.

MATERIALS AND METHODS

Study Area and Plant Samples

This research was conducted in Kahramanmaraş province, located in the eastern of the Mediterranean region of Turkey. Two sampling areas were set at "polluted area (Kahramanmaraş center, Ahmet Uncu street)" where is near the main traffic roads and "non-polluted area (Yenidemir village)" is far from the main traffic roads with a relatively low anthropogenic impact and no any industry. The study was carried out by using fruit samples of *Olea europaea* L. (Olive) collected from olive trees in two different areas where there is no traffic (rural area-Yenidemir village) and heavy-traffic (Kahramanmaraş center, Ahmet Uncu street-roadside). Fruit samples were collected from a total of 3 olive trees for each of the two distances. In order to represent variations and minimize error, a large number of fruit samples were collected.

Laboratory Analyses

The fruit samples were dried at 60 °C until the constant weight, then grounded and sieved. The wet acid digestion methods for ICP-OES (Inductively Coupled Plasma-Optical Emission Spectrometer Perkin Elmer Optima 7000 DV) determination of heavy metals in the fruits of the olive plant were used. For this, 300 mg of the dried olive fruits was weighed and pulverized. Samples were digested with 5 ml HNO_3 (65 %) and 3 ml H_2O_2 (30 %) in the microwave (Berghof, Speedwave MWS 4). Samples were filtered through filter paper (Whatman MN 640w Q125 mm) while transferring to 15 ml centrifuge tubes.

The total volume was completed to 50 ml and the filtrate was used for the analysis of Pb, Cu, Cr, Fe, Zn and Mn by ICP-OES. These heavy metal values were measured in triplicate.

Statistical analyses

Statistical analysis was performed by using SPSS version 21 (IBM SPSS Statistics for Windows, Armonk, NY). One-way analysis of variance (ANOVA) was performed in order to reveal whether heavy metal concentrations changed with respect to localities.

RESULTS

There were no significant differences for all heavy metals among the localities and these differences can be seen in Table 1. Results show that heavy metal concentrations of olive fruits grown in traffic based areas were higher than non-polluted areas (Figure 1-3).

Table 1. Evaluation of Pb, Cr, Cu, Fe, Zn and Mn values (ppm) according to localities by One-Way ANOVA test.

		Sum of Squares	df	Mean Square	F	Sig.
Pb	Between Groups	0.000	1	0.000	0.020	**0.893 NS**
	Within Groups	0.000	4	0.000		
	Total	0.000	5			
Cr	Between Groups	0.000	1	0.000	7.563	**0.051 NS**
	Within Groups	0.000	4	0.000		
	Total	0.000	5			
Cu	Between Groups	0.006	1	0.006	1.280	**0.321 NS**
	Within Groups	0.019	4	0.005		
	Total	0.025	5			
Fe	Between Groups	0.037	1	0.037	4.181	**0.110 NS**
	Within Groups	0.035	4	0.009		
	Total	0.072	5			
Zn	Between Groups	0.008	1	0.008	1.252	**0.326 NS**
	Within Groups	0.024	4	0.006		
	Total	0.032	5			
Mn	Between Groups	0.004	1	0.004	1.811	**0.250 NS**
	Within Groups	0.008	4	0.002		
	Total	0.012	5			

NS: Not Significant

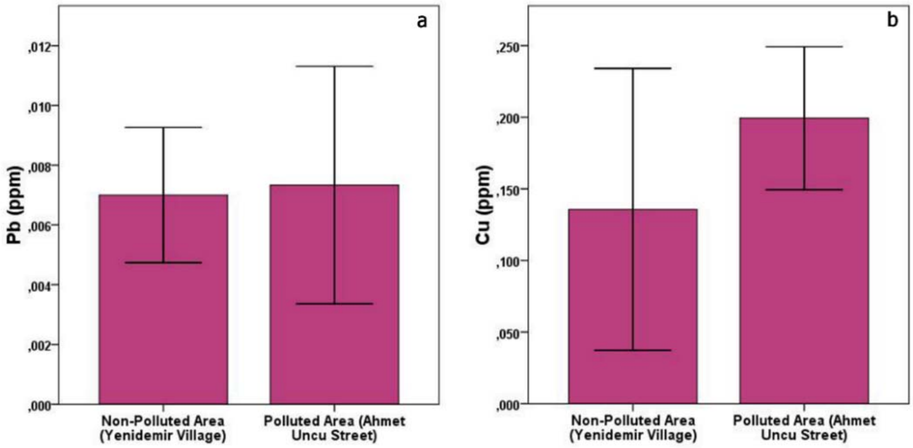

Figure 1. Pb and Cu concentrations (ppm) according to localities.

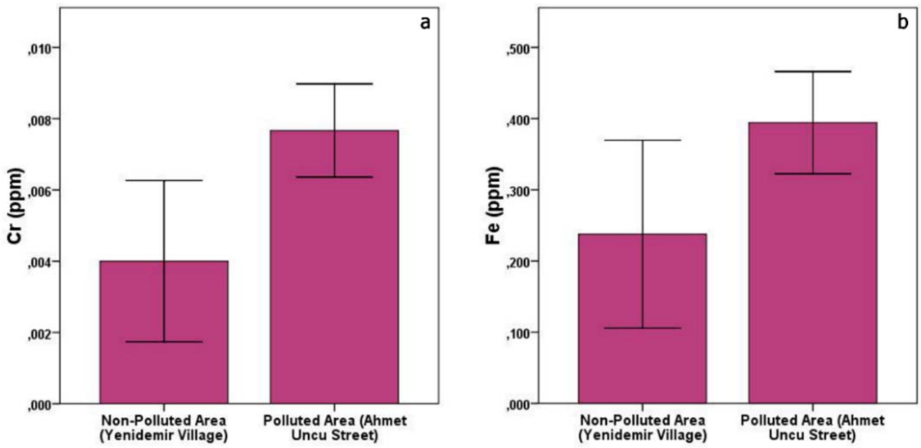

Figure 2. Cr and Fe concentrations (ppm) according to localities.

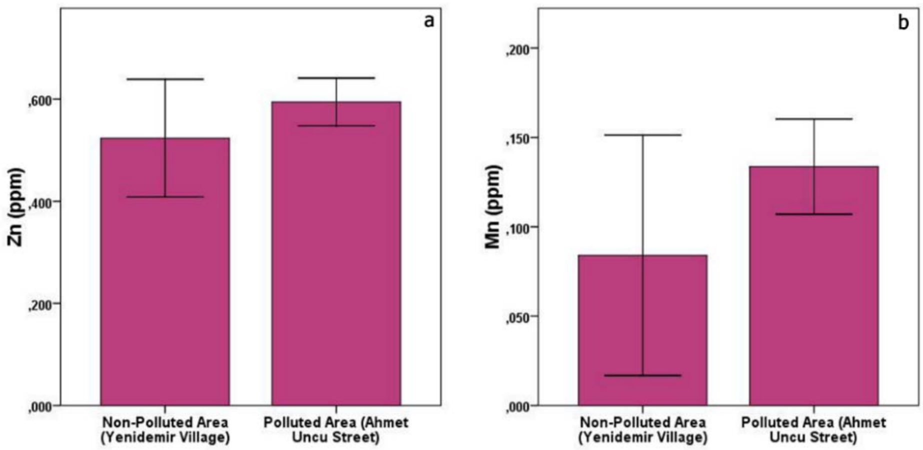

Figure 3. Zn and Mn concentrations (ppm) according to localities.

DISCUSSION

Pb contamination in soil usually can be attributed to industrial activities, agricultural activities and urban activities (Han *et al.*, 2006). Kabata-Pendias and Piotrowska (1984) showed that the average Pb concentration in plants was less than 10 ppm. In this study, the Pb values of olives in the polluted and non-polluted areas were below the threshold range. The Pb values in polluted areas were higher than non-polluted areas (Figure 1a). Also, Cassales (1998) and El-Hasan *et al.* (2002) reported that the traffic intensity caused the accumulation of lead in higher amounts.

Traffic-based copper is usually spread to the environment through the corrosion of metallic parts of cars (Divrikli *et al.*, 2006). At the same time, exhaust emissions have been shown as one of the most important causes of copper pollution (Schäfer *et al.*, 1998). Kabata-Pendias and Piotrowska (1984) reported the normal content of Cu in plants ranges to be 2-20 ppm. Our results indicated that the Cu content varied between 0.05-0.25 ppm in olives. The Cu values in polluted areas were higher than non-polluted areas (Figure 1b). Cu values for olives in these areas were below stated limit.

Cr is a toxic, non-essential element for plants (Shanker *et al.*, 2005), Cr compounds are highly toxic to plants and are detrimental to their growth and development (Yağdı *et al.*, 2000). Cao *et al.* (2001) pointed out that the Cr concentrations in plants ranged from 0.2-8.4 mg kg^{-1}. The Cr values in polluted areas were higher than non-polluted areas (Figure 2a). According to our analyses, Cr concentrations in olive were lower than the reference values.

Iron is an essential element in many metabolic processes such as photosynthesis, chloroplast development and is indispensable for all organisms (Nagajyoti *et al.*, 2010). Kabata-Pendias and Pendias (1994) reported that the normal values of Fe in plant tissues are in between 50-500 mg kg^{-1}, while the critical value is 50 mg kg^{-1}. The Fe values in polluted areas were higher than non-polluted areas (Figure 2b). From our results, Fe concentrations were very low according to mentioned threshold values.

Zinc is an essential element for all organisms and plays an important role in the biosynthesis of enzymes, auxins and some proteins (Bucher and Schenk, 2000). The normal values of Zn in the tissues of some plants ranged from 20 to 100 mg kg^{-1} (Kabata-Pendias and Pendias, 1993) and the critical value of Zn in most plants was 100 ppm in the dry matter (Yilmaz and Zengin, 2004). In the present study, the Zn values in polluted areas were higher than non-polluted areas (Figure 3a). Our Zn concentration data on olives were lower than the reference values.

Manganese plays biochemical and physiological functions in plants is another essential element. 200-300 mg kg^{-1} was reported as the critical value of Mn in most plants by Kabata-Pendias and Pendias (1994). Moreover, Gerber *et al.* (2002) reported that the manganese value is between 1-700 mg kg^{-1} in plants. The Mn values in polluted areas were higher than non-polluted areas (Figure 3b). The findings in our study indicate that the Mn concentrations of olives were much less as compared to the reported critical value.

CONCLUSIONS

Our findings suggest that heavy metal concentrations of olive plants grown in traffic-based areas were higher than non-polluted areas. The heavy metal values obtained from this study conducted on the fruits of the olive plant grown in Kahramanmaraş are below the normal level for all the elements considered. Therefore, heavy metal contamination cannot be mentioned for olives grown in the research area. Given the fact that olive is an agro-economically important crop for Turkey, it has a vital importance to grow in non-contaminated areas and good quality of olive plants for human health.

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Oral Presentation
Wednesday
Diversity of Plant Species, Systematics, and Phylogeny-2

The Achene Surface Morphology and Karyomorphology of Two Populations belonging to *Psephellus simplicicaulis* (Asteraceae)

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ABSTRACT

The populations belonging to *Psephellus simplicicaulis* (Boiss. & A. Huet) Wagenitz show a remarkable variability in the form of the leaves, the size of the appendages and the distinctness of the teeth. In this study, two populations of *P. simplicicaulis*, naturally spreading in Erzurum and Artvin province from Turkey, were compared in terms of achene surface and karyomorphology. The pappus ornamentations are relatively different, although the achene surface ornamentations are the same in both populations. Two populations of this species are constituted by different karyotype formulae as $2n = 60 = 44$ m + 16 sm and $2n = 30 = 28$ m + 2 sm. The karyotype analysis of each population was done separately and various indexes (A_1, A_2, CV_{CL}, CV_{CI}, AI, M_{CA}) were used. As a result, uniform basic chromosome number ($x = 15$) was determined in accordance with previous reports. Different karyotype formula and chromosome number were found in the studied populations of *P. simplicicaulis*. Different habitats may have caused morphological separation or even genetic variation. This instability in chromosome number and size can create problems in identifying the species. In conclusion, the taxonomic problems of the species can only be solved by completing the karyology, micromorphology and molecular analyses of all populations of the species.

Keywords: Chromosome number, Scanning Electron Microscopy, Turkey.

INTRODUCTION

In recent studies, some moderately large genera which are monophyletic were segregated from the genus *Centaurea* L. by combined morphological and molecular data. The one of them is the genus *Psephellus* Cass. *Psephellus* has been accepted as a genus in some previous treatments, by Boissier (1875), Sosnovsky (1948), Dostal (1973), and Gabrieljan (1995), but has been sunk into *Centaurea* in other Floras as Flora SSSR, Flora of Turkey, Flora of Iran and others. Finally, Wagenitz and Hellwig (2000) have presented a new concept relevant to the taxonomy of *Psephellus*, which is supported by molecular, morphological, anatomical, palynological and cytogenetical results. The first result emerged from the study of the pollen morphology (Wagenitz 1955). The genus *Psephellus* has a very conspicuous pollen type named **Centaurea dealbata** type like as *Centaurea* sect. *Cyanus* Mill. There are, however, important differences: in *Cyanus* the appendages are strongly decurrent, crystals are present in the phyllaries, the base chromosome numbers are n = 8, 10, 11, 12 and the style branches are much shorter and completely free. *Psephellus* has several features in common with *Centaurea* s.str. and *Cheirolophus* Cass., e.g. the occurrence of staminodes and the chromosome base number (n = 15 in *Centaurea*, 15 and 16 in *Cheirolophus*), but the pollen types and the apical anther appendages are very different. Extrafloral nectaries, which can be found on the outer face of the phyllaries in *Cyanus* and on the inner surface in *Centaurea*, are lacking in *Psephellus*. This species belongs to *Psephellus* sect. *Hyalinella* (Tzvelev) Wagenitz & Hellwig. This section has seven species, but several of these seem to belong to the polymorphous *Psephellus simplicicaulis* (Boiss. & Huet) Wagenitz. Two species are distributed in NE Anatolia in Turkey. Allied to *Psephellus* sect. *Psephelloidei* (Boiss.) Wagenitz & Hellwig and sect. *Psephellus*. These are *P. pecho* (Albov) Wagenitz ve *P. simplicicaulis*.

The genus *Psephellus* is represented by almost 100 species and is mainly distributed in western Siberia, Turkey, Iran, Caucasus, Ukraine, and Crimea (Susanna & Garcia Jacas 2007). In Turkey, *Psephellus* includes 37 taxa, according to the latest descriptions (Wagenitz 1975, Wagenitz *et al.* 1998, Türkoğlu *et al.* 2003, Aytaç & Duman 2005, Duran & Hamzaoğlu 2005, Wagenitz & Kandemir 2008, Tugay *et al.* 2009, Ertuğrul & Uysal 2013), 28 of which are endemic to Turkey and show a very local distribution. Accordingly, the endemism rate for Turkey is approximately 82% (Ertuğrul & Uysal 2013; Bozkurt *et al.* 2020). To date, several pollen, chromosome and molecular data have been published that support the systematic position of the genus (Garcia-Jacas *et al.* 2001; Aydın *et al.* 2013).

Morphological and anatomical studies on the fruit and seed structures play an important role in systematics (Kumar *et al.* 2012). Microstructural details of the fruit coat and seed make it possible to distinguishing the taxa. These features are important for taxonomic and evolutionary studies that use morphologic parameters for species identification (Kaya *et al.* 2010). Furthermore, it was reported that the observation of micromorphological features can also provide valuable information about developmental strategies, adaptation to different environmental conditions, and evolutionary tendencies within related groups of plants (Johnson *et al.* 2004; Plaza *et al.* 2004; Zeng *et al.* 2004; Kreitschitz & Vallès 2007; Moazzeni *et al.* 2010). The achene surface patterns were reported as ribbed, smooth or undulate for *Psephellus appendicigerus* (K. Koch) Wagenitz, *P. bornmuelleri* (Hausskn. ex Bornm.) Wagenitz, *P. brevifimbriatus* (Hub.-Mor.) Wagenitz, *P. mucroniferus* (DC.) Wagenitz, *P. pulcherrimus* (Willd.) Wagenitz and *P. pyrrhoblepharus* (Boiss.) Wagenitz (Bona 2015).

Karyomorphological studies provide information on the cytological mechanisms that direct the evolution of plant diversity on a phylogenetic scale, as well as the potential evolutionary characteristics of karyotypes. Moreover, karyomorphological studies are a fast and inexpensive approach to classify plant species by defining key cytological parameters including chromosome number, ploidy level, karyotype asymmetry, and karyotype variation coefficient of a species (Guerra, 2008; Sun *et al.* 2020). Karyological studies on the genus *Psephellus* are very few (Garcia-Jacas *et al.* 1998, Wagenitz & Hellwig 2000). The results of some of these studies are also highly controversial (Poddubnaja-Arnoldi 1931, Tonjan 1968, Kuzmanov & Georgieva 1983, Guinochet & Foissac 1962, Inceer *et al.* 2007). However, it can be concluded from reliable studies in recent years that the basic chromosome number of this genus is x = 15 (Garcia-Jacas *et al.* 1998, Wagenitz & Hellwig 2000, Bancheva 2008, Gömürgen *et al.* 2009; Bozkurt *et al.* 2017). The most species are diploid (2n=30) and they could be presented as *P. xanthocephalus* (DC.) Fisch. & C.A. Mey. ex Boiss. & Buhse x=15 (Bakshi Khaniki 1995) ve 2n= 30+ 0-3B (Garcia-Jacas *et al.* 1998), *P. sibiricus* (L.) Wagenitz (Rostovzeva 1979, Pulkina 1988), *P. phaeopappoides* Wagenitz (Garcia-Jacas *et al.* 1998), *P. somcheticus* Sosn. (Tonjan 1968), *P. pyrrhoblepharus* (Tasar *et al.* 2014), *P. marschallianus* (Spreng.) K. Koch (Bancheva 2008), *P. taochius* Sosn. (Tonian 1980) and *P. mucroniferus* (Gömürgen 2006). Additionally, it is known the presence of some *Psephellus* species having both polyploid (Inceer *et al.* 2007, Gömürgen *et al.* 2009) and B chromosomes, unlike the taxa mentioned throughout this publication (Garcia-Jacas *et al.* 1998). The chromosome number was reported as 2n=4x=60 for *P. goeksunensis* (Gömürgen *et al.* 2009).

This study was designed as a preliminary study on the achene surface structures and karyomorphologies of two populations of *Psephellus simplicicaulis*.

MATERIALS AND METHODS

Between 2010 and 2011, samples belonging to populations of *Psephellus simplicicaulis* were collected from Erzurum and Artvin province of Turkey (Erzurum: Oltu, above Orcuk village, stony slopes, 1830 m, 07.07.2010, *K. Ertuğrul* 4090 KNYA! and Artvin: between Artvin and Şavşat, 12-13 km to Şavşat, around İmerhan bridge, on the roks, 683m, 02.06.2011, *K. Ertuğrul* 4292 KNYA!). At least ten achenes for each species were dehydrated in alcohol series (70%, 80%, 96%, and 100%) in SEM analyses for cleaning process. Achenes were coated with gold under ZEISS EVO LS-10 model SEM high-vacuum mode for observing their surface at different magnifications. The terminology of achene characteristics were performed according to Ghimire *et al.* (2016) and Zhang *et al.* (2013). Mature seeds were selected and periodically germinated for chromosomal analyses. Chromosome counts were made on somatic metaphases using the squash technique. Root meristems from germinating seeds collected in the wild were used. Samples were pretreated with 0.002 M 8-hydroxyquinoline at 4°C for 8 h. The material was fixed with Carnoy for 24 h at low temperatures. Before staining, the material was hydrolysed with 5 N HCl for 1 h at room temperature, stained with 1% aceto-orcein and mounted in 45% acetic acid. Slides were made permanent in Euparal by means of Bowen's method (1956). At least 10 metaphases were examined per taxa; the best metaphase plates were photographed (100×) with a digital camera (Olympus DP-72), mounted on an Olympus BX53 microscope. The chromosome numbers and karyotype parameters were studied in each metaphase plate to characterize populations of *P. simplicicaulis*. Karyotype asymmetry was also calculated according to the indexes suggested by Romero Zarco (1986), Paszko (2006) and Peruzzi and Eroğlu (2013). Ideograms and karyograms of these taxa were made using the KAMERAM analysis system. Chromosome nomenclature followed that proposed by Levan *et al.* (1964), with the symbols m and sm designating metacentric and sub metacentric chromosomes, respectively.

RESULTS AND DISCUSSION

In this study, seeds of two populations of *Psephellus simplicicaulis* were examined micromorphologically and karyologically. In all populations studied of this species, all achene ornamentations have striat-retikulat. According to pappus ornamentations, the Oltu population is slightly striat, while the Artvin population is striat (Figure 1, Table 1). Achene micromorphological characters were found useful in systematics of the family Asteraceae (Dittrich, 1985; Abid & Qaiser, 2007, 2009; Garg & Sharma, 2007; Akcin & Akcin, 2010, 2014). Duran & Hamzaoğlu (2005) reported that the achene ornamentation of some *Psephellus* taxa is retikulat. These results are consistent with our findings. Bona (2015) emphasized that achene characteristics are important in the sectional classification of the genus *Psephellus*.

Table 1. The ultrastructural features of seed surface belonging to *Psephellus simplicicaulis* populations

Taxa	Achene length (mm)	Achene width (mm)	Hair	Achene ornamentation	Pappus ornamentation
P. simplicicaulis **(KE4090)**	3.5-5.5	1.5-2.03	+	Striat-retikulat	Slightly striat
P. simplicicaulis **(KE4292)**	4.5-5.09	1.5	+	Striat-retikulat	Striat

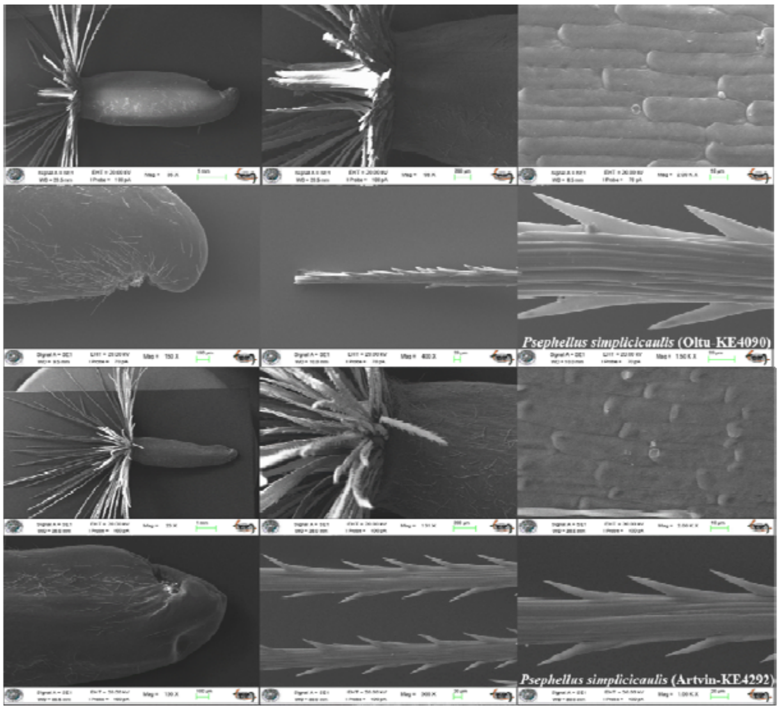

Figure 1. Scanning electron micrographs of the investigated *Psephellus simplicicaulis* populations

We determined the chromosome number diploid (2*n*=30) for Artvin population and tetraploid (2*n*=60) for Oltu population (Figure 2, Table 2). Our results showed that the basic chromosome number was *x*=15 in all populations. The karyotyping analysis revealed the presence of metacentric and submetacentric chromosomes (Table 2). Moreover, we determined that the populations taking place within populations of *P. simplicicaulis* had specific karyotypes own to each population. Although all populations display clearly some differences in terms of chromosome size and variation as well as karyotype formulas. The karyotype formula could be evaluated as very specific and fixed for populations, it indicated that the populations were clearly separated from each other. The Oltu population has the highest total haploid chromosome length (TCL: 77.008μ). Additionally, this population had the highest the coefficient of variation of chromosome length (CV_{CL}), the coefficient of variation of centromeric index (CV_{CI}) and the mean centromeric asymmetry (M_{CA}) values (Table 3). In this study, the chromosome number of *P. simplicicaulis* was found as 2*n* = 30-60. These chromosome numbers are moderately accordant with the only previous reports (Inceer *et al.* 2007; Poddubnaja-Arnoldi 1931). As a result, uniform basic chromosome number (*x* = 15) was determined in accordance with previous reports. Different karyotype formula and chromosome number were found in the studied populations of *P. simplicicaulis*. Different habitats may have caused morphological separation or even genetic variation. This instability in chromosome number and size can create problems in identifying the species. In conclusion, the taxonomic problems of the species can only be solved by completing the karyology, micromorphology and molecular analyses of all populations of the species.

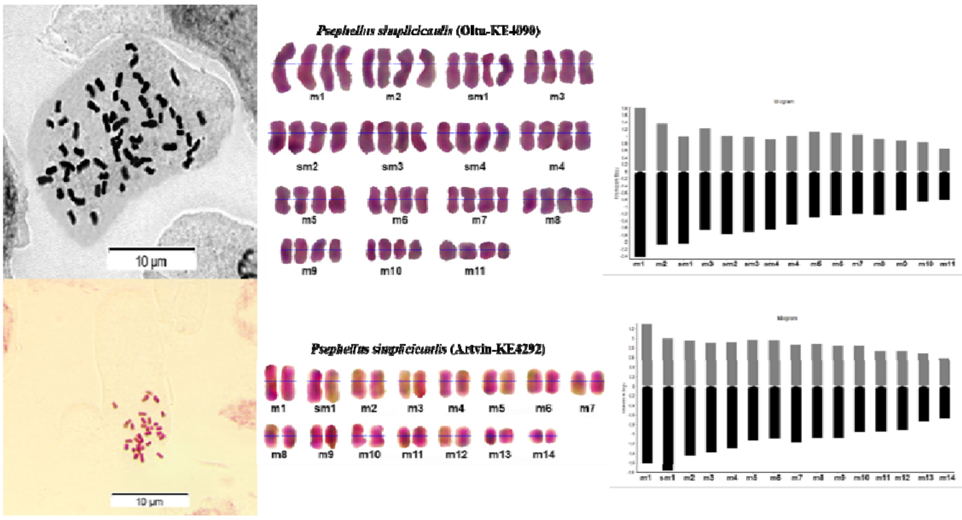

Figure 2. Somatic chromosomes of studied populations of *Psephellus simplicicaulis*

Table 2. The chromosome features of *Psephellus simplicicaulis*.

Taxa	2*n*	SC-LC (µm)	LC / SC	p (µm) (±SD)	q (µm) (±SD)	CL(µm) (±SD)	TCL (µm)	CI (±SD)	KF
KE4090_Oltu	60	1.47 - 4.26	2.893	1.06 (±0.26)	1.51 (±0.44)	2.57 (±0.66)	77.008	42 (±0.05)	44m + 16sm
KE4292_Artvin	30	1.26 - 2.92	2.311	0.88 (±0.16)	1.15 (±0.29)	2.03 (±0.44)	30.419	44 (±0.03)	28m + 2sm

SC: shortest chromosome length, LC: longest chromosome length, p: mean length of the long short arm, q: mean length of the long arm, CL: mean chromosome length, TCL: total haploid chromosome length, CI: mean centromeric index, SD: standart deviation, KF: karyotype formula, m: metacentric, sm: submetacentric, st: subtelocentric.

Table 3. The karyotype indices of *Psephellus simplicicaulis* populations

Taxa	A_1	A_2	CV_{CL}	CV_{CI}	AI	M_{CA}
KE4090_Oltu	0.274	0.258	25.835	11.123	2.874	17.5
KE4292_Artvin	0.214	0.215	21.511	7.436	1.599	13.3

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Oral Presentation
Thursday
Diversity of Animal Species, Systematics, and Phylogeny-2

Cranial Osteology on *Heremites auratus* and *Heremites vittatus* (Lacertilia: Scincidae) species

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ABSTRACT

The *Heremites* genus in Turkey is consisting of 3 species as *Heremites auratus* (Linnaeus 1758), *Heremites vittatus* (Olivier, 1804) and *Heremites septemtaeniatus* (Reuss, 1834). The taxonomic and biological characteristics of the *Heremites auratus* and *Heremites vittatus* populations have been studied with different methods, but a detailed study has not been found on the osteological characteristics of *Heremites auratus* distributed in Çanakkale, and *Heremites vittatus* distributed in Sivas. Morphological measurements of the specimens belonging to *Heremites auratus* and *Heremites vittatus* were taken. And cranial skeletal features, including the bones covering the dermal skull, the palatal complex, the bones surrounding the brain sheath and the lower jaw bones were examined qualitatively and quantitatively using the transparent stained skeleton method. In *Heremites auratus* and *Heremites vittatus*; differences were determined between the number of upper jaw teeth, pterygoid teeth, dental teeth, posterior end of the premaxillary, the size of the pineal foramen, the connection of the parietal with the postfrontal, the posterior end of the postfrontal, the connection of the vomer with the palatine and the end shapes of the suprooccipital.

In this study, the osteological differences and similarities of the skull between *Heremites auratus* and *Heremites vittatus* species were revealed.

Keywords: *Heremites auratus*, *Heremites vittatus,* Cranial Osteology, Turkey

INTRODUCTION

In the classification of reptiles, as in most groups of vertebrates, great importance is attached to osteological characteristics as well as external characters (morphological). Osteological differences in the classification of reptiles are more evident at the level of the order, but they can be seen even between families, genera, species and even subspecies (Romer, 1956; Kaya, 1996). In phylogenetic studies, characters that have undergone the least change during the evolution process, that is, the strongest, are preferred. One of the most suitable and strongest characters is osteological characters. For this reason, skeletal elements constitute one of the most appropriate data for revealing kinship relations (Özeti, 1970).

The Scincidae family accounts for more than 25% of all lizard species. More than 1600 species have been identified in this family (Uetz and Hosek, 2017). The *Heremites* genus in Turkey is consisting of 3 species as *Heremites auratus* (Linnaeus 1758), *Heremites vittatus* (Olivier, 1804) and *Heremites septemtaeniatus* (Reuss, 1834) (Kumlutaş et al., 2015). *H. auratus* and *H. vittatus* species are not protected (LC) according to the IUCN redlist (Lymberakis et al., 2017; Böhme et al., 2017).

The skull anatomy of three species belonging to the Scincidae family (*T. laevis, T. sulcata* and *T. gonwouoi*) was investigated using high-resolution X-ray micro-computed tomography (Paluh and Bauer, 2017). The cranial osteology of *Trachylepis vittata* and *Trachylepis aurata transcaucasica* species, which are distributed in Iran, has been studied with the double staining method and similarities and differences have been revealed (Rastegar-Pouyani et al., 2013).

Showing the distribution Scincidae family members in Turkey, *Ablepharus kitaibelii*, *A. chernovi* and *A. budaki* species cranial and postcranial skeletal features within the scope of comparative osteology and skeletal type demonstrated (Yıldırım et al., 2017).

More taxonomic, morphological and ecological characteristics of *Heremites auratus* and *Heremites vittatus* species, which are distributed in Anatolia, have been investigated. Osteological studies of the species in this family are very limited. However, no detailed studies were found on the comparative cranial osteology of the *Heremites* genus in Anatolia. This study aims to reveal the similarities and differences seen in cranial osteology of the two species.

MATERIALS AND METHODS

In osteological analyzes, samples of *Heremites auratus* (COMU-ZM 78/2014, Ezine, Çanakkale) and *Heremites vittatus* (COMU-ZM 37/2014, Akdere, Sivas) were provided from the Zoology Museum of the Biology Department of Çanakkale Onsekiz Mart University. In *Heremites auratus*, head + body length is 85.79 mm and 98.17 mm; It is 61.87 mm and 70.99 mm in *Heremites vittatus*, and adult specimens have been used in both species.

Although there are different methods in osteological studies, dry and painted skeletons are generally used. In detailed skeletal analyses, the dry skeleton method is somewhat inconvenient, especially on small samples. Because the bones are damaged during the cleaning of the muscles, shrink when left to dry and move away from their normal shape, and especially the cartilage parts curl and lose their natural shape, causing errors in skeletal measurements. For these reasons, the basis of our study is transparent painted skeletons. Transparent painted total skeletons; Özeti (1970) was prepared according to the Alizarin Red-S method of Davis and George (1974) and Taylor (1967), which was applied by changing it.

The bones forming the skull of *H. auratus* and *H. vittatus* were divided into sections and examined. These bones are collected in subtitles as dorsal median bones, upper jaw bones, palate and temporal bones, bones surrounding the orbit, occipital series bones and lower jaw bones. Bones in the dorsal median; premaxilla, nasals, frontal and parietal. Upper jaw bones; premaxilla, maxilla, jugal and quadrat. Palate bones; premaxilla, maxilla, vomer, palatine, pterygoid, ectopterygoid and sphenoid. Temporal bones; It is the supratemporal bone in the inner part and the squamosal in the outer part. The bones surrounding the orbit are prefrontal, frontal, postfrontal, jugal, maxilla, and lacrimal. Occipital series bones; ventrally bacioccipital, laterally two exooccipital, dorsal supraoccipital four bones.

RESULTS

22 qualitative osteological characteristics of the samples were determined and a comparison between species was made (Table 1).

Premaxilla: It is in contact with the maxilla anterioposteriorly, with the septomaxilla anteriodorsally, the nasal posteriorly, and the vomer at the ventral. In *H. auratus* and *H.vittatus*, premaxilla bears 9 pleurodont teeth. The teeth are placed in four on each side and one in the middle. In *H. auratus*, the posterior end of the premaxilla contacts the nasals in a sharp way, and in *H. vittatus* by rolling slightly.

Septomaxillae: These are small bones that extend forward inside the nasal capsules. Each septomaxilla comes into contact with the premaxilla anteriorly.

Maxillae: Anteriorly with premaxilla and septomaxilla, anteriodorsally with nasal, dorsomedial with prefrontal and lacrimal, and posteriorly with jugal. *H. auratus* has 22 locus and 19-21 teeth in each maxilla, and *H. vittatus* has 21 locus and 17-21 teeth. The total number of teeth in the premaxilla and maxilla is 47-51 in *H. auratus* and 43-50 in *H. vittatus*. There are 5 labial foramina in each maxilla in *H. auratus* and 4-5 labial foramina in *H. vittatus*.

Nasals: They come into contact with the premaxilla anteriorly, with the frontal posteriorly, with the prefrontal in the posterolateral, with the maxilla at the venterolateral and are two parts. The distal end of the nasals is sharp in individuals of both species.

Prefrontals: These bones are in contact dorsally with the frontal, anteriodorsally with the nasal, venterolaterally with the maxilla, and posterolaterally with the lacrimal. The place where the prefrontal connects to the orbit proximally is thin and long in individuals of both species.

Lacrimals: It is articulated venterolaterally with the maxilla and anterodorsally with the prefrontal. They are very small and lateral bones.

Frontals: Articulated anteriorly with the nasal, anterolaterally with the prefrontals, posterolaterally with the postfrontals and posteriorly with the parietal. In individuals of both species, the anterior end of the frontals is in contact with the area between the nasals in a slightly pointed way. Individuals of both species do not have sutures at the anterior and posterior ends of the frontal (Figure 1 and 2).

Parietal: It is the widest part of the skull. The posterior surface of the parietal is in the shape of a butterfly. The parietal has protrusions on the posterolateral part that extend from both sides. These protrusions are in contact with the squamosum and supratemporal. It is in contact with the frontal and anteriorly, both laterals and the postfrontal. Dorsally, there is a pineal foramen in its anteromedial part. The pineal foramen is located on the midline from the premaxilla in *H. vittatus*. It can also be seen from the ventral. Pineal foramen in *H. auratus* are small and indistinct (Figure 1 and 2). In both species, more than half of the parietal lateral surface is in contact with the postfrontal. There is more space between the parietal and the posterior end of the postfrontal in *H. auratus* compared to *H. vittatus*.

Postfrontals: It consists of two parts, each anterolaterally located. It is in contact anterolaterally with the postorbital, dorsalolaterally with the parietal, and posterolaterally with the squamosal. In *H. auratus* and *H. vittatus* there is a protrusion at the posterior end of the postfrontal. The protrusion in *H. auratus* is more elongated than in *H. vittatus*. Gaps in the region where the postfrontal corresponds to the parietal are more in *H. auratus*.

Supratemporals: It is a small bone located in the posteroventral part of the lateral surface of the supratemporal process. It is in contact with the squamosal and supratemporal dorsal of the parietal. It is also in contact with the quadrat and otooccipital ventrally.

Postorbitals: These are small bones that connect between the jugal and squamosal. It is articulated anterioventrally with the jugal, dorsal with the postfrontal, and posteroventrally with the squamosal.

Squamosals: They are bones that are long and concave. In the anterior-posterior direction, the postorbital, postfrontal, supratemporal space is in contact with the posterior extension of the parietal.

Jugals: Articulated anteriorly with the maxilla, posteriorly with the postorbital, and posterodorsally with the postfrontal.

Vomers: They are the bones visible from the ventral. The vomers are in contact anterolaterally with the premaxilla, lateral with the maxilla, and the posterior end in contact with the anterior part of the palatine. There is a protrusion towards the palatine at the ventral of the vomer in *H. auratus*, whereas there is no such protrusion in *H. vittatus*.

Palatines: It has a three-dimensional structure. It comes into contact with the vomer and maxilla anteriorly and with the pterygoid posteriorly. The part where the palatines touch each other is straight. It has a dorsomedial height and its dorsal end is indented inward. In *H. auratus*, the palatines are in contact with the vomer anteriorly and the vomers are more intertwined with the palatines than in the *H.*

vittatus. In *H. auratus*, palatines contact the vomer in a serrated way. In *H. vittatus*, palatines tend to the vomer with their tapering tips. In *H. auratus* and *H. vittatus*, palatines are separated from each other in the posterior part. In *H. vittatus*, the ends of the palatines extending towards the lateral are narrowed compared to *H. auratus*. In *H. auratus*, palatines are in full contact with pterygoids and are sutured. In *H. vittatus*, the pterygoid makes a connection with the palatine in a sharp way, it is not in full contact (Figure 1 and 2).

***Pterygoids*:** These are the largest and backmost bones of the palate. Extending from anterior to posterior, these bones extend between the pyriform area of parabacisphenoids and the bacipterygoid protrusions. Each pterygoid is Y-shaped. There are teeth near the pyriform cavity of each pterygoid. Pterygoid teeth are 2 + 1 in *H. auratus* and 3 + 5 in *H. vittatus*.

***Ectopterygoids*:** Rectangular in shape. It is articulated anteriorly with the maxilla and jugal, posteriorly with the pterygoid.

***Quadrates*:** It is located in the posterolateral corners of the skull. It articulates with the lower jaw. It contacts squamosal and supratemporal dorsally, otooccipital dorsomedially, pterygoid posteromedially and articular ventrally.

***Dentale*:** It is the largest of the mandibular bones. In individuals of both species, there is no tooth on the back of the dental. The number of teeth on dentale is 24 + 22 and 22 + 22 in individuals of *H. auratus*, and 21 + 21 and 17 + 18 in *H. vittatus*.

***Bacioccipital*:** It forms the posterior base of the brain muscle from the ventral. It articulates anteriorly with a parabacisphenoid. It articulates with the otooccipital laterally posteriorly.

***Otooccipital*:** It is formed by the fusion of exoccipital and opistotic bone. It forms the lateral border of the foramen magnum and the posterolateral wall of the otic capsule. It is in contact with the prootic capsule anteriorly, the basioccipital at the venteromedial, the supraoccipital dorsally, and the quadrat, supratemporal, and stirrups laterally.

***Prootics*:** It forms the anterodorsal portion of the basicranium. It contacts the supraoccipital posterodorsally, the autooccipital and the bacioccipital posteriorly, and the parietal dorsally.

Supraoccipital: It forms the back roof of the brain muscle. It forms the posterodorsal border of the neurocranium. Its anterior view is in the shape of "Inverted U". The tip of the cartilaginous structure in the supraoccipital is slightly rounded in *H. vittatus* and flat in *H. auratus* (Figure 1 and 2).

Table 1: Compared characters of the skull skeletons of *Heremites auratus* and *Heremites vittatus* specimens

Characters	*Heremites auratus* 78/2014-2 ♂	*Heremites auratus* 78/2014-1 ♀	*Heremites vittatus* 37/2014-3 ♂	*Heremites vittatus* 37/2014-5 ♂
Number of teeth in premaxilla	9(4+1+4)	9(4+1+4)	9(4+1+4)	9(4+1+4)
The number of teeth in the maxilla	19+19	21+21	20+21	17+17
The number of teeth in the upper jaw (premaxilla+maxilla)	47	51	50	43
Tooth structure	Pleurodont	Pleurodont	Pleurodont	Pleurodont
Tooth locus in the maxilla	44	44	42	37
Number of labial foramina in the maxilla	5+5	5+5	4+5	5+4
Proximal connection of the prefrontal to the orbit	Elongated	Elongated	Elongated	Elongated
Connection of the posterior end of the premaxilla with the nasals	Pointed	Pointed	Slightly round	Slightly round
Shape of the distal end of the nasals	Pointed	Pointed	Pointed	Pointed
Connection of frontal and nasals	Slightly pointed	Slightly pointed	Slightly pointed	Slightly pointed
Suture degrees of the anterior and posterior ends of the frontal	No sutures	No sutures	No sutures	No sutures
Postfrontal articulation of the parietal	More than half of the parietal side surface in contact with the postfrontal, with space between the posterior of the postfrontal and the parietal	More than half of the parietal side surface in contact with the postfrontal, with space between the posterior of the postfrontal and the parietal	More than half of the parietal side surface in contact with the postfrontal, less space between posterior postfrontal and parietal	More than half of the parietal side surface in contact with the postfrontal, less space between posterior postfrontal and parietal
Shape of the postfrontal	The postfrontal protrusion at the posterior end is long	The postfrontal protrusion at the posterior end is long	The postfrontal protrusion at the posterior end is short	The postfrontal protrusion at the posterior end is short

The location of the pineal foramen in the parietal	The upper part of the medial line ,small and indistinct	The upper part of the medial line ,small and indistinct	The upper part of the medial line and marked	The upper part of the medial line and marked
The shape of the palatine bone	Flat stomach, have a dorsomedial height, the part in contact with the pterygoid is rough	Flat stomach, have a dorsomedial height, the part in contact with the pterygoid is rough	Flat stomach, have a dorsomedial height, the part in contact with the pterygoid is indented inward	Flat stomach, have a dorsomedial height, the part in contact with the pterygoid is indented inward
Connection of palatine with vomer	Slightly notched towards the vomere	Slightly notched towards the vomere	No notch	No notch
Connection of the palatine with the pterygoid	Full contact and sutured	Full contact and sutured	It makes contact with the spikes and there is space between the bones	It makes contact with the spikes and there is space between the bones
Pterygoid shape	Y shaped	Y shaped	Y shaped	Y shaped
The number of teeth on the pterygoid	2+1	2+1	3+5	No teeth
The shape of the protrusion on the supraoccipital	Sharp pointed	Sharp pointed	With round ends	With round ends
The condition of the teeth on the posterior protrusion of the maxilla	No teeth	No teeth	No teeth	No teeth
The number of teeth on dentale	24+22	22+22	21+21	17+18

Figure 1. Dorsal (A) and Ventral (B) views of the skull of *Heremites auratus* (78/2014-1), Dorsal (C) and Ventral (D) views of the skull of *Heremites auratus* (78/2014-2)

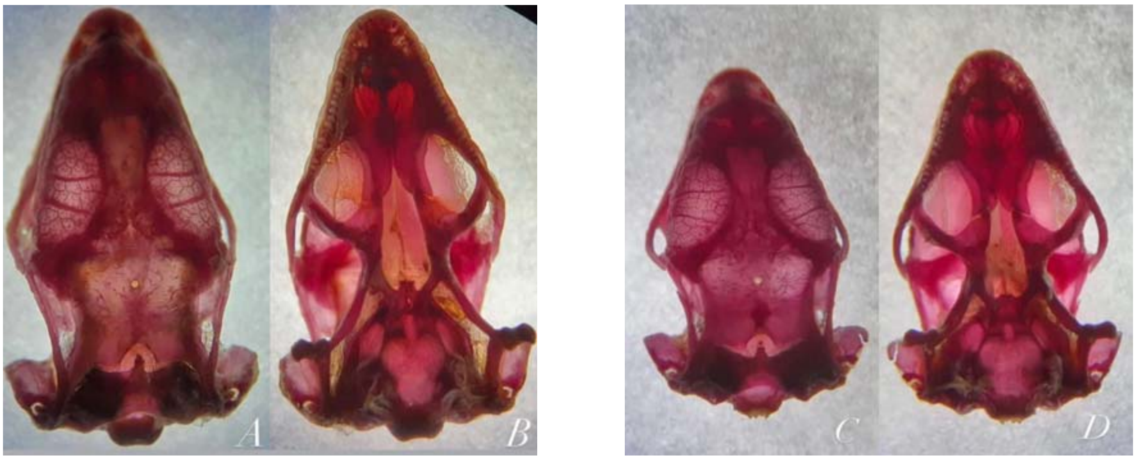

Figure 2. Dorsal (A) and Ventral (B) views of the skull of *Heremites vittatus* (37/2014-3), Dorsal (C) and Ventral (D) views of the skull of *Heremites vittatus* (37/2014-5)

DISCUSSION

In *H. auratus*, the posterior end of the premaxilla touches the nasals in a sharp way, and in *H. vittatus* by rolling slightly. *H. auratus* has 22 locus and 19-21 teeth in each maxilla, and *H. vittatus* has 21 locus and 17-21 teeth. Paluh and Bauer (2017) reported that there are 16 maxillar tooth loci and 11 teeth in *Trachylepis laevis*, 19 maxillar tooth loci and 16 teeth in *T. sulcata*, 27 maxillar tooth loci and 24 teeth in *T. gonwouoi*. In terms of the number of teeth in the maxilla, *H. auratus* and *H. vittatus* differ from other species mentioned in the literature.

Rastegar-Pouyani et al. (2013) reported that there are 4-6 labial foramen in *Trachylepis vittata* and 5-7 in *Trachylepis aurata transcaucasica*. In this study, there are 5 labial foramina in each maxilla in *H. auratus* and 4-5 labial foramina in *H. vittatus* and are in harmony with the literature.

The pineal foramen in the parietal is located on the midline vertically coming from the premaxilla in *H. vittatus*. It is similar to the previous study (Rastegar-Pouyani et al., 2013) that the pineal foramen in *T. vittata* is in the median suture line. Pineal foramen in *H. auratus* are small and indistinct.

There is a protrusion towards the palatine in the ventral of the vomer in *H. auratus*, whereas there is no such protrusion in *H. vittatus*. In the previous study, it was stated that the rear end of vomer is sharper than *T. vittata* in *T. aurata* (Rastegar-Pouyani et al., 2013). In *H. auratus* the palatines are slightly notched towards the vomer. In *H. vittatus*, palatines do not notch towards the vomer.

The part where the palatines touch each other is straight. It has a dorsomedial height and its dorsal end is indented inward. Paluh and Bauer (2017) reported that palatines have high in *Trachylepis laevis*, *T. sulcate* and *T. gonwouoi*.

In *H. auratus*, palatines are in full contact with pterygoids and are sutured. In *H. vittatus*, the pterygoid makes a connection with the palatine in a sharp way, it is not in full contact. The pterygoid process is narrowest and longest in *T. laevis,* widest and shortest in *T. sulcata*, medium in *T. gonwouoi*, and varies in length and width (Paluh and Bauer, 2017).

Pterygoid teeth are 2 on the right and 1 on the left in *H. auratus*. In the sample of *H. vittatus* (37 / 2014-3), there were 3 on the right and 5 on the left. No pterygoid tooth was found in *H. vittatus* (37 / 2014-5). It was reported by Paluh and Bauer (2017) that there were two pterygoid teeth in a depression in the lower part of the pterygoid of *T. gonwouoi*, but there were no pterygoid teeth in *T. laevis* or *T. sulcata*.

The tip of the cartilaginous structure in the supraoccipital is slightly rounded in *H. vittata* and flat in *H. auratus*. Rastegar-Pouyani et al. (2013), it has been stated that it is similar to *T. vittata*.

In this study, the similarities and differences of the skull osteological features of *Heremites auratus* and *Heremites vittatus* species, which are also distributed in our country, have been comparatively revealed.

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Oral Presentation
Thursday
Microbial Diversity-2

Detection of phage and plasmid biodiversity of *Lactobacillus pentosus* strains through CRISPR/Cas systems spacer analyses

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ABSTRACT

CRISPR-Cas system (Clustered regularly interspaced short palindromic repeats- CRISPR associated genes) helps the bacteria or the archaea to gain immunity against phage or plasmid invasions. In this study, phage and plasmid biodiversity of 19 *Lactobacillus pentosus* strains were investigated through the CRISPR/Cas system and spacer analyses. Therefore, firstly, CRISPR types of strains were detected with CRISPR-Cas++ tool. 18 strains had type II-A while 19 strains had type I-E. Strain SLC13 had the maximum spacer count. According to spacer analysis, phage and plasmid invaders of SLC13, krglsrbmofpi2, IG10, IG7, and IG4 were able to detect with CRISPRTarget analysis tool. Plasmid DNAs of *Lactobacillus plantarum* was detected in CRISPR systems of two strains.

Keywords: *Lactobacillus pentosus,* phage, plasmid, CRISPR-Cas, spacer

INTRODUCTION

CRISPR-Cas (Clustered regularly interspaced short palindromic repeats- CRISPR associated genes) is an immune system of bacteria or archaea against invasions of phages or plasmids (Makarova *et al.*, 2011). CRISPR systems are classified into two classes (Class 1 and Class 2), 6 Types (I-VI), and 33 subtypes according to Cas genes composition, repeat sequences, and crRNA-effector complex (Alkhnbashi *et al.*, 2020; Crawley *et al.*, 2018). A CRISPR array consists of spacers and direct repeats that are conserved short sequences (Biswas *et al.*, 2014; Lopatina *et al.*, 2019). Thereby, all spacer sequences captured by bacteria or archaea correspond to a part of phage or plasmid DNA.

Lactobacillus pentosus is a fermentative lactic acid bacterium that is in "GRAS (Generally recognized as safe)" status of EFSA (European Food Safety Authority) and can be used as a starter culture for olive fermentation together with *Lactobacillus plantarum* (Landete *et al.*, 2010). Therefore, it can be isolated from the end of the olive fermentation (Abriouel *et al.*, 2019; Lidia & Audry, 2018; Montoro *et al.*, 2016).

Lactobacillus pentosus has been shown to have antimicrobial, anticancer, and probiotic activity (Lidia & Audry, 2018; Montoro *et al.*, 2016).

This study aims to compare the CRISPR-Cas system diversity and phage/plasmid biodiversity of 19 *Lactobacillus pentosus* strains.

MATERIALS AND METHODS

Complete genome sequences

5 whole-genome and 14 draft genome sequences of *Lactobacillus pentosus* strains published up to date in NCBI (National Center for Biotechnology Information Genome Bank) were used for the analyses (Sayers *et al.*, 2020).

CRISPR/Cas system identification and obtaining spacer sequences

CRISPR/Cas systems, spacers, and repeats sequences were identified with CRISPR-Cas++ and CRISPRDetect tools (Biswas *et al.*, 2016; Grissa *et al.*, 2007). CRISPR Recognition Tool (CRT) v1.0 was used to confirm repeats swiftly (Bland *et al.*, 2007). Spacer sequences were downloaded from CRISPR-Cas++ tool.

Spacer analyses

Spacers belonging to a bacteriophage or plasmid were analyzed with the CRISPRTarget tool (http://crispr.otago.ac.nz/CRISPRTarget/crispr_analysis.html). Spacers, which are more than 6, were used as a query to search against the phage or plasmid database by giving a cut-off score of 20 (Biswas *et al.*, 2013). Exhibiting a maximum of two mismatches was considered as a parameter for a strong match (Yang *et al.*, 2020).

The phylogenetic analysis of the Cas1 and Cas2 proteins

Cas1 and Cas2 amino acid sequences were obtained from NCBI. All Cas1 and Cas2 amino acid sequences were aligned by the ClustalW alignment algorithm with the MEGA X tool and the UPGMA tree was constructed by using bootstrap method 500 replicates in Geneious Prime 2020.1 software (Kearse *et al.*, 2012).

RESULTS

CRISPR/Cas system of strains

19 *Lactobacillus pentosus* strains were analyzed. 18 strains had type II-A while 19 strains had type I-E (Table 1). 4 different repeat sequences revealed within type II-A strains while 7 different repeat sequences revealed within type I-E.

Spacer target analyses

All spacers were analyzed and Lactobacillus plantarum bacteriophage phiJL-1, Lactobacillus phage Sha1, Lactobacillus phage PM411, brevis strain UCCLBBS449 plasmid pUCCLBBS449_E, Lactobacillus phage Bassarid, Lactobacillus bacteriophage phig1e, faecalis strain C10 plasmid pC10, and plantarum strain ATCC 8014 plasmid pLP39 were detected in five strains while other strains did not meet criteria for a strong match.

The phylogenetic analysis of the Cas1 and Cas2 proteins

Cas1 and Cas2 are involved in the acquisition of spacers and present universally in all types of CRISPR. According to results, Cas1 revealed a considerable agreement with subtypes, type II-A and I-E were clustered on the two different branches of the tree. However, even though Cas2 results were almost similar to Cas1, type II-A Cas2 of *L. pentosus* ATCC 8041 was clustered on separate branch of tree (Figure 2 and Figure 3). Pairwise Identity of Cas1 was 53.2% while Cas2 was 37.5% and hydrophobic amino acids were the most abundant in both proteins.

DISCUSSION

Lactobacillus pentosus is a fermentative bacterium that is used as a starter culture for olive fermentation. Starter cultures can be exposed to phage or plasmid invasions during the fermentation process that decreases the yield of bacteria (Galvan *et al.*, 2016). Therefore, a survey of phage or plasmid diversity will be useful to detect the most common invaders of strains to produce phage-resistant starter cultures for the industry.

Spacer analysis results were consistent with a previous study conducted with *Lactobacillus pentosus* strain KCA1. In this mentioned study, researchers found Lactobacillus bacteriophage phig1e and Lactobacillus plantarum bacteriophage phiJL-1 as phage invaders of strain.

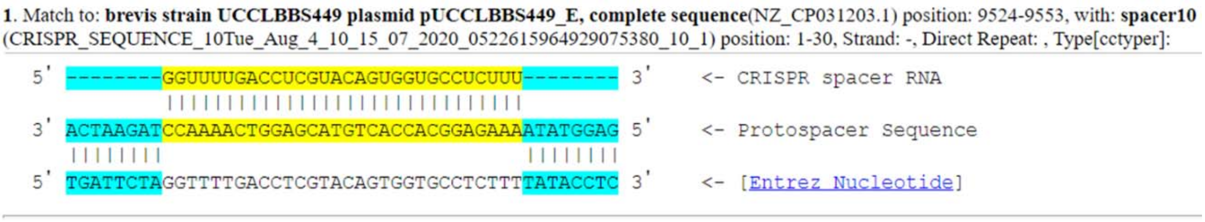
Table 1: CRISPR/Cas systems, accession numbers, spacer counts, and repeat sequences of *Lactobacillus pentosus* strains

	Strains	Accession Number	CRISPR/Cas Type	Spacer counts	Repeat sequences	Genome
1.	DSM 20314	NZ_CP032757_1	II-A, I-E	10, 12	gtcttgaatagtagtcatatcaaacaggtttagaac ggatcacccccgcatacgcggggaacag	Whole
2.	BGM48	NZ_CP016491.1	II-A, I-E	10, 12	gtcttgaatagtagtcatatcaaacaggtttagaac ctgttccccgcgtatgcgggggtgatcct	Whole
3.	ZFM222	NZ_CP032654.1	II-A, I-E	23, 19	gtcttgaatagtagtcatatcaaacaggtttagaac ggatcacccccgcatacacggggaacag	Whole
4.	ZFM94	NZ_CP032659.1	II-A, I-E	23, 19	gtcttgaatagtagtcatatcaaacaggtttagaac ggatcacccccgcatacacggggaacag	Whole
5.	SLC13	NZ_CP022130.1	I-E	31	ctgttccccgcgtatgcgggggtgatcc	Whole
6.	ATCC 8041	NZ_PUFM00000000.1	II-A, I-E	10, 12	gttctaaacctgtttgatatgactactattcaagac ctgttccccgcgtatgcgggggtgatcc	Draft
7.	FL0421	NZ_LFLY00000000.1	II-A, I-E	7, 13	gttctaaacctgtttgatatgactactattcaagac ctgttccccgcgtatgcgggggtgatcc	Draft
8.	krglsrbmofpi2	NZ_WHJB00000000.1	II-A, I-E	10,7	gttctaaacctgtttgatatgactactattcaagac ctattccccgtgtatacgggggtgatcc	Draft
9.	IG12	NZ_RDCH00000000.1	II-A, I-E	17, 13	gtcttgaatagtagtcatatcaaacaggtttagaac ggatcacccccgcatacacggggaacag	Draft
10.	IG11	NZ_RDCI00000000.1	II-A, I-E	17, 13	gttctaaacctgtttgatatgactactattcaagac ctgttccccgtgtatgcgggggtgatcc	Draft
11.	IG10	NZ_RDCJ00000000.1	II-A, I-E	16, 4	gttctaaacctgtttgatatgactactattcaagac ctattccccgtgtatacgggggtgatcct	Draft
12.	IG9	NZ_RDCK00000000.1	II-A, I-E	15, 13	gttctaaacctgtttgatatgactactattcaagac ctgttccccgtgtatgcgggggtgatcc	Draft
13.	IG8	NZ_RDCL00000000.1	II-A, I-E	17, 13	gttctaaacctgtttgatatgactactattcaagac ctgttccccgtgtatgcgggggtgatcc	Draft
14.	IG7	NZ_PVNW00000000.1	II-A, I-E	6, 12	gtcttgaatagtagtcatatcaaacaggtttagaac ctgttccccgtgtatgcgggggtgatcc	Draft
15.	IG6	NZ_PVNX00000000.1	II-A, I-E	6, 6	tcttgaccttattgatttaatgtccttctgaaac gggatcacccccgtatacacggggaatacа	Draft
16.	IG5	NZ_PVNY00000000.1	II-A, I-E	6, 6	tcttgaccttattgatttaatgtccttctgaaac tgtattccccgtgtatacgggggtgatccc	Draft

17.	IG4	NZ_PVNZ00000000.1	II-A, I-E	14, 10	gtcttgaatagtagtcatatcaaacaggtttagaac ggatcacccccgcatacgcggggaacag	Draft
18.	IG3	NZ_PVOA00000000.1	II-A, I-E	6, 6	tcttgaccttattgatttaatgtccttctgaaac tgtattccccgtgtatacgggggtgatccc	Draft
19.	IG2	NZ_PVOB00000000.1	II-A, I-E	4, 8	gtcttgaatagtagtcataccaaacaggtttagaac ctgttccccgcgtatgcgggggtgatcc	Draft

Table 2: CRISPR/Cas system related phage or plasmid invaders of *L. pentosus* strains

***Lactobacillus pentosus* strains**	**Spacer number**	**Phage and plasmid biodiversity**
SLC13	9	*Lactobacillus plantarum* bacteriophage phiJL-1
	18	*Lactobacillus* phage Sha1
	27	*Lactobacillus* phage PM411
krglsrbmofpi2	10	brevis strain UCCLBBS449 plasmid pUCCLBBS449_E
IG10	2	*Lactobacillus* phage Bassarid
IG7	5	*Lactobacillus* bacteriophage phig1e
IG4	1	faecalis strain C10 plasmid pC10
	11	plantarum strain ATCC 8014 plasmid pLP39


1. Match to: **brevis strain UCCLBBS449 plasmid pUCCLBBS449_E, complete sequence**(NZ_CP031203.1) position: 9524-9553, with: **spacer10** (CRISPR_SEQUENCE_10Tue_Aug_4_10_15_07_2020_0522615964929075380_10_1) position: 1-30, Strand: -, Direct Repeat: , Type[cctyper]:

```
5' --------GGUUUUGACCUCGUACAGUGGUGCCUCUUU-------- 3'   <- CRISPR spacer RNA
           ||||||||||||||||||||||||||||||
3' ACTAAGATCCAAAACTGGAGCATGTCACCACGGAGAAAATATGGAG 5'   <- Protospacer Sequence
   ||||||||                              ||||||||
5' TGATTCTAGGTTTTGACCTCGTACAGTGGTGCCTCTTTTATACCTC 3'   <- [Entrez Nucleotide]
```

Figure 1. CRISPRtarget tool result of *L. pentosus* strain krglsrbmofpi2

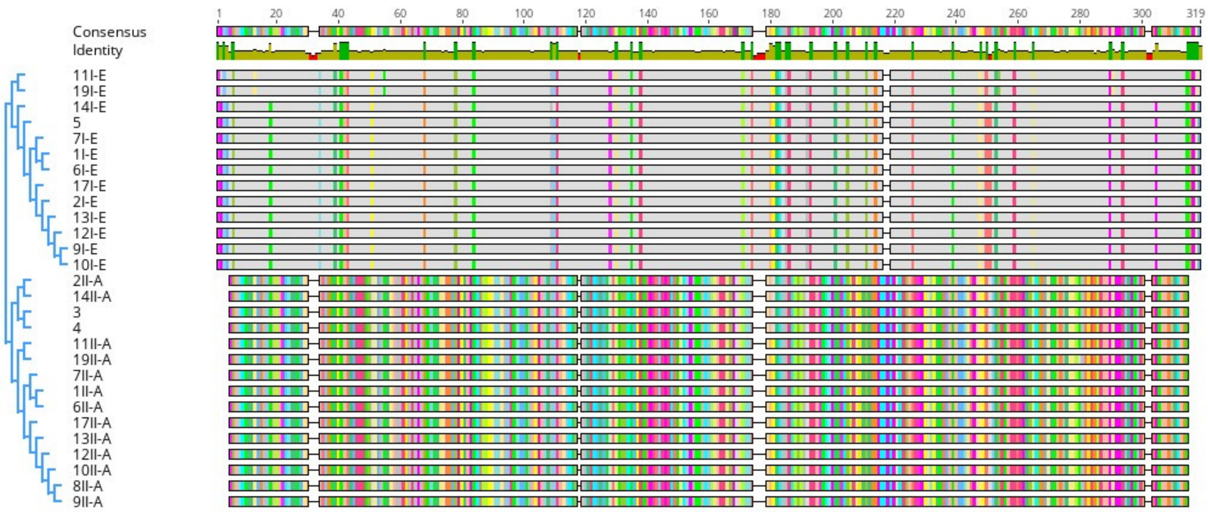


Figure 2: Phylogenetic comparison of Cas1 proteins of strains

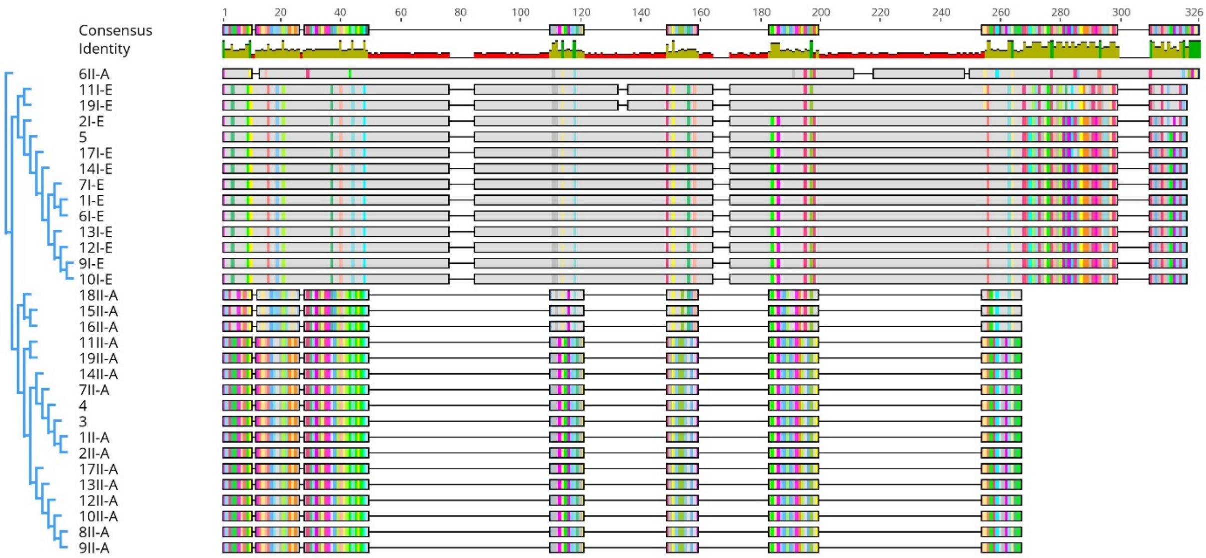


Figure 3: Phylogenetic comparison of Cas2 proteins of strains

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Oral Presentation
Thursday
Diversity of Animal Species, Systematics, and Phylogeny-3

Fish Fauna of the Upper Porsuk River Basin

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ABSTRACT

The upper basin of the Porsuk River is within the boundaries of Kütahya Province. Porsuk Stream is an important source of the Sakarya River. The aim of this study is to determine the fish fauna and anthropogenic effects of the upper basin of the Porsuk River. The fieldwork was carried out twice, in May 2018 and November 2018, in wet and dry seasons. In this study, the species *Alburnoides kosswigi, Alburnus escherichii, Barbus escherichii, Capoeta baliki, Carassius gibelio, Cyprinus carpio, Gobio sakaryaensis, Chondrostoma angorense, Pseudorasbora parva, Squalius pursakensis, Oxynoemacheilus angorae, Seminemacheilus lendlii, Cobitis simplicispina,* and *Oncorhynchus mykiss* were determined from the upper Porsuk basin.

Keywords: Porsuk River, Fish Fauna, Kütahya, Anthropogenic effect

INTRODUCTION

In recent years, the number of studies related to fish has increased considerably in Turkey. As a result of these studies, 409 fish species were reported in Turkey (Çiçek *et al.*, 2018). These studies are increasing day by day, and new species are reported for ichthyofauna (Çiçek, 2020; Turan *et al.*, 2020; Kaya *et al.*, 2020a; Yoğurtçuoğlu *et al.*, 2020). Different researchers conducted faunistic studies based on provinces and basins and reported the distribution of fish (Bayçelebi *et al.*, 2017; Öztürk and Küçük, 2017; Özuluğ and Saç, 2019; Kaya *et al.*, 2020b). There has not been a comprehensive faunistic study on the fish of the Porsuk River until today. Köse *et al.* (2012) reported out that there were some species (*Cyprinus carpio*, *Squalius pursakensis*, *Capoeta baliki*, *Capoeta sieboldii*, *Carassius gibelio*, *Rutilus rutilus*, *Barbus tauricus*) from the Porsuk stream. *Seminemacheilus lendlii* species has been reported from the upper Porsuk basin (Çiçek, 2020; Yoğurtçuoğlu *et al.*, 2020). This study is aimed to determine the current fish fauna of the upper Porsuk basin.

MATERIALS AND METHODS

This study was conducted between May 2018 and November 2018 to reveal the freshwater fish fauna of the Upper Porsuk basin. Fish samples were collected from 3 different points (Figure 1, Table 1) and evaluated systematically. The primary aim of the research is to reveal the current fish fauna of the upper Porsuk basin. Fish sampling was done according to the biological monitoring communique (Ministry of Agriculture and Forestry (MAF), 21 June 2019, No: 30808, Article 35: 1). The fish caught were anesthetized first, then detected in 10% formaldehyde solution, brought to the laboratory and classified at the species level (Kottelat Freyhof, 2007; Geldiay and Balık, 2009; Aksu *et al.*, 2019). Valid scientific names of the species were determined using literature, Fishbase (Froese and Pauly, 2019), Catalog of fishes (Fricke *et al.*, 2020), and Freshwater fishes of Turkey (Geldiay and Balık, 2009).

Table 1. Sampling locations

Stations	Longitude	Lattitude
Murat mountain (1)	29.835	38.979
Eymir (2)	30.041	39.151
Entry to Kutahya (3)	30.066	39.380

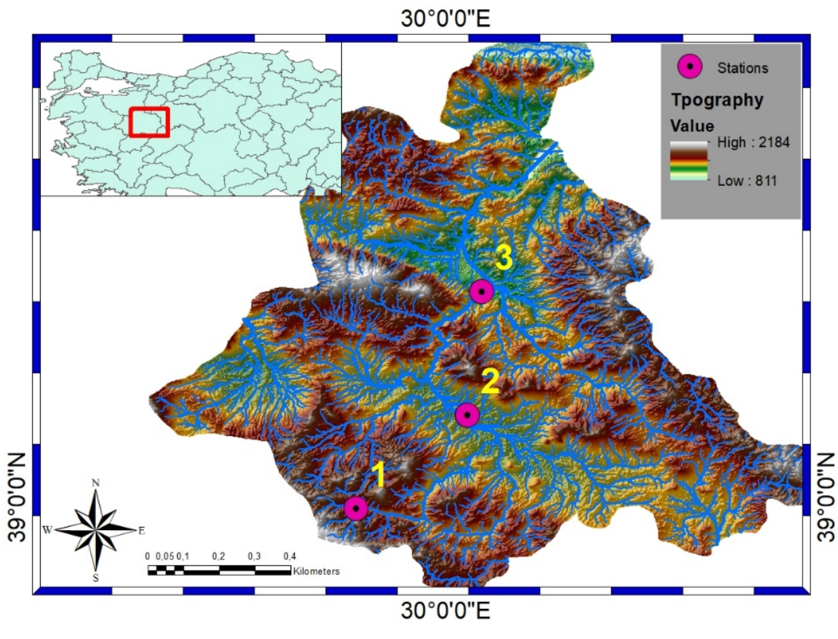

Figure 1. Sampling locations map of upper Porsuk basin.

RESULTS

In this study, which aimed to reveal the fish fauna of the upper basin of the Porsuk River, fish samples were collected at three stations in the region between May 2018 and November 2018 and evaluated taxonomically. According to our research, a total of 14 fish species was identified in the research area, 10 of which (*A. kosswigi, A. escherichii, B. escherichii, C. baliki, C. angorense, G. sakaryaensis, S. pursakensis, S. lendlii, C. simplicispina, O.angorae*) are endemic to our country, one native (*C.carpio*), and three are invasive (*C. gibelio, P. parva, O. mykiss*) species (Table 2). 10 of these species are endemic to Turkey's inland waters.

Tablo 2. Fish species of the Upper Porsuk basin

Familia	Species
Cobitidae	*Cobitis simplicispinna* Hankó, 1925
	Barbus escherichii Heckel, 1839
	Capoeta baliki Turan, Kottelat, Ekmekçi & Imamoglu, 2006
Cyprinidae	*Carassius gibelio* (Bloch, 1782)
	Cyprinus carpio Linnaeus, 1758
	Pseudorasbora parva (Temminck & Schlegel, 1846)
Gobionidae	*Gobio sakaryaensis* Turan, Ekmekçi, Luskova & Mendel, 2012
	Alburnus escherichii Steindachner, 1897
Leuciscidae	*Alburnoides kosswigi* Turan, Kaya, Bayçelebi, Bektaş & Ekmekçi, 2017
	Squalius pursakensis (Hankó, 1925)
	Chondrostoma angorense Elvira, 1987
Nemacheilidae	*Oxynoemacheilus angorae* (Steindachner, 1897)
	Seminemacheilus lendlii (Hanko, 1925)
Salmonidae	*Oncorhynchus mykiss* (Walbaum, 1792)

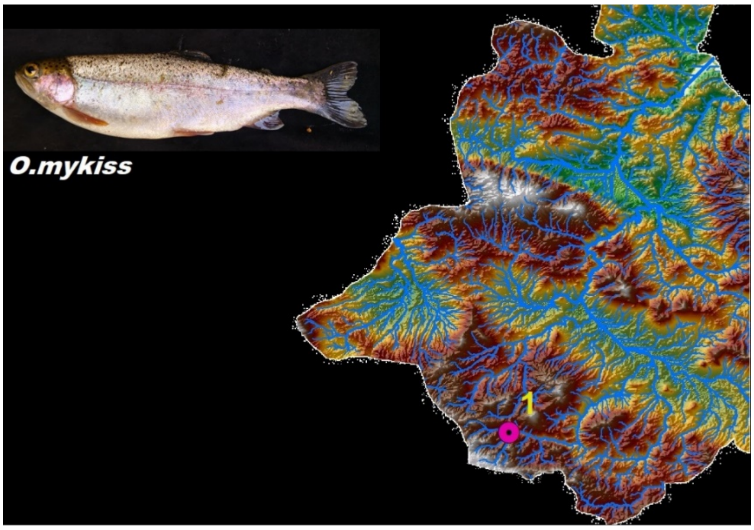

Figure 2. Species distributed in station 1

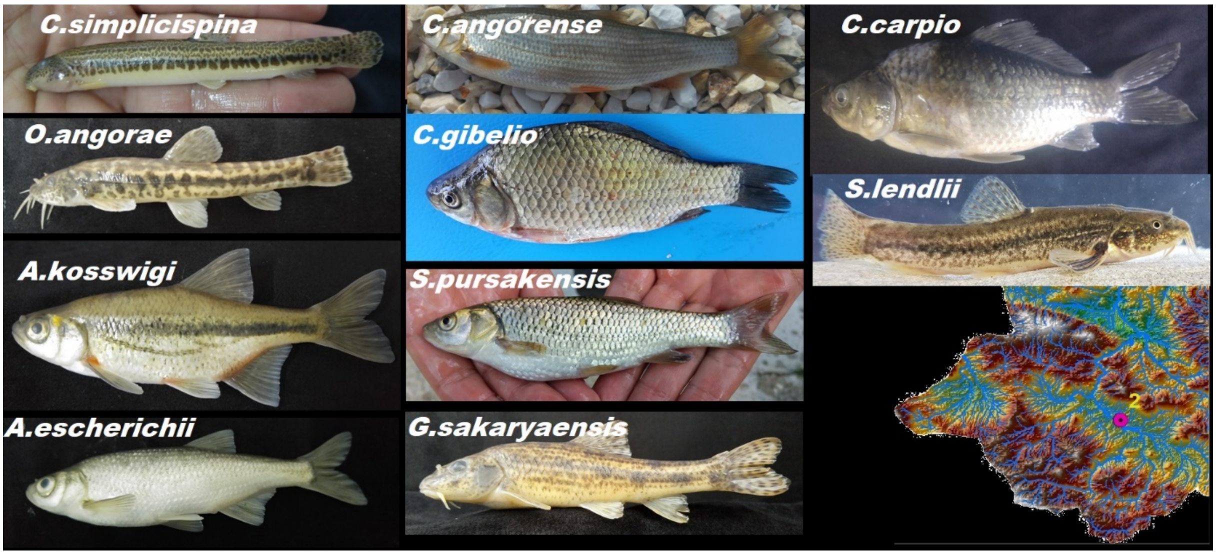

Fig 3. Species distributed in station 2

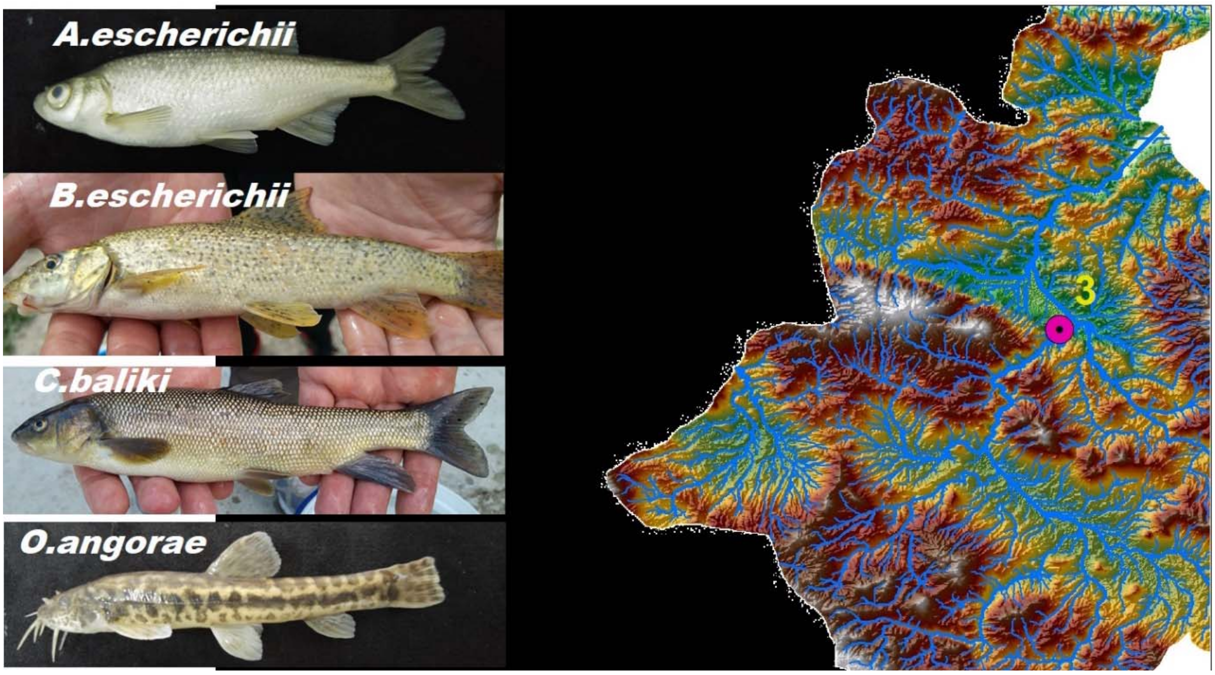

Figure 4. Species distributed in station 3

DISCUSSION

As a result of this study, the fish fauna of the upper Porsuk basin were determined. Only the main tributaries of the river were evaluated in this study area. Dams were not included in the study. Among the sampled points, station two fish diversity is the highest. Sampling station 1 is the source of the Porsuk Stream. The water connection is cut between the source point and station two during the summer months. This situation affects the biodiversity of the source point. The use of water for agricultural irrigation affects fish diversity and distribution. The Porsuk dam is located, between the upper Porsuk basin and the lower Porsuk basin. The dam completely disconnects both regions. *B.escherichii, A.escherichii, C. baliki, and O. angorae* species were detected at station 3, the Kütahya entrance of Porsuk Stream. In the summer, the water of the point approaches the drying point. The Porsuk River is under pollution pressure at the Kütahya exit point, and the dissolved oxygen level decreases to 3.30 mg / L and the oxygen saturation to 44% (Köse *et al.*, 2016). These levels are not suitable for fish life (Çiçek *et al.*, 2018).

CONCLUSIONS

According to this study results, the fish biodiversity of the upper Porsuk basin is rich. However, it is important to study fish diversity in the whole Porsuk river basin in more detail.

ACKNOWLEDGEMENTS

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Oral Presentation
Thursday
Diversity of Animal Species, Systematics, and Phylogeny-3

Faunistic Studies on *Dorcadion* Dalman, 1817 (Coleoptera: Cerambycidae) Species of Collected from the Province of Erzurum and EMET Collection*

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ABSTRACT

The faunistic studies were conducted to determine insect species belonging to the genus *Dorcadio*n Dalman, 1817 (Coleoptera: Cerambycidae) collected from some districts of Erzurum province (Aşkale, Aziziye, Çat, İspir, Horasan Oltu, Palandöken, Yakutiye) during the years of 2018-2019 and protected in EMET (Entomology Museum, Erzurum, Turkey) where the insect species were collected from different provinces of Turkey in previous studies. In the result of this study, 25 species and subspecies (*Cribridorcadion* Pic, 1901 (24) and *Maculatodorcadion* Breuning, 1966 (1)) were found. These are: *Dorcadion* (*C.*) *bisignatum* Jakovlev, 1899, *Dorcadion* (*C.*) *mesopotamicum* Breuning, 1944, *Dorcadion* (*C.*) *scabricolle balikesirense* Breuning, 1962, *Dorcadion* (*C.*) *catenatum catenatum* Waltl 1838, *Dorcadion* (*C.*) *mniszechi* Kraatz, 1873, *Dorcadion* (*C.*) *scabricolle shirakense* Lazarev, 2020, *Dorcadion* (*C.*) *catenatum loratum* Thomson, 1867, *Dorcadion* (*C.*) *nitidum* Motschulsky, 1838, *Dorcadion* (*C.*) *scabricolle korbianum* Lazarev, 2020, *Dorcadion* (*C.*) *catenatum mytilinense* Kraatz, 1873, *Dorcadion* (*C.*) *nobile ivani* Pesarini and Sabbadini, 2011, *Dorcadion* (*C.*) *sodale* Hampe, 1852, *Dorcadion* (*C.*) *coiffaiti* Breuning, 1962, *Dorcadion* (*C.*) *oezdurali* Önalp, 1988, *Dorcadion* (*C.*) *subsericatum* Pic, 1901, *Dorcadion* (*C.*) *crux* Billberg, 1817, *Dorcadion* (*C.*) *olympicum* Ganglbauer, 1882, *Dorcadion* (*C.*) *wagneri* Küster, 1846, *Dorcadion* (*C.*) *dimidiatum dimidiatum* Motschulsky, 1838, *Dorcadion* (*C.*) *piochardi* Kraatz, 1873, *Dorcadion* (*M.*) *triste* Frivaldszky, 1845, *Dorcadion* (*C.*) *haemarrhoidale* Hampe, 1852, *Dorcadion* (*C.*) *scabricolle lazistanum* Lazarev, 2020, *Dorcadion* (*C.*) *infernale infernale* Mulsant and Rey, 1863 and *Dorcadion* (*C.*) *scabricolle salhanum* Lazarev, 2020. From these species; *D.* (*C.*) *coiffaiti* is the new report for Kütahya, *D.* (*C.*) *crux* for Isparta, *D.* (*C.*) *dimidiatum dimidiatum* and *D.* (*C.*) *nitidum* for Ardahan, *D.* (*C.*) *haemarrhoidale* for Gümüşhane, *D.* (*C.*) *mesopotamicum* for Diyarbakır and Yalova, *D.* (*C.*) *oezdurali* for Erzincan, *D.* (*C.*) *olympicum* for Kars and *D.* (*C.*) *wagneri* for Diyarbakır, Muş and Yalova provinces. *D.* (*C.*) *wagneri*, *D.* (*C.*) *scabricolle lazistanum*, *D.* (*C.*) *scabricolle shirakense* and *D.* (*C.*) *nitidum* are having higher population than others species. The great majorty of determined species were collected from under stones and grass plants. In this study, the distribution of *Dorcadion* species were added new localities, too. Useful information has been provided for researchers work on this issue in the following years.

Keywords: *Dorcadion*, Cerambycidae, Coleoptera, Fauna, Turkey

*This study is part of Muhammed TATAR master thesis accepted by Atatürk Universty Graduate School of Natural and Applied Sciences.

INTRODUCTION

Cerambycidae Latreille included in Coleoptera, is a rich family constituting approximately 10% of all species in order (Jenis, 2001). It is stated that the number of species in the world is 36.300 (Wang, 2017). Because they are well known for their long and developed antennae, family name means "insects with long antennae" which comes from a Greek word (Lodos, 1998). The genus of *Dorcadion* Dalman, 1817 is located in the tribus of Dorcadionini Latreille, 1825 in Cerambycidae. All of the bodies of the Cerambycidae species, especially the elytra, are covered with very dense, slanting black, brown or gray colored feathers. These feathers form patterns and stripes in different colors, especially in the *Dorcadion* genus. Elytra mostly covers the abdomen, in *Dorcadion* individuals, it is seen as fused in suture and enlarged in the middle (Gül Zümreoğlu, 1975). The researches determine *Dorcadion* species according to narrow rows pits, bands and brown-black ground feathers on the elytra and gray-white-yellowish feathers on the pronotum (Önalp, 1990).

Turkey is a very rich country for *Dorcadion* species. In the Palearctic Region Catalog prepared by Danilevsky (2019), it is recorded that there is 666 *Dorcadion* species in the world and 293 of them is in Turkey. This species represents 43.99% of the Palearctic Region. It is also noteworthy that 258 of this species in Turkey (88.05%) is endemic.

All of *Dorcadion*'s adults cannot fly, because some of them have not a rear wing. *Dorcadion* larvae, which feed on the roots of grass plants, cause damage in most grass areas economically (Kumral *et al.*, 2012). It is recorded that species of this genus give offspring every two years (Baur *et al.*, 1997). Females lay their eggs preferably on the stems of narrow-leaved plants such as *Bromus erectus, Lolium perenne, Festuca indigesta, F. valesiaca, F. iberica, Dactylis glomerata, Poa bulbosa, Psathyrostachys juncea, Nardus stricta, Stipa* spp*., Triticum aestivum, T. durum* and *Zea* mays in late March and April or May (Fabbri and Hernandez, 1996). It is reported that the larvae hatch from these eggs at the end of May or June and feed on the root parts of grass plants. It is stated that after spending the wintering period as mature larvae, they enter the pupal period approximately 13-14 weeks later and adults appear 2-3 weeks later. It is also stated that the new generation adults are not active immediately, and after going through another wintering period, they reach the soil surface in March. It is recorded that adult individuals that emerged to the soil surface reached sexual maturity after 1 month and started to lay eggs by mating (Baur *et al.*, 2002).

Turkey, due to its unique geographical location and different climatic zones, is one of the countries with the richest biodiversity in the West Palaearctic Region. Three quarters of European and Central Asian hot zone (Caucasus, Iran-Anatolia and Mediterranean Basin points) is located partly within the borders of Turkey. Turkey, as well as being the center of many taxa, exceptionally despite having variety of topography and harsh geological and climatic changes has living space to ensure the survival of many species. Therefore, Turkey has a rich flora and fauna including many endemic species (Myers *et al.,* 2000; Çıplak, 2003, 2004; Konstantinov *et al.,* 2009; Ekiz *et al.,* 2013; Conservation International, 2015). The Cerambycidae fauna, which is an important group in this diversity, has not been fully revealed until today. This study about *Dorcadion* is aimed to contribute to the Cerambycidae fauna.

MATERIALS AND METHODS

Dorcadion adult species collected from districts of Erzurum (Aşkale, Aziziye, Çat, Horasan, İspir, Narman, Oltu, Palandöken and Yakutiye). The collected specimens were protected in Atatürk University, Agricultural Faculty Entomology Museum (EMET, Entomological Museum, Erzurum, Turkey). The adults were caught by pit food traps (for 1 liter of mixture; 900 ml of water, 100 ml of red wine, 25 ml of vinegar and 25 g of sugar) and hand. These samples collected were killed in collection bottles containing ethyl acetate in liquid form and brought to the laboratory with paper cones placed in polyethylene bags or bottles. The altitude of each locality where the species were collected is given.

Adult specimens kept in cotton envelopes were pinned with insect needles suitable for their size in the laboratory or glued individually on appropriate sized insect sticking cards. They were placed in drawers in insect protection cabinets at Atatürk University Faculty of Agriculture Plant Protection Department Entomology Museum (EMET).

The information like the scientific name, the spreading area in the world and Turkey, the host (if it has been determined), the place where collected, the number of male or female individuals etc. is also given.

RESULTS

In the result of study, total 25 species and subspecies were identified from *Cribridorcadion* Pic 1901 subspecies (24) and *Maculatodorcadion* Breuning, 1966 subspecies (1) (Table 1; Figure 1). From these species; *D.* (*C.*) *coiffaiti* is the new report for Kütahya, *D.* (*C.*) *crux* for Isparta, *D.* (*C.*) *dimidiatum dimidiatum* and *D.* (*C.*) *nitidum* for Ardahan, *D.* (*C.*) *haemarrhoidale* for Gümüşhane, *D.* (*C.*) *mesopotamicum* for Diyarbakır and Yalova, *D.* (*C.*) *oezdurali* for Erzincan, *D.* (*C.*) *olympicum* for Kars and *D.* (*C.*) *wagneri* for Diyarbakır, Muş and Yalova provinces. *D.* (*C.*) *wagneri*, *D.* (*C.*) *scabricolle lazistanum, D.* (*C.*) *scabricolle shirakense* and *D.* (*C.*) *nitidum* are having higher population than others species. The determined species are listed below.

***Dorcadion* Dalman, 1817**

Tip tür: *Cerambyx glycyrrhizae* Pallas, 1773

Altcins: C*ribridorcadion* Pic, 1901

***Dorcadion* (*Cribridorcadion*) *bisignatum* Jakovlev, 1899**

Distribution in the World: Turkey (Danilevsky, 2019).

Distribution in Turkey: Artvin (Jakovlev, 1899; Plavilstshikov, 1958; Breuning, 1962; Breuning and Villiers, 1967; Özdikmen, 2010, 2012, 2016; Bernhauer and Peks, 2013).

Material examined: Artvin: Ardanuç, Kutul, 1700 m, 12.VII.2000, 1♀. It is stated in the label information that it was collected from under stone.

***Dorcadion* (*C.*) *catenatum catenatum* Waltl, 1838**

Distribution in the World: Turkey (Danilevsky, 2019).

Distribution in Turkey: Antalya, **Aydın** (Kuşadası, Nazilli), **Balıkesir, Burdur, Bursa, Denizli**, **Eskişehir, Isparta, İzmir** (Bornova, Çiğli, Foça, Karaburun-Mordoğan, Karşıyaka-Yamanlar, Kemalpaşa, Menderes, Menemen, Ödemiş-Bademli, Seferihisar, Selçuk, Urla-Zeytinler), **Kahramanmaraş** (Ahır Mountain), **Konya, Kütahya, Manisa** (Şehzadeler), **Mersin** (Mut), **Muğla** (Bodrum-Aspat) (Küster, 1846; Kraatz, 1873; Ganglbauer, 1884; Pic, 1899, 1917; Breuning, 1946; 1962, 1966; Demelt, 1963; Sama, 1982; Önalp, 1991; Özdikmen, 2010, 2012, 2016; Şenyüz and Özdikmen, 2013; Tezcan *et al.,* 2020; Özdikmen and Tezcan, 2020).

Material examined: Izmir: Bornova-Ege University Campus, 30 m, 15.V.1991, 1♀.

***Dorcadion* (*C.*) *catenatum loratum* Thomson, 1867**

Distribution in the World: Turkey (Danilevsky, 2019).

Distribution in Turkey: Balıkesir (Edremit-Akçay, Elbis, Havran), **Çanakkale**, **Eskişehir**, **İzmir** (Balçova, Bornova, Buca, Çiğli, Karşıyaka-Yamanlar, Menemen, Ödemiş, Selçuk, Urla), **Manisa** (Sarıgöl) (Thomson 1867; Braun 1978; Özdikmen 2010, 2012, 2016; Özdikmen and Tezcan, 2020b).

Material examined: Izmir: Bornova-Ege University Campus, 30 m, 15.V.1991, 1♀.

***Dorcadion* (*C.*) *catenatum mytilinense* Kraatz, 1873**

Distribution in the World: Turkey and Greece (Danilevsky, 2019).

Distribution in Turkey: Aydın (Kuşadası), **Balıkesir**, **İzmir** (Bornova, Menemen, Seferihisar) (Kraatz, 1873; Özdikmen, 2010; Özdikmen, 2016; Varlı *et al.,* Özdikmen and Tezcan, 2020b).

Material examined: Izmir: Yamanlar, 497 m, 30.III.1995, 1♀. It is stated in the label information that it was collected from over grass plants.

***Dorcadion* (*C.*) *coiffaiti* Breuning, 1962**

Distribution in the World: Turkey (Danilevsky, 2019).

Distribution in Turkey: Balıkesir (Atköy, Manyas, Centrum, Demirci) (Breuning, 1962; Pesarini and Sabbadini, 2009; Özdikmen, 2010; 2012; Özdikmen and Tezcan, 2020b).

Material examined: Kütahya: Yemişli env. (20 km N of Simav), 790 m, 23.IV.1997, 1♂, 1♀.

***Dorcadion* (*C.*) *crux* Billberg, 1817**

Distribution in the World: Turkey (Danilevsky, 2019).

Distribution in Turkey: Balıkesir, **Bilecik** (Söğüt), **Bursa**, **Eskişehir**, **İstanbul (Alem Mountain), İzmir** (Bergema, Ödemiş-Bozdağ), **Konya** (Akşehir), **Kütahya**, **Osmaniye** (Bahçe), **Uşak** (Ganglbauer, 1884; Bodemeyer, 1900; 1906; Pic, 1900; Breuning, 1946; 1962; Demelt, 1963; Tuatay *et al.,* 1972; Braun, 1978; Adlbauer, 1988; Önalp, 1991; Özdikmen *et al.,* 2005; Özdikmen, 2010; 2012, 2016).

Material examined: Isparta: Davraz, 1200 m, 01.IV.2000, 1♀. It was collected from under stone.

***Dorcadion* (*C.*) *dimidiatum dimidiatum* Motschulsky, 1838**

Distribution in the World: Argentina, Armenia, India, the Caucasus, Iran and Turkey (Danilevsky, 2019).

Distribution in Turkey: Ağrı, Erzincan, Erzurum, Malatya, (Thomson, 1867; Plavilstshikov, 1958; Villiers, 1967; Gfeller, 1972; Braun, 1978; Özbek, 1978; Önalp, 1991; Özdikmen and Hasbenli, 2004b; Özdikmen, 2010, 2016).

Material examined: Ardahan: Centrum, 1870 m, 8.V.1974, 1♀; **Erzurum**: 9-15 Km S of Çat, 1800 m, 12.IV.2002, 2♂; **Erzurum:** 9-15 Km S of Çat, 1814 m, 12.IV.2002, 2♂; **Erzurum:** Çobandede Mountain, 26.V.2014, 1♂; **Erzurum:** Konaklı, 2150 m, 02.VII.2004, 1♂, 2♀; **Erzurum:** Palandöken Mountain, Tuzcu, 2200 m, 15.V.2005, 2♀; **Erzurum:** Palandöken Mountain, Tuzcu, 1900 m, 21.VI.2004, 1♀. In the label information of the samples, it is stated that they were collected from under stones and on grass plants.

***Dorcadion* (*C.*) *haemarrhoidale* Hampe, 1852**

Distribution in the World: Argentina, Armenia, India, the Caucasus, Iran and Turkey (Danilevsky, 2019).

Distribution in Turkey: Ağrı (Taşlıçay, N of Bayazıt), **Ankara**, **Erzurum** (Aşkale) (Plavilstshikov, 1958; Gfeller, 1972; Braun, 1978; Önalp, 1990; Özdikmen, 2010, 2016).

Material examined: Gümüşhane: Centrum; 02.IV.2002, 1♀; **Erzurum:** Şenkaya, Esenyurt, 19.VI.1997, 1♂; **Erzurum:** İspir, Madenköprübaşı, 6.VI.1980, 1♀; **Erzurum**: Pazaryolu, Kartal Plateau, 3000m, 5.VII.2000, 2♂.

***Dorcadion* (*C.*) *infernale infernale* Mulsant and Rey, 1863**

Distribution in the World: Turkey (Danilevsky, 2019).

Distribution in Turkey: Amasya, **Ankara**, **Antalya**, **Bilecik**, **Burdur**, **Çorum**, **Eskişehir**, **İçel**, **İzmir**, **Konya**, **Kütahya**, **Niğde** (Ulakışla), **Sivas**, **Uşak, Yozgat** (Akdağmadeni) (Ganglbauer, 1884; Aurivillius, 1921; Bodemeyer, 1900, 1906; Daniel, 1900; Pic. 1903; Daniel and Daniel, 1903; Heyrovský, 1932; Breuning, 1946, 1962; Demelt, 1963; Braun, 1978; Önalp, 1990; Adlbauer, 1992; Özdikmen and Hasbenli, 2004a; Özdikmen, 2006, 2016; Özdikmen *et al.* 2009; Sama *et al.,* 2012; Şenyüz and Özdikmen, 2013; Özdikmen and Tezcan, 2020a).

Material examined: Eskişehir: İnönü, 840 m, 27.IV.1996, 1♂, 1♀.

***Dorcadion* (*C.*) *mesopotamicum* Breuning, 1944**

Distribution in the World: Iraq and Turkey (Danilevsky, 2019).

Distribution in Turkey: Mardin, **Şanlıurfa** (Siverek) (Breuning, 1962; Braun, 1978; Özdikmen, 2010, 2016).

Material examined: Diyarbakır: Silvan, 837 m, 17.IV.1995, 6♂, 2♀; **Yalova**: Horticultural Research Institute, 2m, 27.IV.2003, 1♂, 2♀.

***Dorcadion* (*C.*) *mniszechi* Kraatz, 1873**

Distribution in the World: Argentina, the Caucasus (Armenia), Turkey and Iran (Danilevsky, 2019).

Distribution in Turkey: Ağrı (Ağrı Dağı), **Erzurum**, **Isparta**, **İzmir** (Ödemiş-Bozdağ), **Kars** (Kağızman), **Sivas** (Karayün Village), **Kars** (Kağızman), **Ağrı** (Ağrı Mountain), **Erzurum**. (Plavilstshiko, 1958; Danilevsky and Miroshnikov, 1985; Lodos, 1998; Özdikmen and Hasbenli, 2004a; Özdikmen, 2007, 2010, 2016; Lazarev, 2014).

Material examined: Kars: Sarıkamış Karakurt Şeytangeçmez, 2100 m, 2.VI.1999, 1♀. It was collected from under stone.

***Dorcadion* (*C.*) *nitidum* Motschulsky, 1838**

Distribution in the World: Argentina, Guernsey, the Caucasus (Armenia, Azerbaijan) and Turkey (Danilevsky, 2019).

Distribution in Turkey: Artvin (Şavşat- Çengel Plateau, Yalnızçam), **Erzurum** (Centrum and near), **Yozgat** (Yozgat National Park) (Plavilstshikov, 1958; Breuning, 1962; Özbek, 1978; Danilevsky and Miroshnikov, 1985; Adlbauer, 1988; Önalp, 1990; Lodos, 1998; Özdikmen and Hasbenli, 2004a; Özdikmen, 2010, 2016).

Material examined: Ardahan: Centrum, 1870 m, 30.V.1973, 1♂; 7.V.1974, 16♂, 13♀; **Erzurum**: Horasan, 1600 m, 11.V.1973, 1♂.

***Dorcadion* (*C.*) *nobile ivani* Pesarini and Sabbadini, 2011**

Distribution in the World: Turkey (Lazarev, 2019).

Distribution in Turkey: Bingöl, **Muş** (Kardeşler) (Pesarini and Sabbadini, 2011; Özdikmen, 2012; Rapuzzi and Sama, 2012; Özdikmen, 2016.

Material examined: 12 km West, 1330 m, 38° 55' 56"N - 40° 22' 13"E, 06.V.2003, 1♂. It was collected over the grass plant.

***Dorcadion* (*C.*) *oezdurali* Önalp, 1988**

Distribution in the World: Turkey (Danilevsky, 2019).

Distribution in Turkey: Adıyaman (Nemrut Mountain), **Kahramanmaraş** (Ahır Mountain, Göksun-Mehmetbey) (Önalp, 1988; 1991; Rejzek and Hoskovec, 1999; Pesarini and Sabbadini, 1998; 2013; Özdikmen and Okutaner, 2006; Özdikmen, 2010; 2012, 2016; Sama *et al.*, 2012; Özdikmen and Koçak, 2013).

Material examined: Erzincan: Kemaliye-Sandık Village, 950 m, 21.VII.1984, 1♀.

***Dorcadion* (*C.*) *olympicum* Ganglbauer, 1882**

Distribution in the World: Turkey (Danilevsky, 2019).

Distribution in Turkey: Anatolia (no locality) (Winkler, 1924, 1932), **Turkey** (no locality) (Lodos, 1998), **Ankara**, **Bilecik**, **Bursa** (Uludağ, Uluabat Lake), **İstanbul** (Belgrad Forest, Alem Mountain), **Kütahya** (Akdağ) (Ganglbauer, 1884; Bodemeyer, 1906; Aurivillius, 1921; Breuning, 1962; Demelt, 1963;

Breuning and Villiers, 1967; Braun, 1978; Adlbauer, 1988; Krätschmer, 1987; Önalp, 1990; Özdikmen, 2010; 2012, 2016; Özdikmen and Tezcan, 2020a).

Material examined: Bursa: Hürriyet, 5.VII.1991, 1♂; **Bursa**: Uludağ, 7.VII.1991, 1♂, 1♀; **Kars**: Sarıkamış, Karakurt-Şeytangeçmez, 1450 m, 02.V.2000, 1♂; 04.VI.2000, 1♂. It was collected from grass and herbaceous plants around the roots and under the stones.

***Dorcadion* (*C.*) *piochardi* Kraatz, 1873**

Distribution in the World: Turkey (Danilevsky, 2019).

Distribution in Turkey: Amasya (Akdağ, Borabay Lake-Taşova, Merzifon), **Çanakkale**, **Çorum** (Alaca, Centrum, Mecitözü, Yazılıkaya), **Samsun** (Canik-Çayırkent, Havza, Centrum, Ladik-Aslantaş-Karadağ-Akdağ, Vezirköprü), **Sinop** (Boyabat (Bektaş), **Yozgat** (Centrum) (Kraatz, 1873; Ganglbauer, 1884; Jakovlev, 1901; Aurivillius, 1921; Winkler, 1924, 1932; Lodos, 1998; Breuning, 1962; Breuning and Villiers, 1967; Braun, 1978; 1979; Önalp, 1991; Adlbauer, 1992; Özdikmen, 2007, 2010, 2012, 2016; Lazarev, 2011).

Material examined: Amasya: Centrum; 1150 m, 10.IX.1993, 1♀.

***Dorcadion* (*C.*) *scabricolle lazistanum* Lazarev, 2020**

Distribution in the World: Turkey (Lazarev, 2020).

Distribution in Turkey: Gümüşhane, **Erzurum** (Trabzon-Rize between, south foothill of Rize-Gümüşhane Range (Gümüşhane and İspir env.)) (Lazarev, 2020).

Material examined: Gümüşhane: Centrum, 1153 m, 2.IV.2002, 1♂, 1♀; **Erzurum:** Aşkale, 1850 m, 11.IV.2002, 1♂; **Erzurum:** Aşkale; 1600 m, 27.IV.2002, 1♂, 3♀; **Erzurum:** Hamam Stream, 1700 m, 20.IV.2003, 1♀; **Erzurum:** Horasan, 11.V.1973, 3♂; **Erzurum:** Horasan, Aras Valley, Şeytangeçmez, 1425 m, 20.IV.2005, 3♂, 4♀; **Horasan**, Bulgurlu Village, 1870 m, 28.V.2019, 3♂, 2♀; **Erzurum:** Ilıca; 1850 m, 11.IV.2003, 3♀; **Erzurum:** Ilıca, Gülpınar Village, 1825 m, 29.V.2019, 5♂, 2♀; **Erzurum:** Narman Kireçli Pass, 2415 m, 25.V.2019, 1♀; **Erzurum:** Oltu, Çamlıbel, 1750 m, 17.V.2003, 1♀; **Erzurum:** Oltu, Karakaban, 27.V.1995, 1♀; **Erzurum**: Palandöken Mountain, Tuzcu, 2200 m, 15.V.2005, 1♀; **Erzurum:** Tekederesi, 2100 m, 16.VI.2014, 1♂; **Erzurum:** Tortum, Aksu, 1800 m, 18.IV.2004, 1♂. It is reported that the samples collected were obtained from around grass roots and under stones.

***Dorcadion* (*C.*) *scabricolle salhanum* Lazarev, 2020**

Distribution in the World: Turkey (Lazarev, 2020).

Distribution in Turkey: Bingöl (6 km south-eastwards Salhan, Buglan Pass); **Bitlis** (Tatvan Environs, 4 km West Tatwan, Orenlik, West Tatvan, Kolbaşı); **Kahramanmaraş** (Göksun, Mağaraözü, Afşin, Emirilyas Village); **Malatya** (Yukari Ulupinar, 30 km SE Darende); **Tunceli** (Pulumur Env.); **Van** (Kuskum Kiran Pass) (Lazarev, 2020).

Material examined: Bingöl: Hamamlar, 1400 m, 5.VI.2003, 1♂, 1♀.

***Dorcadion* (*C.*) *scabricolle balikesirense* Breuning, 1962**

Distribution in the World: Armenia ad Turkey (Danilevsky, 2019; Lazarev, 2020).

Distribution in Turkey: Balikesir (Centrum and Environs, Yenikoi Environs, Kepsut Environs; Selimaga Environs), **Bursa** (Northwest Harmancik), **Kütahya** (Tavşanli Environs) (Breuning, 1962; Braun, 1978; Özdikmen, 2010, 2012, 2016; Lazarev, 2020).

Material examined: Bursa: Uludağ University Campus; 100 m, 8.III.2002, 2♂, 4♀. It was collected over grass plants.

***Dorcadion* (*C.*) *scabricolle shirakense* Lazarev, 2020**

Distribution in the World: Armenia and Turkey (Lazarev, 2020).

Distribution in Turkey: Ağrı, **Ardahan**, **Artvin**, **Erzurum** (Çat), **Kars** (Karakurt, Kağızman); **Van** (Lazarev, 2020).

İncelenen materyal: Ardahan: Centrum, 1870 m, 7.V.1974, 1♀; 8.V.1974, 3♂; **Erzurum:** Çat, 1814 m, 12.IV.2002, 1♂, 3♀; **Erzurum:** Çat 9-15 km South, 1800 m, 12.IV.2002, 6♂, 8♀; **Kars:** Kağızman, 1.V.1969, 1♂; **Kars**: Kağızman Aydınkavak; 1150 m, 3.VI.2004, 5♂; **Kars:** Kağızman, 1020 m, 4.V.2003, 1♂; **Kars:** Kağızman, 1425 m, 6.V.2019, 1♂, 2♀; **Kars:** Sarıkamış, Karakurt, 1450 m, 16.V.1978, 2♂, 1♀; **Kars:** Sarıkamış, Karakurt, 02.V.2000, 2♂, 5♀; 02.V.2000, 2♂, 1♀; **Kars:** Sarıkamış, Karakurt, Şeytangeçmez; 04.VI.2000, 1♂; **Kars:** Sarıkamış, Karakurt; 1501 m, 17.IV.2002, 3♂, 1♀; **Kars:** Sarıkamış 14 km E of Karakurt, 1400 m, 4.V.2003, 2♂. In the label information, it is stated that the samples were obtained from the grass roots and under the stones.

***Dorcadion* (*C.*) *scabricolle korbianum* Lazarev, 2020**

Distribution in the World: Turkey (Lazarev, 2020).

Distribution in Turkey: Afyonkarahisar (Sultan Mountain), **Isparta** (Barla Environs, Sultan Environs, S Akşehir-Cankurtaran), **Konya** (Akşehir Environs) (Lazarev, 2020).

Material examined: Konya: Southern border, Örenboyalı, 1020 m, 27.II.2002, 6♂, 5♀. It is stated that it is collected over grass plants.

***Dorcadion* (*C.*) *sodale* Hampe, 1852**

Distribution in the World: Turkey (Danilevsky, 2019).

Distribution in Turkey: Turkey (Kolat Mountain) (Breuning, 1962), **Bayburt**, **Erzurum** (Aşkale, Centrum, İspir-Ovacık), **Giresun**, **Trabzon** (Soğanlı Pass, Zigana Mountain) (Plavilstshikov, 1958; Villiers, 1959; Breuning, 1962; Breuning, 1966; Breuning and Villiers, 1967; Demelt, 1967; Gfeller, 1972; Braun, 1978; Adlbauer, 1988; Önalp, 1990; Lodos, 1998; Özdikmen, 2010; 2012, 2016).

Material examined: Erzurum: Palandöken, 2200 m, 29.VI.1980, 1♂, 1♀; **Erzurum:** Tortum, 13.VII.1974, 1♂; **Erzurum:** Yeşilyayla-Radar Road, 2300-2700 m, 30.VI:2001, 3♂; **Trabzon:** Kadırga Plateau, 13.VIII.1993, 1♂. It is stated that some samples were collected from grass plants.

***Dorcadion* (*C.*) *subsericatum* Pic, 1901**

Distribution in the World: Turkey (Danilevsky, 2019).

Distribution in Turkey: Ankara (Bayındır Dam, Ayaş Road-Başayaş Village, Çubuk), **Çankırı**, **Konya** (Kulu-Beşkardeş-Zincirlikuyu Village between), **Karabük** (Safranbolu), **Kastamonu** (Devrekani, Ilgaz Mountain, Tosya-Bürnük Village, Yaralıgöz Mountain, Yılancı Village, 5 km. to Çankır province) (Breuning, 1962; Demelt, 1967; Braun, 1978; Sama, 1982; Adlbauer, 1992; Özdikmen and Hasbenli, 2004a; Özdikmen, 2006, 2010, 2012, 2016; Al-Hamadani and Özdikmen, 2014; Özdikmen and Tezcan, 2020a).

Material examined: Kastamonu: Devrekani, 1100 m, 6.IV.1977, 1♂, 1 ♀.

***Dorcadion* (*C.*) *wagneri* Küster, 1846**

Distribution in the World: Caucasus, Turkey and Iran (Danilevsky, 2019).

Distribution in Turkey: Turkey (no locality) (Lodos, 1998), **Ağrı** (East Beyazıt, Ağrı Mountain), **Erzurum** (Hasankale), **Kars** (Kuster, 1848; Ganglbauer, 1884; Plavilstshikov, 1958; Danilevsky and Miroshnikov, 1985; Önalp, 1990; Özdikmen, 2010, 2012, 2016).

Material examined: Diyarbakır: Silvan, 837 m, 17.IV.1995, 1♂; **Erzurum**: Aşkale, 1600 m, 27.IV.2002, 1♂, 2♀; **Erzurum**: Atatürk University Campus, 1850 m, 21.VI.1994; 14.VI.1996, 1♀; 16.IV.2000, 1♂, 1♀; 18.IV.2000, 4♂, 4♀; 11.V.2000, 1♂; 16.VI.2000, 1♀; 28.IV.2001, 2♂, 1♀; 13.IV.2004, 1♂, 1♀; 17.V.2004, 4♀; 21.V.2004, 3♂, 2♀; 07.VI.2004, 2♀; 29.V.2017, 1♂ (Trap); 30.IV.2019, 1♂ (Trap); 3.V.2019, 1♂ (Trap); 1850 m, 17.V.2019, 1♂; 21.V.2019, 6♂ (Trap); **Erzurum**: Çat, Highways, 1500 m, 18.IV.2002, 1♂, 2♀; **Erzurum:** Eastern Anatolia Agricultural Research Institute, 1850 m, 19.IV.2002, 1♂, 6♀; 20.IV.2002, 1♀; **Erzurum:** Dutçu Village, 1850 m, 04.V.2003, 2♂, 3♀; **Erzurum:** Horasan, Aras Valley, Şeytangeçmez, 1425 m, 20.IV.2005, 1♂, 2♀; **Erzurum:** Ilıca, 1825 m, 11.V.2003, 7♂, 2♀; 29.V.2019, 1♀; **Erzurum:** Palandöken Mountain, Tuzcu; 2150 m, 23.IV.2005, 1♀; 15.V.2005, 1♂, 6♀; **Erzurum:** Tortum, Aksu, 1800 m, 18.IV.2004, 1♀; **Erzurum:** Tortum, 5.V.1974, 1♂; **Erzurum:** Uzundere, Yedigöller, 21.V.1998, 1♂, 1♀; **Erzurum:** Centrum, 1850 m, 5.V.1979, 3♀; 5.VI.1980, 1♂; 16.V.1980, 2♂; 18.V.1980, 2♂, 2♀; 1.VI.1983, 1♀; 9.VI.1983, 2♀; 10.IV.1996, 1♂, 2♀; 11.IV.1996, 2♂, 1♀; 12.IV.1996, 3♀; 13.IV.1996, 2♂, 2♀; 14.IV.1996, 1♀; 15.IV.1996, 1♂; 18.IV.1996, 1♂; 01.V.1996, 1♂, 1♀; 02.V.1996, 1♂; 03.V.1996, 2♂, 1♀; 04.V.1996, 1♀; 06.V.1996, 6♀; 07.V.1996, 1♂, 1♀; 10.V.1996, 4♀; 13.V.1996, 2♀; 14.V.1996, 1♂; 16.V.1996, 1♀; 17.V.1996, 4♀; 17.VI.1996, 1♀; **Erzurum:** 4th Well, 1850 m, 22.IV.2002, 4♂, 3♀; **Kars:** Digor Yeniköy, 1695 m, 04.VI.2004, 1♀; **Kars:** Sarıkamış, Karakurt, 16.V.1978, 8♂, 4♀; 02.V.2000, 6♂, 7♀; 17.IV.2002, 2♂, 2♀; **Muş:** Centrum, 1404 m, 16.VII.1996, 1♂; 24.VII.1996, 1♂; 11.VIII.1996, 1♂; **Yalova:** Horticultural Research Institute, 2 m, 27.IV.2003, 2♀. Some specimens were caught under the stone, some over grass plants and soil, and some with pit fattening traps. It is stated in the label information of some samples that they were collected from under stones.

Altcins: *Maculatodorcadion* Breuning, 1943

Tip tür: *Dorcadion quadrimaculatum* Küster, 1848

***Dorcadion* (*Maculatodorcadion*) *triste* Frivaldszky, 1845**

Distribution in the World: Turkey (Danilevsky, 2019).

Distribution in Turkey: Anatolia (no locality) (Winkler, 1924, 1932), **Turkey** (no locality) (Lodos, 1998), **Antalya** (Ova SE Korkuteli, Bakacak beli N Saklıkent), **Balıkesir** (Balya, Susurluk), **Bursa** (Karacabey, Mustafa Kemal Paşa), **İzmir** (Bornova, Buca, Dikili-Makaron, Kınık), **Manisa** (Turgutlu) (Ganglbauer, 1884; Aurivillius, 1921; Breuning, 1962; Demelt, 1963; Gül-Zümreoğlu, 1972; Braun, 1978; Kratschmer, 1985; Önalp, 1990; Peks, 1993; Özdikmen; 2010, 2012, 2016; Özdikmen and Kaya, 2015; Özdikmen and Tezcan, 2020a).

Material examined: Izmir: Selçuk, 20 m, 17.V.1985, 1♀.

DISCUSSION

In the catalogue called **"Catalogue of Palaearctic Cerambycoidea"** prepared by Danilevsky (2019), it has been recorded that there are 6 genus in the Dorcadionini tribe, namely *Dorcadion* Dalman, *Eodorcadion* Breuning, *Iberodorcadion* Breuning, *Neodorcadion* Ganglbauer, *Politodorcadion* Danilevsky, and *Trichodorcadion* Breuning; and that there are 6 subgenus of the *Dorcadion* species, namely *Acutodorcadion* Danilevsky, Kasatkin and Rubenyan, *Carinatodorcadion* Breuning, *Cribridorcadion* Pic, *Dorcadion* Dalman, *Maculatodorcadion* Breuning and *Megalodorcadion* Pesarini and Sabbadini (Figure 2).

When the catalogue prepared by Löbl and Smetana (2010) is examined, it can be seen that the Dorcadionini family in the Palaearctic Region has 664 species (five genus, 12 subgenus), and that it has 200 species in Turkey. Özdikmen (2010) reported that Turkey has 192 species of the Dorcadionini family (*Dorcadion* genus 186), and that 134 of these is in an endemic state. Later, the same researcher reported the Dorcadionini family's species number to be 278 in Turkey, and the *Dorcadion* genus' number to be 266 (Özdikmen 2016). Danilevsky (2019), stated that there are 666 species belonging to the *Dorcadion* genus in the Palearctic Region (North Africa, Europe to China). This species represents 43.99% of the Palearctic Region. It is also noteworthy that 258 of this species in Turkey (88.05%) is endemic.

In the Danilevsky (2019) catalogue, the ratio of *Dorcadion*'s subgenus in the Palaearctic Region and the number of species is: *Acutodorcadion* Danilevsky, Kasatkin and Rubenyan 9%; *Carinatodorcadion* Breuning 3%; *Cribridorcadion* Pic 81%; *Dorcadion* Dalman 5%; *Maculatodorcadion* Breuning 1%, and *Megalodorcadion* Pesarini and Sabbadini 1%. The highest dispersion rate of 81% belongs to the *Cribridorcadion* Pic subgenus (Figure 3).

In the Danilevsky (2019) catalogue, the ratio in Turkey of *Dorcadion*'s subgenus and number of species is: *Acutodorcadion* Danilevsky, Kasatkin and Rubenyan 2005, no spread; *Carinatodorcadion* Breuning 1943, 1%; *Cribridorcadion* Pic 1901, 95%; *Dorcadion* Dalman 1817, no spread; *Maculatodorcadion* Breuning 1943, 2% and *Megalodorcadion* Pesarini and Sabbadini 1999, 2%. The highest dispersion rate of 95% belongs to the *Cribridorcadion* Pic 1901 subgenus (Figure 4).

In the Danilevsky (2019) catalogue, the ratio in Turkey of *Dorcadion*'s endemic species number and species at the subgenus level are: *Acutodorcadion* Danilevsky, Kasatkin and Rubenyan no spread; *Carinatodorcadion* Breuning 0%; *Cribridorcadion* Pic 96%; *Dorcadion* Dalman no spread; *Maculatodorcadion*

Breuning 2%, and *Megalodorcadion* Pesarini and Sabbadini 2%. The highest dispersion rate of 96% belongs to the *Cribridorcadion* subgenus (Figure 5).

CONCLUSIONS

In the study, a total of 25 species (14 species and 11 subspecies) were identified to belong to the subgenus of *Cribridorcadion* (24) and *Maculatodorcadion* (1) of the *Dorcadion* Dalman, 1817 genus (Table 1; Figure 1). The high endemic rate of the genus reveals the richness of our country's fauna and indicates that there will be new species belonging to this genus. *Dorcadion* species may be important problem for grasses area in golf courses, football fields and parks in Turkey which is a country of tourism in future. Therefore, it is necessary to reveal the biological and ecological characteristics of these species.

Although there are many studies on the *Dorcadion* genus, the fact that there are differences of opinion among researchers working on this subject. The reasons for this are difficulties in identifying species belonging to this genus, existence of many synonyms and subspecies of species (more than one from the same region), different statuses given to a species by different researchers. *Dorcadion (C.) scabricolle* species is an example for this situation: Danilevsky (2019) listed 18 subspecies belonging to the *Dorcadion* (*C.*) *scabricolle* species and reported that eight subspecies of this species is found in Turkey and seven of them are endemic. On the other hand, Lazarev (2020), in the study he conducted on *D.* (*C.*) *scabricolle*, listed 39 subspecies, and noted that 16 subspecies showed spread in Turkey. These species are *Dorcadion* (*C.*) *scabricolle lazistanum* ssp. n.; *Dorcadion* (*C.*) *scabricolle salhanum* ssp. n.; *Dorcadion (C.) scabricolle antonkozlovi* Danilevsky, 2017; *Dorcadion* (*C.*) *scabricolle caramanicum* K. Daniel and J. Daniel, 1903; *Dorcadion* (*C.*) *scabricolle yahyaliense* Bernhauer and Peks, 2011; *Dorcadion (Cribridorcadion) scabricolle apakoyense* ssp. n.; *Dorcadion* (*C.*) *scabricolle hajdajorum* ssp. n.; *Dorcadion* (*C.*) *scabricolle korbianum* ssp. n.; *Dorcadion* (*C.*) *scabricolle crassofasciatum* Özdikmen, 2013; *Dorcadion* (*C.*) *scabricolle balikesirense* Breuning, 1962; *Dorcadion* (*C.) scabricolle uludaghicum* Breuning, 1970; *Dorcadion* (*C.*) *scabricolle inonuense* ssp. n.; *Dorcadion* (*C.*) *scabricolle gazii* ssp. n.; *Dorcadion* (*C.*) *scabricolle alucranum* ssp. n.; *Dorcadion* (*C.*) *scabricolle paphlagonicum* Breuning, 1962 and *Dorcadion* (*C.*) *scabricolle shirakense* ssp. n.

It is of great importance for those who will specialize on this genus to examine the collections in prominent museums around the world. This situation, which seems very difficult, can be resolved with the support that researchers give to each other. Increase in these kinds of faunistic studies will certainly contribute to the exposure of the very rich fauna of Turkey and the world.

ACKNOWLEDGEMENTS

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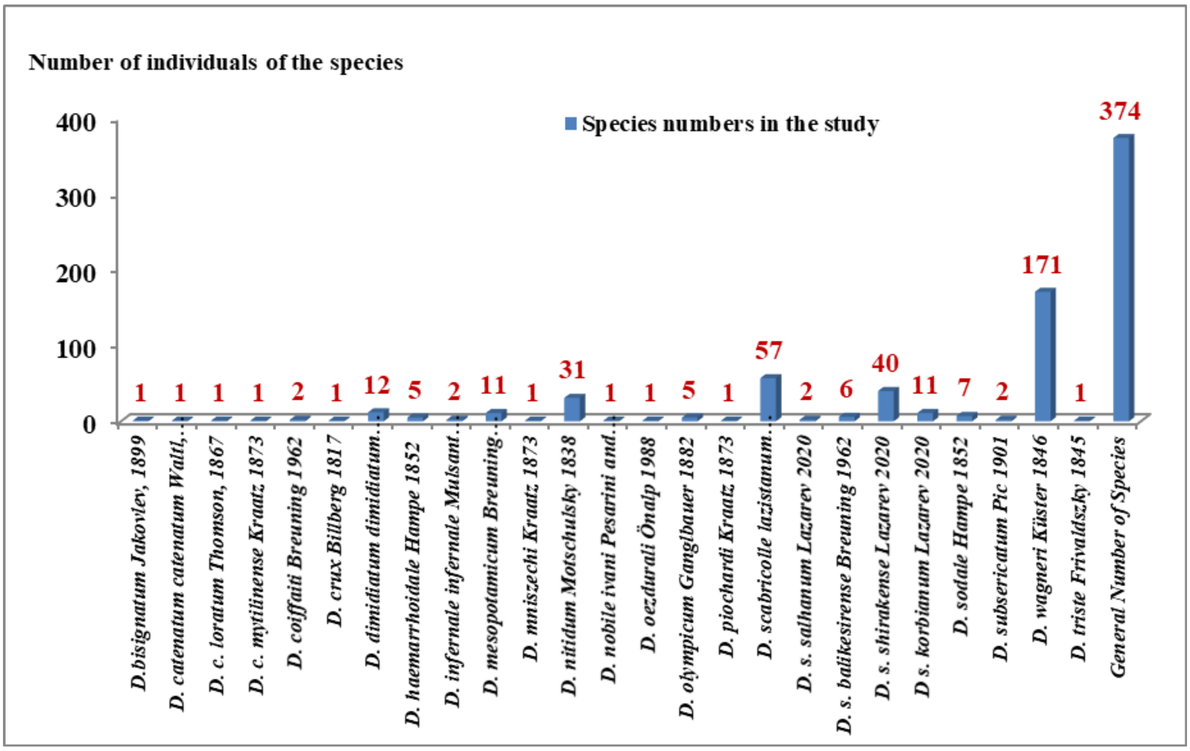


Figure 1. Individual numbers of the species obtained in the study

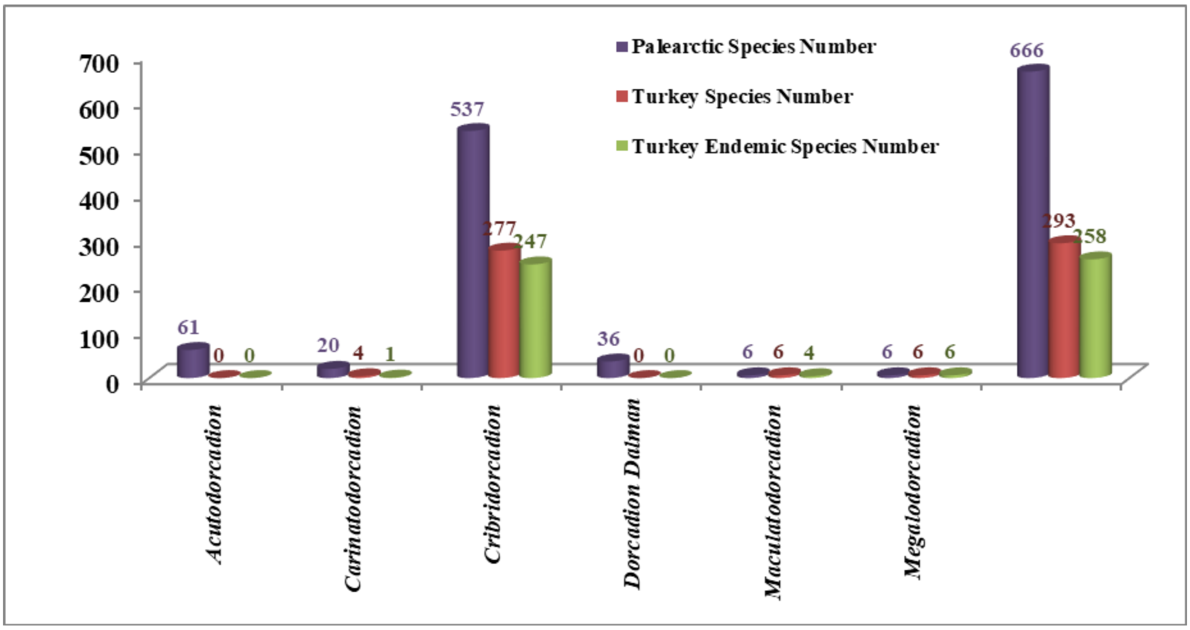
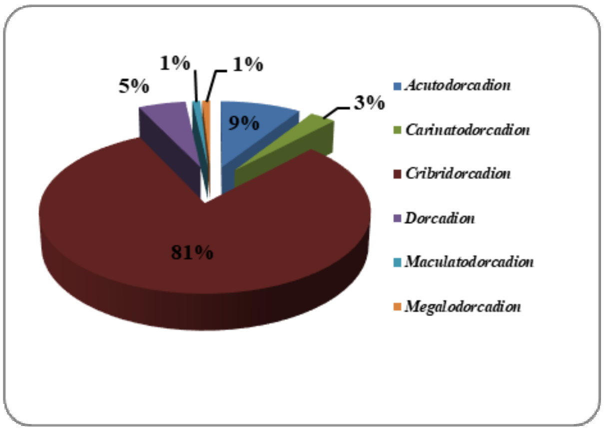


Figure 2. *Dorcadion* species (in Turkey and World) and endemic *Dorcadion* species (in Turkey)



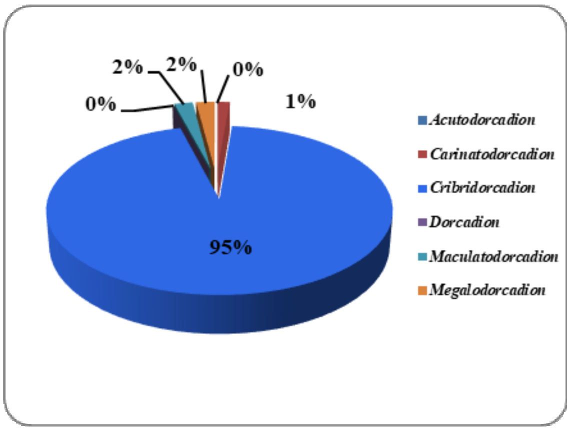


Figure 3. Number of subgenus species of *Dorcadion* in Palaearctic Region

Figure 4. Number of subgenus species of *Dorcadion* in Turkey

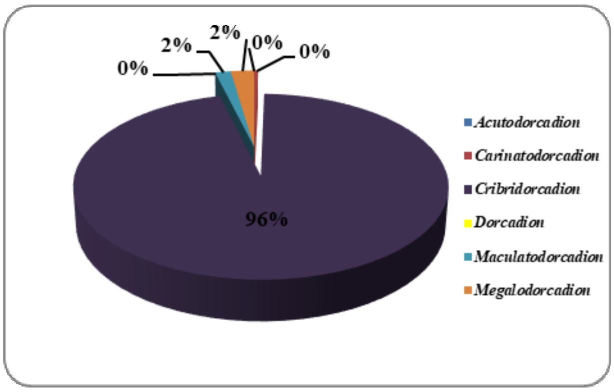


Figure 5. Number of endemic subgenus species of *Dorcadion* in Turkey

The provinces where the species were found are given with the star mark (asterisk) in Figure 6. *D. coiffaiti* Breuning, *D. crux* Billberg, *D. dimidiatum dimidiatum* Motschulsky, *D. nitidum* Motschulsky, *D. haemarrhoidale* Hampe, *D. mesopotamicum* Breuning, *D. oezdurali* Önalp, *D. olympicum* Ganglbauer and *D. wagneri* Küster are marked red, green, purple, yellow, blue, orange, black, brown and pink, respectively in Figure 6.

Figure 6. First records for provinces in Turkey.

Table 1. Species numbers in the study, vertical distributions, collecting monts, habitats, distribution of Turkey and distribution World

Genus: *Dorcadion* Dalman, 1817									
Subgenus	**Species**	**Number of Specimens**		**Total Number of Species**	**Vertical Distributions (Altitude) (m)**	**Collecting Months**	**Habitats**	**Distribution of Turkey**	**Distribution of World**
		Male ♂	**Female ♀**						
Cribridorcadion Pic	*D. bisignatum* Jakovlev	1	0	1	1700	July	Under stone	Artvin	Turkey
	D. catenatum catenatum Waltl	0	1	1	30	May	-	Izmir	Turkey
	D. c. loratum Thomson	0	1	1	30	May	-	Izmir	Turkey
	D. c. mytilinense Kraatz	0	1	1	497	March	On grass plants	Izmir	Turkey and Greece
	D. coiffaiti Breuning	1	1	2	790	April	-	Kütahya	Turkey
	D. crux Billberg	1	0	1	1200	April	Under stone	Isparta	Turkey
	D. dimidiatum dimidiatum Motschulsky	6	6	12	1800-2200	April, May, June	Under stone and on grass plants	Ardahan, Erzurum	Argentina, Armenia, India, Caucasus, Iran and Turkey
	D. haemarrhoidale Hampe	3	2	5	3000	April, June, July	-	Gümüşhane, Erzurum	Argentina, Armenia, India, Caucasus, Iran and Turkey
	D. infernale infernale Mulsant and Rey	1	1	2	840	April	-	Eskişehir	Turkey
	D. mesopotamicum Breuning	7	4	11	2-837	April	-	Diyarbakır,	Iraq and

								Yalova	Turkey
	D. mniszechi Kraatz	0	1	1	2100	June	Under stone		Turkey
	D. nitidum Motschulsky	18	13	31	1600-1870	May	-	Ardahan, Erzurum	Argentina, Guernsey, Armenia, Azerbaijan and Turkey
	D. nobile ivani Pesarini and Sabbadini	1	0	1	1330	May	On grass plants	Bingöl	Turkey
	D. oezdurali Önalp	0	1	1	950	July	-	Erzincan	Turkey
	D. olympicum Ganglbauer	4	1	5	1450	May, June, July	Around the roots of grass and herbaceous plants and under stone	Bursa, Kars	Europe (Greece, Bulgaria, Turkey)
	D. piochardi Kraatz	0	1	1	1150	September	-	Amasya	Turkey
	D. scabricolle lazistanum Lazarev	26	31	57	1153-2000	April, May, June	Around the roots of grass and under stone	Gümüşhane, Erzurum	Turkey
	D. s. salhanum Lazarev	1	1	2	1400	June	-	Bingöl	Turkey
	D. s. balikesirense Breuning	2	4	6	100	March	On grass plants	Bursa	Armenia and

Cribridorcadion Pic									Turkey
	D. s. shirakense Lazarev	30	10	40	1020-1870	April, May, June	Around the roots of grass and under stone	Ardahan, Kars	Armenia and Turkey
	D. s. korbianum Lazarev	6	5	11	1020	February	-	Konya	Turkey
	D. sodale Hampe	6	1	7	2200-2700	June, July, August	On grass plants	Erzurum	Turkey
	D. subsericatum Pic	1	1	2	1100	April	-	Kastamonu	Turkey
	D. wagneri Küster	73	98	171	2-2150	April, May, June, July, August	Uunder stone, on grass and soil ground and pitfall trap	Diyarbakır, Erzurum, Kars, Muş, Yalova	Caucasus, Turkey and Iran
Maculatodorcadion Breuning	*D. triste* Frivaldszky	0	1	1	20	May	-	Izmir	Turkey
	General total of species	188	186	374					

Figures of species determined in the study.


1


2


3


4


5


6


7


8


9


10


11


12



13	14	15



16	17	18



19	20	21



22	23	24

25

Figure 7. ***Dorcadion*** **(*C.*)** ***bisignatum*** Jakovlev 2. ***Dorcadion*** **(*C.*)** ***catenatum catenatum*** Waltl 3. ***Dorcadion*** **(*C.*)** ***catenatum loratum*** Thomson 4. ***Dorcadion*** **(*C.*)** ***catenatum mytilinense*** Kraatz 5. ***Dorcadion*** **(*C.*)** ***coiffaiti*** Breuning 6. ***Dorcadion*** **(*C.*)** ***crux*** Billberg 7. ***Dorcadion*** **(*C.*)** ***dimidiatum dimidiatum*** Motschulsky 8. ***Dorcadion*** **(*C.*)** ***haemarrhoidale*** Hampe 9. ***Dorcadion*** **(*C.*)** ***infernale infernale*** Mulsant and Rey 10. ***Dorcadion*** **(*C.*)** ***mesopotamicum*** Breuning 11. ***Dorcadion*** **(*C.*)** ***mniszechi*** Kraatz, 12 ***Dorcadion*** **(*C.*)** ***nitidum*** Motschulsky 13. ***Dorcadion*** **(*C.*)** ***nobile ivani*** Pesarini and Sabbadini 14. ***Dorcadion*** **(*C.*)** ***oezdurali*** Önalp 15. ***Dorcadion*** **(*C.*)** ***olympicum*** Ganglbauer 16. ***Dorcadion*** **(*C.*)** ***piochardi*** Kraatz 17. ***Dorcadion*** **(*C.*)** ***scabricolle lazistanum*** Lazarev 18. ***Dorcadion*** **(*C.*)** ***scabricolle salhanum*** Lazarev 19. ***Dorcadion*** **(*C.*)** ***scabricolle balikesirense*** Breuning 20. ***Dorcadion*** **(*C.*)** ***scabricolle shirakense*** Lazarev 21. ***Dorcadion*** **(*C.*)** ***scabricolle korbianum*** Lazarev 22. ***Dorcadion*** **(*C.*)** ***sodale*** Hampe 23. ***Dorcadion*** **(*C.*)** ***subsericatum*** Pic 24. ***Dorcadion*** **(*C.*)** ***wagneri*** Küster 25. ***Dorcadion*** **(*M.*)** ***triste*** Frivaldszky.

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Oral Presentation
Thursday
Aquatic (Marine and Freshwater) Biodiversity-1

Experimental Longline Fisheries in Artificial Reefs on The Northern Aegean Sea

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Abstract

Artificial reefs are defined as any structures that are placed at the bottom of the sea for purposes such as protection of sensitive ecosystems, an increase of marine biodiversity, development of diving tourism, and support of small-scale fishery. The longline has been recommended for sustainable fisheries in artificial reefs. The aim of the study is to determine the seasonal variation of the catch composition and catch per unit effort of the longline in artificial reefs on the Northern Aegean Sea. This study was conducted between December 2018 and September 2020 in Edremit Bay Artificial Reefs Area. The mainline was made of polyamide (PA) multifilament (210d/54) and branch lines were constructed to mainline which were made of monofilament material. Fitted with straight and cross hooks (Mustad 2315 DT-14) the snoods attached to the main body using swivels. The baited hooks were set manually at sunset and hauled back early the next morning. During the survey, soak time, the coordinates of operations were recorded. The fish caught were measured and their CPUE values were calculated. A total of 27 species belonging to 16 families were recorded and 160 individuals (33.9 kg) were caught. *Diplodus vulgaris, Pagellus erythrinus*, and *Mustelus mustelus* are the main caught fish species. The percentage distribution of the total catch was 81.4% commercial species. As a result of year-round sampling, it is seen that the number of fish caught in summer increased, but the highest values in terms of biomass were reached in winter. The highest CPUE was recorded in the autumn and the lowest CPUE in the summer. As a result, longline can be successfully used in small-scale fishing in artificial reefs. However, echosounder should be used during fishing operations to increase fisheries efficiency and to prevent possible ghost fishing problems.

Keywords: Artificial reefs, longline, small-scale fisheries, Aegean Sea, Edremit Bay.

INTRODUCTION

Artificial reefs (ARs) is defined as any structures that is placed at the bottom of the sea for purposes such as protection of sensitive ecosystems, increase of marine biodiversity, development of diving tourism and support of small scale fishery (FAO, 2015). They were used Japan in 1600s a firstly. It has been started to use in Mediterranean after 1960s. Artificial reefs seems that at the beginning of 1980's and the first scientific study was carried out 1991 in Turkey (Bombace, 1989; Lök *et al.*, 2011). Nowadays, within the scope of 68 projects carried out in Turkey, ~15000 concrete blocks, 3000 amphora, 19 ships, 10 trolleybuses, 7 planes and 1 tank are left to the sea to be used as artificial reefs. In 2009, within the scope of national artificial reef master plan, the largest artificial reef area of the Mediterranean Sea was created in Edremit Bay using with 6700 concrete blocks (Özgül and Lök, 2017). The role of artificial reefs in protecting marine biodiversity, supporting small-scale fisheries, and in preventing illegal fisheries is often discussed in terms of fishery management. However, the most considerable issue is to sustain fisheries without damaging the marine ecosystem in artificial reefs (Koeck *et al.*, 2011). Trammel nets, hand-line, and demersal long-line are generally used as small-scale fishing methods in artificial reef areas. Especially, the longline has been recommended for sustainable fisheries in artificial reefs (FAO, 2015). The aim of the study is to determine the seasonal variation of the catch composition and catch per unit effort (CPUE) of the experimental longline in artificial reefs on the Northern Aegean Sea.

MATERIALS AND METHODS

The study was carried out in the Edremit Bay artificial reef area, the Northern Aegean Sea between 2018 and 2020. An artificial reef area was created by the Republic of Turkey Ministry of Food, Agriculture and Livestock between 2009 and 2012 to improve marine biodiversity and develop small-scale fisheries in the region. There are 215 reef groups, each consisting of 30 concrete blocks structured in seven main different fields with number of artificial units is approximately 7000 and total volume is 25000 m3 (Figure 1).

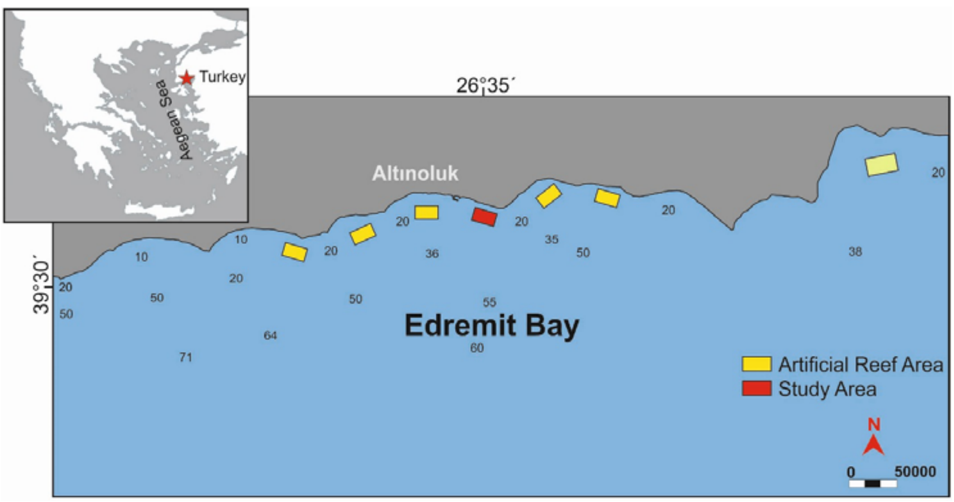


Figure 1. Study area located in the artificial reef areas of Edremit Bay, (NW Aegean Sea)

Artificial reefs were sampled 30 times by experimental fishing with a bottom long-line that was consists of 50 hooks. While multi-filament polyamide (PA, 210d/54) rope is used as the mainline, snoods are made from a 0.40 mm nylon monofilament. Fitted with straight and cross hooks (Mustad 2315DT-14) the snoods attached to the main body using swivels (Figure 2).

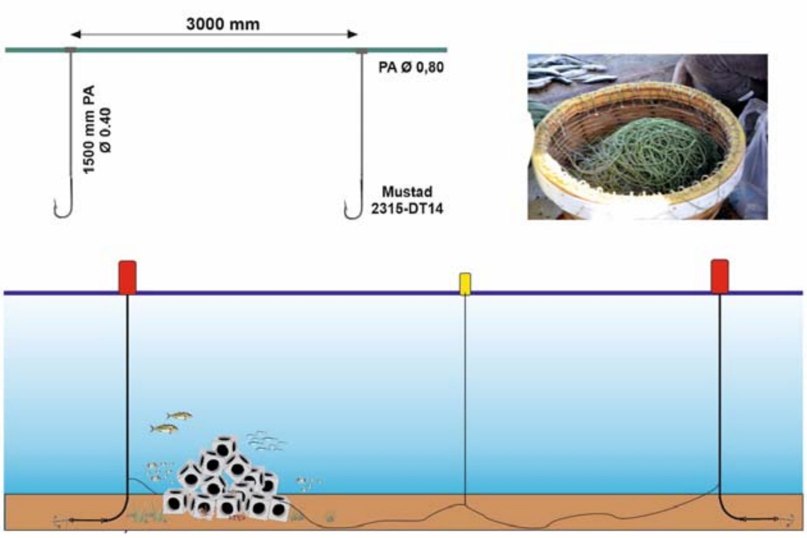


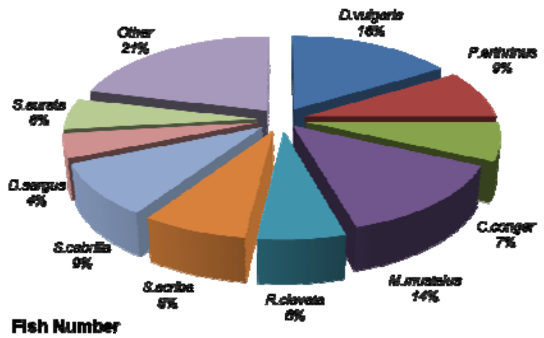
Figure 2. Figure 2. Schematic drawing of experimental long-line

Grooved razor shell (*Solen marginatus*), cuttlefish (*Sepia officinalis*), shortfin squid (*Illex coindetii*), Mediterranean mud shrimp (*Upogebia pusilla*) were used as bait in this study. The baited hooks were set manually at sunset in the artificial reefs area and hauled back early the next morning. The water depths in the area where the trials are conducted vary between 12 and 35 m.

During the survey, the weather and sea conditions, soak time, the number of fish caught were recorded. The fishes were identified to the species level. Their weights and their total lengths were measured. Catch Per Unit Effort (CPUE) in terms of number and biomass of fish was used and it was standardized for a hundred hooks (De Metrio and Megalofonou, 1988). The comparison between seasons was examined with a paired sample-T test. All differences were considered statistically significant at $p \leq 0.05$ (Zarr, 1984).

RESULTS

As a result of 30 experimental longline deployments, 27 species belonging to 18 families were obtained, 160 individuals totally weighed 33. 9 kg. Experimental long-line caught mostly *Diplodus vulgaris, Pagellus erytrinus*, and *Mustellus mustelus* in the articial reefs area. In this study, Sparidae was the most abundant family an 81.4% of the caught species are of commercial importance (Figure 3; Table 1).



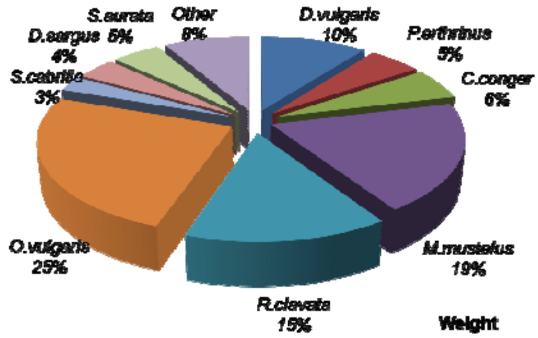


Figure 3. Catch composition by fish species in terms of individuals and weights.

Table 1. List of fish species caught by long-line in the artificial reefs area, NE Aegean Sea

Species	Number	Weight (g)	Length Size (cm)
*Boobs boops**	1	65.6	19.3
*Diplodus annularis**	5	428.2	13.2-21.5
*Diplodus vulgaris**	26	3546.0	11.3-28.1
*Diplodus sargus**	7	1330.1	13.0-29.6
*Sparus aurata**	9	1608.1	20.2-26.0
*Pagellus erthrinus**	14	1748.5	15.2-28.8
*Spondyliosoma cantharus**	1	182.2	21.7
*Spicara maena**	2	63.2	14.7-15.2
*Mullus barbatus**	1	34.6	15.0
*Serranus scriba**	12	526.6	12.0-19.8
*Serranus cabrilla**	15	920.7	12.5-24.0
Serranus hepatus	4	62.6	10.5-11.4
Gobius niger	1	51.3	16.7
Coris julis	1	61.5	18.8
Blennius ocellaris	1	17.2	6.3
*Merlangius merlangus**	1	61.2	19.0
*Physic physic**	1	98.4	24.0
Conger conger	11	1902.0	36.0-64.1
*Scopaena scrofa**	2	149.5	15.0-18.1
*Scopaena porcus**	1	26.8	11.5
*Trachirus draco**	4	419.0	20.1-29.0
*Trigla lucerna**	2	315.0	17.0-35.0
*Mustelus mustelus**	22	6605.8	20.0-71.3
*Raja clavata**	10	4931.8	30.6-80.0
*Raja polystigma**	2	249.0	32.1-34.0
Squila mantis	1	37.7	
*Octopus vulgaris**	3	8500.0	
TOTAL	**160**	**33 942.1**	

* Commercial species are denoted by an asterisk.

Fifteen species were caught during summer trials with experimental long-line. *D. vulgaris* and *S. cabrilla* were dominant in terms of number. Cartilaginous fish make up the bulk of the catch. 11 species were detected in trials in the autumn. *P. erythrinus* and *S. scriba* are the most caught species. In the winter, we have identified 14 species with long-line in the artificial reefs area. *D. vulgaris* and *C. conger* have an important place in caught composition in this season. Furthermore, It is remarkable in the octopus caught this season. Finally, 15 species were identified in the spring. Mostly, *D. vulgaris* and *D. sargus* were caught in this season. The amount of *M. mustelus* captured is remarkable. In comparison to the seasonal comparison of experimental long-line trials in the artificial reef area (Figure 4), it is seen that the number of fish caught in summer with long-line has increased, but the highest values in terms of biomass are reached in winter ($p>0.05$).

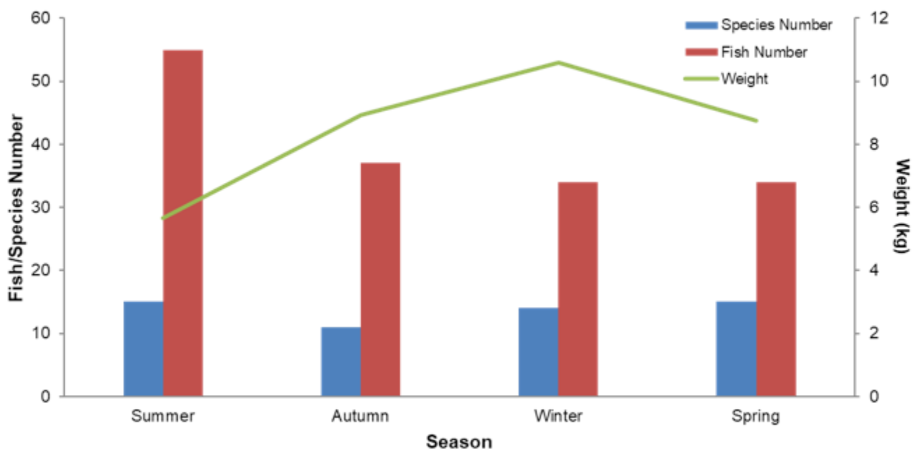


Figure 4. Seasonal comparison of experimental long-line trials in artificial reefs area

The number of species, individuals, and the rates of catch yield per unit effort (CPUE) is given in Table.2. When CPUE values are compared, the most productive season is summer in terms of fish number however, the most productive season is autumn is according to the fish weight ($p>0.05$).

Table 2. The number of species and fish, weight, and the CPUE values according to the seasons caught by long-line in the artificial reefs

Season	Number of Species	Number of Fish	Biomass (kg)	CPUE $_{Fish}$	CPUE $_{Weight}$
Summer	15	55	5.6	5.5	564.0
Autumn	11	37	9.0	3.7	897.2
Winter	14	34	10.6	2.4	735.4
Spring	15	34	8.7	3.8	391.7
Average	**13.8 ± 1.9**	**40.0±10.1**	**8.5 ± 2.1**	**3.9±1.3**	**647.1± 217.9**

DISCUSSION

The longline fishery is very common in the Aegean and Mediterranean coast of Turkey. The fishery is mostly conducted daily by small vessels (6-10 m length) with one or two fishermen (Soykan *et al.*, 2016). It is classified as one of the small-scale fishing techniques for artificial reef areas (FAO, 2015). In particular, longline fishing is recommended especially in artificial reef projects planned to support small-scale fishing. In similar, it is also emphasized longline can be used in marine protected areas as small-scale fishing methods (Forcada *et al.*, 2010; Gregalis *et al.*, 2012).

In this study, it has been seen that the longline can be successfully used for small-scale fishing in the field of artificial reefs. Similar results have been reported from other artificial reef areas in the Mediterranean (Fabi and Fiorentini, 1994; Santos and Monteiro, 1998; Gökçe, 2015). In the study, species of high commercial importance such as *D. vulgaris*, *D. sargus*, and *P. erythrinus f*rom the Sparidae family were caught. These species are target species for demersal longline fisheries in the Aegean Sea and the Mediterranean Sea (Soykan *et al.*, 2016; Gülşahin and Soykan, 2017).

Many cartilaginous fish species identified as discard were caught in the study. Of these species, *M. mustelus* and Raja sp. are dominant in the caught composition. These species have been defined as discards in many longline studies in the Mediterranean and Aegean Seas Özgül *et al.*, 2015; Gülşahin and Soykan, 2017; Güçlüsoy *et al.*, 2020). However, the local fisherman has been observed to sell these species alive to marine aquariums.

In this study, the average CPUE was calculated as 3.9 ± 1.3 fish and 647.1 ± 217.9 gr in terms of fish number and weight. This value is similar to other studies in the Mediterranean (Stobart *et al.*, 2012; Soykan *et al.*, 2016; Soykan and Gülşahin, 2017). Despite the small sample size in this study, it is thought that the reason for achieving CPUE values is due to the attraction effect of artificial reefs.

The longline is considered to be an environment-friendly fishing gear (Løkkeborg, 2000). It is considered to be species and size-selective, catching few non-target species, while the proportion of large fish of the target species is high (Løkkeborg and Bjordal, 1992). Furthermore, there is no evidence of ghost fishing by lost lines, which in the case of gill net is a serious ecological problem (Hameed and Boopendranath, 2000). Therefore, it is very important to promote longline fishery to establish ecosystem-based fishery management in artificial reefs area. In order to sustainable fishing in this area, an echo-sounder should be used during longline operations. Thus, both fishing efficiency can be increased and ghost fishing can be prevented.

Artificial reefs can contribute to fisheries management as an alternative area in reducing fishing pressure on natural reefs. However, illegal fishing and over-fishing must be controlled. As a result, in areas such as artificial reefs and marine protected areas (MPA's), it is recommended to use traditional fishing methods such as longline and line-fishing in a controlled manner.

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Oral Presentation
Friday
Effects of Biodiversity to Human Health-1

Biological Activities of *Pistacia terebinthus* subsp. *terebinthus* L.

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ABSTRACT

The use of plants in the prevention and treatment of human diseases also goes back to ancient times. Plants that are important from a medical point can also be used in Turkey and other countries from the past to the present day. It has been reported by World Health Organization that there are approximately 20.000 medicinal plants in the world and 500 of them are commercially produced. The geographical structure and climate characteristics of our country allow for extremely rich plant diversity. It has been determined that there are more than 9,000 plant species growing in Anatolia until today and 3,000 of them are endemic, that is, they grow only in our country. Turkey is a very large gene centre with 13 species for *Pistacia* L. which belongs to Anacardiaceae family. *Pistacia* L. is one of the non-wood forest products that are naturally found in the forests of more than 50 provinces of our country. Especially in the Mediterranean region, some people have benefited as food from the past to the present. Various parts of *Pistacia terebinthus* L. species such as leaves, fruits, fresh shoots, flowers, roots, and bark are used as folk medicine and food from past to present for medicinal and aromatic purposes. In this review antioxidant, analgesic, antimicrobial, anti-inflammatory, antiseptic, antispasmodic, anthelmintic, antidiabetic antihypertensive, cytotoxic and anticancer activities of *P. terebinthus* L. has been discussed.

Keywords: *Pistacia terebinthus* subsp. *terebinthus* L., Biological activity, Antioxidant, Antimicrobial

INTRODUCTION

Pistacia terebinthus, also known as turpentine or hackberry and is a member of the Anacardiaceae family, is native to the Mediterranean and Asia, is a small-sized plant species that grows in the south of Turkey. It is a broad, bushy and deciduous plant that has slow branches to grow, and can grow up to 25-30 feet high, with bright leaves and a heavy resin scent. The flowers, which bloom in March and April, are red-purple in colour and bud from the shoots of the previous year. The fruits are small, spherical pistachios that turn brown as they mature. Although it has the same cold resistance as almond tree, it buds in the last weeks of spring. It has been observed that this species grows on the dry and rocky slopes of the hills of the pine forests, especially in the parts of the Taurus Mountains with an altitude of 1600 meters in Turkey (Davis,1967). The most recent study on the systematic of *Pistacia* genus was conducted by Al-Saghir and Porter (2012). They reported that the genus consists of 13 taxa, includes 10 species and 5 subspecies, and consists of two sections and only one subspecies. The most studied species included in *Pistacia* genus are *P. vera*, *P. lentiscus, P. atlantica, P. terebinthus, P. khinjuk*, respectively. (Bozorgi *et al.*,2013).

It is seen that *P. terebinthus* plant, which was unearthed by archaeological research and whose ethno botanical history dates back to the chalcolithic ages, has been used for various purposes such as nutrition and treatment from these ages to the present day. According to the findings obtained from the archaeological excavations in Adana Tatarlı Höyük and Urfa Göbeklitepe in Anatolia, fruits and various parts of *P. terebinthus* were also used by people living in the region in prehistoric times (Neef, 2003; Kavak *et al.*, 2012). It has also been determined in archaeological researches that the resin of *P. terebinthus*, found in Egyptian pharaoh tombs, was used for the mummification of meat (Clark *et al.*, 2013).

Ethnobotanical research contributes significantly to the scientific evaluation of plants with their contents, which are acquired through trial and error and reflect invaluable information that has been passed down from generation to generation after a long period of time (Sadıkoğlu, 1998).

Today, people prefer components obtained from natural sources due to the negative effects caused by some synthetic compounds obtained by chemical synthesis. The benefits of bioactive components such as polyphenolic components and carotenoids found in plants have been revealed by studies. It has been associated with its high antioxidant capacities that mainly slow down the rate of oxidative stress, its use in the treatment of cancer, cardiovascular diseases, and its protective effects. Therefore, diets rich in antioxidants appear to be a promising approach to strengthen the physiological antioxidant defence system and reduce the incidence of chronic diseases (Gil-Chávez *et al.*, 2013). In this review antioxidant, analgesic, antimicrobial, anti-inflammatory, antiseptic, antispasmodic, anthelmintic, antidiabetic antihypertensive, cytotoxic and anticancer activities of *P. terebinthus* L. has been discussed.

Traditional using

The *P. terebinthus* has extensive traditional uses and different parts of this species have different uses in various parts of the world (Table 1). The fruits of this species are used in the fermentation of a special village bread variety. Tannic acid and is rich in archaeological findings resinous compounds and the aromatic and medicinal properties since ancient times. Archaeological findings, used to show that the peanut diet since 7000 years before Christ of this tree. It has been used as a fertilizer for several millennia while eating young shoots and fruits. In folk medicine, decoction of its leaves is used as a stomach remedy, but its fruits have also been used as a stimulant, diuretic and cold medicine in the treatment of abdominal pain, rheumatism and cough (Baytop, 1984; Duke, 1989).

Table 1. Traditional use of *P. terebinthus* in four countries.

Species Name	Country	Part (s) of the plant	Traditional Use Sources and Reference
P. terebinthus	Turkey	Fruit	Common cold medicine Diuretic, stomach medicine Appetizer, coffee, soap making (Couladis *et al.*, 2003; Topçu, 2007; Altundag and Öztürk, 2011; Çakılcıoğlu, 2011)
	Turkey	Leaf	Stomach medicine, lymphoma treatment, Antidiabetics (Sezik, 2001; Couladis *et al.*, 2003; Topçu, 2007; Uğurlu and Seçmen, 2008)
	Turkey	Resin	Urinary and respiratory antiseptics (Topçu,2007)
P. terebinthus ssp. terebinthus	Turkey	Leaf	Anticancer (Tuzlacı, 2016)
P. terebinthus	Iranian	Resin and shell air filtration Leave and bark	Antiseptic, antidiarrhea, astringent, aphrodisiac, liver/heart treatment, Treatment of respiratory disorders, (Shrafhandi, 2008; Aghili, 2009; Mohagheghzadeh, 2010).
P. terebinthus	Greece	Resin	Antidote, Aphrodisiac, expectorant, treatment of leprosy (Duke,1989).
P. terebinthus	Spain	Flower and leaf. Fruit and branch	Toothache, dislocated joint treatment, Antiseptic, antihypertensive.(Duke 1983; Agelet and Valles 2003 ; Benitez *et al.*,2010)

Chemical content of P. terebinthus

Chemical studies on the Pistacia genus have shown that there are high levels of vitamins and minerals. In addition, these studies have led to the discovery of various secondary metabolites in members of this genus (Bozorgi *et al.*, 2013).

When examining the biological activities of plants, it is important to know their chemical structure for biological activities. The fruits of *P. terebinthus* are an important source of phytochemicals. It contains 40% oil rich in unsaturated fatty acids, tocopherols, polyphenols and carotenoids (Durmaz *et al.*, 2011).

In study has been reported masticadienolicacid, masticadienonicacid and moralic acid isolated from *P. terebinthus*. Parts of *P. terebinthus* and isolated chemical compounds are as follows: Pinene in fruit leaves, limonene and ocimene in immature leaves and fruits have been. Unripe fruits and leaves contain Terpinen-4-ol. Flowers contain Gemacrene-D, resin contains masticadienolic acid, moralicacid, oleanolicacid, tirucallol, dammaradienone, Amyrin, Lupeol and the fruit contains Hydroxyhypolaetin and 3-Methyleter (Giner-Larza *et al.*, 2002).

In another study, the mineral content of *P. terebintus* (hackberry) fruits was determined. In terms of mineral concentration, it has been reported that K, Mg and Zn contents are lower and Na and P contents are higher. In addition, K, P, Ca and Fe concentrations of fruits were found to be higher than some fruits such as bananas. In addition, hackberry oil has a high content of oleic and linoleic acid and is therefore a healthy composition for nutrition. These findings can be beneficial for diet. It can be used in the food industry with its high protein and fat content and pleasant smell and taste (Özcan, 2004).

Biological activity of P. terebinthus

In studies on phytochemical and pharmacological properties and ethnobotanical use of *Pistacia* genus, it has been noted that biochemicals obtained from various parts of plants belonging to this genus have many biological activities. It is stated to be an important source of natural compounds due to its radical scavenging, anti-inflammatory, anticancer, antimicrobial, analgesic antidiuretic, hypoglycemic, cardioprotective and antipyretic properties of species included in *Pistacia* genus (Raufa *et al.*,2017).

Antioxidant activity of P. terebinthus

In the study conducted with the antioxidant activity of *P. terebinthus,* it was determined that the extract obtained from the leaf of the plant has approximately 12 times higher antioxidant capacity than BHA and ascorbic acid (Kavak *et al.*, 2010). *P. terebinthus* fruits have been reported to show noticeable metal chelating properties compared to EDTA and high radical scavenging activity similar to standards. In addition, it was concluded that the antioxidant activity of this type of fruit can be increased by roasting (Orhan *et al.*, 2012).

The effects of *P. terebinthus* extract on digestive enzyme activity, antioxidant enzyme activity, non-specific immune parameters, hematological parameters and growth performance in rainbow trout (*Oncorhynchus mykiss*) were investigated. It was determined that the methanolic extract of *P. terebinthus* added to the diet given to experimental fish increased the secretion of digestive enzymes, antioxidant enzyme activities, non-specific immune responses and growth performance parameters. Because of these results, it has been shown that this strain is beneficial to add to the diet (Ali, 2019).

In another study, total antioxidant activity, radical scavenging activity, DPPH, FRAP test and metal chelating activities were studied separately to determine the antioxidant and antiradical activities of the extracts. It was observed that leaf, flower and fruit extracts of *P. terebinthus* species had higher cleaning activity and the highest DPPH radical removal activity was found. In addition, total phenolic compounds in extracts were determined as the amount of pyrocatechol and quercetin. Thus, it was stated that the extracts showed active antioxidant activity. (Giner-Larza *et al.*, 2000).

In the study conducted with acetone and methanol extracts of the fruits of *P. terebinthus*, it was found that *Pistacia* species can be used as important sources of natural antioxidants. It has been determined that they contain phenolic and flavonoids such as quercetin and αtocopherol, which are standard antioxidant compounds (Türkoğlu *et al.*, 2017).

Other antioxidant activity studies of various parts of *P. terebinthus* are summarized in Table 2.

Table 2. Antioxidant activities of various parts of *P. terebinthus*.

Species	Part of plant	Assay	Observations and Reference
P. terebinthus ssp. terebinthus	Fruits	DPPH test Superoxide anion scavenging activity	High radical scavenging activity. In this study used to methanol and acetone extract. Both extract had scavening activity near to ascorbic acid (Topçu *et al.*, 2007).
	Fruits	FRAP	The acetone extract shows more reducing power than to-tocopherol, while the acetone extracts equivalent to tocopherol (Topçu *et al.*,2007)
P. terebinthus	Fruits and 4 *P. terebinthus* cofee brands	DMPD Radical Scavenging activity. H202 Radical scavenging activity FRAP assay Metal chelation effect	Scavenging effect lower than that of quercetin. Inactive in scavenging H_2O_2 radical. High reducing power Remarkable metal-chelation properties as compared to EDTA (Orhan *et al.*,2012).

Anti-inflammatory effects of P. terebinthus

The gall of *P. terebinthus* showed anti-inflammatory activity in different in vivo models of acute and chronic inflammation (Giner-Larza*et al.*,2000).Masticadienonic acid, masticadienolic acid and morolic acid, which are three triterpenes isolated from *P. terebinthus* galls have been shown to be effective against chronic and acute inflammation on mouse ear infections by performing 12 repeated applications (Giner-Larza *et al.*, 2002) In addition, it has been found that oleanonic acid from the bile of *P. terebinthus* galls reduces the production of leukotriene B4 from rat peritoneal leukocytes and shows antiedematous activity in mice (Giner-Larza *et al.*,2001).

Antispasmodic effect of P. terebinthus

The anticholinesterase group is mostly preferred ın order to create an antispasmodic effect that prevents smooth muscles from contracting. The antispasmodic effect has traditionally been used in many countries using the fruits of *P. terebinthus* tree (Orhan *et al.*, 2012). Orhan *et al.* (2012) were also found that *P. terebinthus* tree coffee brands were found to inhibit butyrylcholinesterase (BChE) at moderate levels (50%) with methanol chunks.

Antidiabetic effect of P. terebinthus

It was determined that extracts of *P. terebinthus* exhibited antidiabetic effect in diabetic rats in experimental environment. It has been revealed that it significantly reduces the immune reactivity in the β cells of the pancreas. It was revealed that regular treatment with *P. terebinthus* also provided protection against complications related to diabetes on the liver, kidney and pancreas (Uyar and Abdulrahman, 2020).

Anticancer activity of P. terebinthus

Many studies have been conducted on the biological activity of the *Pistacia* genus considering their protective effects against flavonoids, anthocyanins and other phenolic compounds, cancer and cardiovascular diseases. It has been reported that *Pistacia* species contain anthocyanin compounds (Bozorgi *et al*., 2013). Taştekin *et al.* (2014) have studied the efficacy and safety of *P. terebinthus* soap in patients with metastatic colorectal cancer (colon cancer) who developed emergency toxicity. As a result, patients with 1st, 2nd and 3rd degree skin toxicity were reported to regress at the rates of 100%, 33% and 1%, respectively, and it was determined that it can be used safely and effectively for skin toxicity caused by colon cancer (Cetuximab). Preliminary studies suggest that *P. terebinthus* can be used more effectively in cancer prevention (Taştekin *et al*., 2014).

Antimicrobial activity of P. terebinthus

Antibacterial activity of aqueous ethanol extracts of 42 plants, including *P. terebinthus*, was tested and one of the most promising plants with antibacterial activity was identified as *P. terebinthus* (Kaçar, 2008). Antifungal activity was tested in the study in which antimicrobial activity was determined by disk diffusion method using leaf extracts of *P. terebinthus*. *Pythium ultimum*, *Rhizoctonia solani, Fusarium sambucinum* were used as test microorganisms, which have significant harm in agriculture. The growth of *P. ultimum* and *R. solani* was significantly inhibited and did not show any activity against *F. sambucinum*. (Kordali *et al*., 2003). In another study, *P. terebinthus* leaf extract antagonistic effects were tested against *Escherichia coli*, *Micrococcus luteus, Streptococcus mutans*, *Pseudomonas aeruginosa*, *Klebsiella pneumoniae*, *Listeria monocytogenes*, *Streptococcus mutans*, *Staphylococcus aureus* and *Trichophyton rubrum* test microorganisms. As a result, it was determined that it did not inhibit the growth of *E. coli*, *S. aureus, S. mutans, K. pneumoniae, L. monocytogenes* bacteria and *T. rubrum* fungus. However, Inhibition of *M. luteus* and *P. aeruginosa* test bacteria were were determined by plants extract (Sinaplı, 2010). Ramazani *et al*., (2004) and Paraschos *et al*., (2011) were found that *P. vera, P. lentiscus, P. atlantica, P. terebinthus, P. khinjuk* have significant antibacterial activity on *Helicobacter pylori*. In another study, plant materials from different organs of *P. terebinthus*, chemical variability of essential oils between native populations were investigated and tested for potential antibacterial activity against *S. aureus*. MIC values against 3 strains of *S. aureus* (NRS385, LAC and UAMS-1) were examined to determine the antibacterial activity of essential oils. It has been found to exhibit growth inhibitory activity against *S. aureus (*Pulaj *et al*., 2016). The antimicrobial effects of the galls of *P. terebinthus*, which are formed by stimulation by *Slavum* aff. *Mortvilkoii* aphidia, have been investigated. The antimicrobial effect was tested by the disk diffusion method and while the most sensitive microorganism was *S. aureus,* the extracts have low activity against *S. pyogenes* and *C. albicans* (Algan, 2019). The antifungal activity of essential oils obtained by hydrodistilation from leaves of *P. terebinthus* collected in Bizerte (Tunisia) and Baunei (Italy) was tested. As a result, the essential oil of plant leaves collected from Tunisia has been shown to have higher antifungal activity than the oil of plant leaves collected from Italy. The MIC and MLC values have been shown to be in the range of 0.16-0.32 µL/mL, and the results obtained support the use of Tunisian oil in the treatment of dermatophytosis (Piras *et al.*, 2017). In another study, the antibacterial activities of the ethanol extract of *P. terebinthus* fruits is tested against to *Streptococcus agalactia*, *S. aureus* Cowan I, *Salmonella enteritidis*, *Salmonella gallinarum*, *E. coli* and *P. aeruginosa* by disk diffusion and dilution techniques. As a result, while 10 mm, 10 mm, 8 mm inhibition zones were measured against *S. gallinarum*, *S. aureus* and *S. enteritidis*, respectively, no inhibition zone was measured against other bacteria. MIC values against *S. gallinarum* and *S. aureus* were found as 2 mg /mL and there is no MIC value for other microorganisms (Keleş *et al.*, 2001).

In other scientific study, antibacterial activity of *P. terebinthus* fruit extracts against Methicillin-resistant *S. aureus* (MRSA) and Vancomycin-resistant *Enterococcus* (VRE) was tested. Hexane, ethanol and water extracts were prepared by maceration and pressurized solvent extraction (BSE) methods and examined by disk diffusion technique. Hexane extract, ethanol extract, water extract formed 8-16 mm, 11-18 mm and 10-35 mm inhibition zones against 14 clinical MRSA strains, respectively. Crude *P. terebinthus* hexane extract, 11-14 zones of inhibition were measured against five clinical VRE strains. When the antibacterial activity of crude and mature extracts was compared, it was found that crude *P. terebinthus* extracts were higher ($p<0.05$). Crude *P. terebinthus* extracts have the property of carrying new active ingredients against MRSA and VRE and create a potential for new studies, has been pointed out from this point of view. (Altunova, 2016).

Cytotoxic Effects of P. terebinthus

In the study on rainbow trout, the fruit extract of *P. terebinthus* was added to the feed at the rate of 0.1%, 0.5% and 1%, and it was not found to have a negative effect on the blood parameters of the fish was observed. These findings showed that the addition of fruit extract was not toxic to fish at trial doses and experimental conditions were kept under control, and the health status of fish was good (Ali, 2019). Another study was conducted in which the possible pharmacological and toxicological effects of dried fruit of *P. terebinthus* plant on rabbits causing hypercholesterolemia were investigated, and no toxic effects from the plant were found according to biochemical test results. It was pointed out that the reason for this result may be the unsaturated fatty acid flavonoid and phenolic compounds of the fruits (Bakırel *et al.*, 2003). When this study was examined, the metabolic criteria of liver and kidney damage were at an acceptable value in the group that was given only herbs, and that the dose used did not cause systemic toxicity also were determined. Antigenotoxic activity of *P. terebinthus* was investigated on *Drosophila* *melanogaster* with somatic mutation and recombination test by SMART. The results of adult individuals from the larvae fed with *P. terebinthus* were compared with the water control group. In the results, 0.5 mL dose of *P. terebinthus* was found to be genotoxic and the doses of 2.5 and 5 mL were found to be weak genotoxic (Ramezani *et al.*, 2004). As can be understood from the biological activities mentioned above, *P. terebinthus* is clearly a valuable species. In the oral administration of *Pistacia* extracts to living subjects, although there is no evidence showing acute toxicity on the toxicity profile, also dosage of the determining factor has been conducted (Ramezani *et al.*, 2004).

Analgesic effects of P. terebinthus

Pistagremic acid found in *Pistacia* species has been found to have antininoceptive and pain reliever activity in the nervous system. For this purpose, *P. integerrima* bark extract showed an antipyretic effect on mice at a dose of 100mg/kg (Ahmad *et al.*, 2010). There is no study in the literature for this biological activity of *P. terebinthus*. However, in terms of chemical content analysis, studies in other members of this genus can lead to analgesic studies for this species as well.

Antihypertensive effect of P. terebinthus

Hypertension in the living body can lead to a range of cardiomyopathies, including asfaxia, atherosclerosis, atrial fibrillation, myocardial ischemic injury, stroke, and cardiac arrest. Decreasing dyslipidemia can bring blood pressure back to normal, improving heart health. In vitro studies put forth that*,* *P. terebinthus* fruits inhibit the development of atherosclerotic lesions in the thoracic artery in rabbit subjects were clearly demonstrated (Ahmad *et al.*, 2010). In the qualitative studies of *P. terebinthus* fruits, the presence of unsaturated fatty acids as well as phenolic compounds, catechin tannins and flavonoids are known. In studies using in vivo and in vitro oxidation model, it is known that catechins are the strongest antioxidants among plant phenols, and they highly suppress lipid peroxidation (200 times more than alpha tocopherol). It is also known that it increases the excretion of cholesterol from the body by decreasing its solubility Dufresne and Farnwoth (2000). Studies conducted in recent years have reported that diets rich in cholesterol cause the formation of artherosclerotic plaque by accumulating superoxide radicals in the vascular endothelium. There are findings that the bleeding and coagulation time was prolonged in the experimental groups where *P. terebinthus* was given alone and with cholesterol compared to the control groups. These findings are associated with the polyunsaturated fatty acids contained in *P. terebinthus* (Sugano *et al.*, 1991; Abeywardena *et al.*,1997). The effect of *P. terebinthus* on experimental 155ypercholesterolemia and atherosclerosis in rabbits was investigated. This study shows that the dose used in the cases of hypercholesterolemia and atherosclerosis in rabbits fed with pellet feeds containing *P. terebinthus* plant extract compared to the control group may have a significant therapeutic effect (Bakırel *et al.*, 2003).

Anthelmintic effect of P. terebinthus

Although there is no anthelmintic in vitro study of *P. terebinthus,* this effect is used in traditional medicine as anthelmintic in many countries, especially India, China and Iran (Bakırel *et al.*, 2003).

CONCLUSIONS

In conclusion *P. terebinthus* is a good candidate for new drug development in spite of wide range of its phytochemicals and bioactivities supported from its traditional uses. There is a dire need to further explore and standardize this medicinally important species up to clinical trials and approval.

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Oral Presentation
Friday
Effects of Biodiversity to Human Health-2

Antimicrobial Activity of *Ajuga chamaepitys* subsp. *chia* (Schreb.) Arcang

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ABSTRACT

This study, biological screening of the ethanol, methanol, acetone and ethyl acetate extract obtained from *Ajuga chamaepitys* subsp. *chia* (Schreb.) Arcang were carrying out on antimicrobial effects. Antimicrobial activities of the extracts were determined for *Escherichia coli* NRRL B-3704, *Pseudomonas aeruginosa* ATCC 27853, *Proteus vulgaris* ATCC 13315, *Acinetobacter baumanii* ATCC 19606, *Bacillus subtilis* ATCC 6633, *Staphylococcus aureus* ATCC 25923, *S. haemolyticus* ATCC 43252 and *Candida albicans* ATCC 10231 test microorganisms by using the disk diffusion and micro broth dilution methods. All extracts of *A. chamaepitys* subsp. *chia* showed an antibacterial activity against *P. aeruginosa* ATCC 27853 and *Staphylococcus aureus* ATCC 25923 higher. On the basis of the mentioned results, *A. chamaepitys* subsp. *chia* may be a potential source of antibacterial agent.

Keywords: Antimicrobial activity, *Ajuga chamaepitys* subsp. *chia* (Schreb.) Arcang., antibacterial.

INTRODUCTION

Lamiaceae family is represented by 400 genera and 3200 species in the world (Kahraman *et al.*, 2009; Bazarragchaa *et al.*, 2012). Members of these families are concentrated mainly in the Mediterranean countries, Australia, South West Asia and South America. Almost in all habitat types and at all heights, Lamiaceae family members can grow and there are very few regions in which they cannot be seen. Lamiaceae family in Turkey is one of the important gene centers. About 546 species are represented in 45 genuses. The rate of endemism in Turkey is approximately 44.5%. Most of the members of the Lamiaceae family are rich in ornamental leaves, flowers, angular bodies and volatile oil; for this reason, they are very important in landscape architecture, pharmacy, food and cosmetic industries (Castro *et al.*, 2011; Kahraman *et al.*, 2009; Guo *et al.*, 2011; Dönmez and Önal, 2019). The genus *Ajuga*, knowing as mullein, has approximately, which are distributed in Europe, Asia and Africa. *Ajuga* genus, family Lamiaceae belongs to a genus with over 300 taxa in the world. In Turkey, 23 taxa 13 species, 10 subspecies, are available (Buluş, 2019).

In ethno pharmacological studies, *Ajuga* species used for traditional treatment certain diseases such as toothache, dysentery, high blood pressure, diabetes and hypertension urinary increase, strength, perspiration, wound healing toxic and as an antidote in scorpion and snake bites in Africa and Asia (Baytop, 1984; Aliotta ve Pollio, 1994). *Ajuga* species are used in folk medicine of different parts of the world for the treatment of rheumatism, gout, asthma, malaria, ulcers and diarrhea and have antibacterial, antitumor, anti-inflammatory, antioxidant, antifeedant and vulnerary properties. *Ajuga* plants are used to treat diabetes, and hypertension. There are also some reports on the phytochemical analysis of species belonging to *Ajuga* found in the literature but only a very small number of these species have so far been studied chemically for their essential oils. Some scientific studies on *Ajuga* species show the presence of many compounds belonging mainly to the groups of alkaloids, anthocyanins, tannins, withanolides, clerodane and neo-clerodane diterpenoids, sterols, ionone, iridoid, phenethyl alcohol and phenylpropanoid glycosides (Türkoğlu *et al.*, 2010).

Ajuga chamaepitys subsp. *chia* (Schreb.) Arcang. also known as Ground Pine can be occurred in Greece, Crimea, Palestine, North West and West Iran, Northern Iraq. In Turkey; it can be seen in almost all regions, up to 2000 m above sea level (Davis, 1982; Coll and Tandron, 2008). This taxa, which can be sized up to 30 cm in diameter and 10 cm in length, is yellow in color and can be flowered during the vegetation period (Dönmez and Önal, 2019). Antioxidant, antimutagenic, antiproliferative, anticaryogenic, antibiofilm and hemostatic activities of *A. chamaepitys* subsp. *chia* (Schreb.) Arcang have been also previously reviewed (Mitic *et al.*, 2011; Duran, 2015). However, antimicrobial activity studies of *A. chamaepitys* subsp. *chia* are very limited, except Sarac and Ugur 2007). This extended study was to evaluate the antimicrobial activities of ethanol, methanol, acetone and ethyl acetate extracts of *A. chamaepitys* subsp. *Chia.*

MATERIALS AND METHODS

The specimens belong to *A. chamaepitys* subsp. *chia* were collected from Canakkale in 2019. The specimens were identified with the aid of Flora of Turkey (Davis *et al.*, 1988) and other relevant publications by Dr. Ersin KARABACAK. Voucher specimens were deposited in the Biology Department at Çanakkale Onsekiz Mart University, Çanakkale, Turkey (Table 1).

Table 1. Voucher Specimen Used in This Study.

Species	Collected area	Identification by
Ajuga chamaepitys subsp. *chia* (Schreb.) Arcang	Çanakkale Onsekiz Mart Universtiy Terzioğlu Campus, 40° 6´36.67″ N; 26° 25´ 1.54 ″ E elevation 90 m	*E. Karabacak*

Test microorganisms

Gram-negative bacteria (*Escherichia coli* NRRLB 3704, *Pseudomonas aeruginosa* ATCC 27853, *Proteus vulgaris* ATCC 13315, *Acinetobacter baumanii* ATCC 19606), Gram-positive bacteria (*Bacillus subtilis* ATCC 6633, *Staphylococcus aureus* ATCC 6538P, *Staphylococcus haemolyticus* ATCC 43252) and yeast (*Candida albicans* ATCC 10231) were used for determining the antimicrobial activity of *Ajuga* plant extracts.

Preparation of extracts

The plants samples were air-dried. Each dry powdered fungal material 15 g [at a ratio of 10:1 (10 mL/g)] was extracted with 150 mL of ethanol, methanol, acetone and chloroform (Merck, Darmstadt, Germany) for 24 h by using Soxhlet equipment. The extract was filtered using Whatman filter paper no. 1, and the filtrates were then evaporated under reduced pressure and dried using a rotary evaporator at 55 °C. Dried extract was stored in labeled sterile screw-capped bottles at -20 °C (Khan *et al.*, 1988).

Screening for antimicrobial activities

The dried plants extracts were dissolved in 10% aqueous dimethyl sulfoxide (DMSO) to a final concentration of 200 mg/mL and sterilized by filtration through a 0.45 µm membrane filter. Empty sterilized antibiotic discs having a diameter of 6 mm (Schleicher and Schull No. 2668, Dassel, Germany) were each impregnated with 50 µL of extract (10 mg/disc) at a concentration of 200 mg/mL. All the bacteria mentioned above were incubated at 35 ± 0.1°C for 24 h by inoculation into Nutrient Broth (Difco Laboratories, MI, USA) and the yeast culture studied was incubated in Malt Extract Broth (Difco Laboratories, MI, USA) at 25 ± 0.1°C for 48 h. An inoculum containing 10^6 bacterial cells or 10^8 yeast cells/mL was spread on Mueller Hinton Agar (MHA) (Oxoid Ltd., Hampshire, UK) plates (1 mL inoculum/plate). The discs injected with extracts were placed on the inoculated agar by pressing slightly. Petri dishes were placed at 4 °C for 2 h, plaques injected with the yeast culture was incubated at 25±0.1 °C and bacteria were incubated at 35±0.1 °C for 24 h (Collins *et al.*, 1989). At the end of the period, inhibition zones formed on the medium were evaluated in millimeters. Studies were performed in triplicate. Treatments with penicillin (P10), and nystatin (NYS30) served as positive controls and treatments with ethanol, methanol, acetone and chloroform without plant materials served as negative controls.

For quantitative antimicrobial analyses, Minimum Inhibitory Concentration (MIC) values of all samples were determined. MIC and Minimum Bactericidal Concentration or Minimum Fungicidal Concentration (MBC or MFC) were investigated as recommended instruction of the Clinical and Laboratory Standards Institute (CLSI, 2006). Briefly, stock solution of each extract was diluted in the Muller Hinton Broth (MHB) in two-fold serial dilutions to obtain final concentrations range of 20-0.156 mg/mL at a total volume of 100 µL per well in 96-well microtiter plates. The lowest concentration of extracts inhibiting visible growth of each test microorganisms was taken as the MIC. The medium, 0.1% (w/v) Streptomycin (ST) and 10% DMSO were used as the non-treated, positive and negative controls, respectively. To confirm each MIC and to establish the MBC and MFC, 10 µL of the following dilutions were inoculated into dishes with MHA to evaluate microbial growth. After 24 h of incubations at 35±0.1 °C for bacteria cultures and 48 h incubations at 25±0.1 °C for the yeast culture, the plates with no apparent CFU of surviving microorganisms were determined. Each experiment was repeated for three times (Teanpasian *et al.*, 2017)

RESULTS

The antimicrobial activities of the plant extracts against different test microorganisms were assessed according to inhibition zones diameter and MIC and MBC or MFC values (Table 2). All extracts show higher antimicrobial effect against all tested microorganisms except *E. coli* NRRLB 3704 (ethanol and methanol, ethyl acetate), *A. baumanii* ATCC 19606 (methanol), *B. subtilis* ATCC 6633 (methanol and acetone) and *C. albicans* ATCC 10231 (methanol and ethyl acetate). All extracts also showed higher antibacterial effect against *P. aeruginosa* ATCC 27853 and *S. aureus* ATCC 43252 (except ethanol). The lowest MIC value (1.25 µg/mL) was recorded by all extracts of *A. chamaepitys* subsp. *chia* against all tested microorganisms except acetone and ethyl acetate extracts against *S. aureus* ATCC 6538P, *C. albicans* ATCC 10231 and *P. aeruginosa* ATCC 27853, *P. vulgaris* ATCC 13315, *A. baumanii* ATCC 19606, *S. aureus* ATCC 6538P, *C. albicans* ATCC 10231, respectively.

DISCUSSION

Plant extracts have been for some time of interest to scientists as possible new substances for treating various microbial infections. It is known by previous studies that *Ajuga* species has antimicrobial properties thus it can be used as medicinal and aromatic plant (Turkoğlu *et al.*, 2010; Yaldiz, 2012; Delezar *et al.*, 2012; Göger *et al.*, 2015; Salem, 2017).

In the study of Turkoğlu *et al.* (2010), methanol, water and chloroform extracts of *A. chamaepitys* subsp. *euphratica* and subsp. *chamaepitys* were investigated. According to the authors, this subspecies may be considered as a promising source of natural substances. However, major differences can be noticed when comparing these two subspecies. Differences between these two subspecies can be noticed also in the case of antimicrobial activity. The antimicrobial activity of *A. chamaepitys* subsp. *euphratica* was examined using the disc diffusion method and Gram-negative bacteria were more sensitive than Gram positive bacteria opposite to the case of *A. chamaepitys* subsp. *chamaepitys*. In the study conducted by Sarac and Ugur (2007) with *A. chamaepitys* subsp. *chia* ethanolic extract from aerial parts and the results indicated no inhibition of selected Gram-positive bacteria. Jakovljević *et al.* (2015), tested the antimicrobial activity of *A. chamaepitys* subsp. *chamaepitys* were determined against Gram-negative and Gram-positive bacteria. They indicated that their acetone extracts have higher antibacterial activity against *B. cereus*, with MIC and MBC values of 1.25 mg/mL.

Table 2. Disc Diffusion, MIC, MBC, and MBC/MIC ratios of the *A. chamaepitys* subsp. *chia* extracts of strains

Test bacteria	Plant extracts																	
	*Disc Diffusion[a]					MIC					MBC or MFC				MBC or MFC/MIC			
	E1	E2	E3	E4	Control P10/NY100	E1	E2	E3	E4	Control ST/NY100	E1	E2	E3	E4	E1	E2	E3	E4
E.coli NRRLB 3704	0	7.0	13.0	8.0	16.0	**1.25**	**1.25**	**1.25**	**1.25**	4.0	1.25	40	1.25	1.25	1	32	1	1
P. aeruginosa ATCC 27853	**11.0**	**19.0**	**24.0**	**18.0**	8.0	1.25	1.25	1.25	40	1.0	1.25	40	40	40	1	32	32	1
P. vulgaris ATCC 13315	10.0	12.0	9.0	**13.0**	13.0	**1.25**	**1.25**	**1.25**	40	4.0	1.25	40	40	40	1	32	32	1
A. baumanii ATCC 19606	11.0	7.0	**13.0**	**12.0**	12.0	**1.25**	**1.25**	**1.25**	40	4.0	40	40	40	40	32	32	32	1
B. subtilis ATCC 6633	11.0	7.0	8.0	13.0	14.0	**1.25**	**1.25**	**1.25**	**1.25**	2.0	40	40	40	40	32	32	32	32
S. aureus ATCC 6538P	14.0	**16.0**	**25.0**	**24.0**	15.0	**1.25**	**1.25**	40	40	5.0	40	40	40	40	32	32	1	1
S. haemolyticus ATCC 43252	12.0	**14.0**	12.0	9.0	14.0	**1.25**	**1.25**	**1.25**	**1.25**	4.0	1.25	40	40	40	1	32	32	32
C.albicans ATCC 10231	11.0	0	13.0	8.0	16.0	**1.25**	**1.25**	40	40	2.5	1.25	40	40	40	1	32	1	1

E1: Ethanol, E2: Methanol, E3: Acetone, E4: Ethyl acetate; *Inhibition zone (mm); a includes diameter of disk (6 mm); P10 = Penicillin (10 ug/disc); ST: Streptomycin; NY100 Nystatin 100 ug/disc

In another study; the antimutagenic, antiproliferative, anticariogenic, antibiofilm and haemostatic activities of *A. chamaepitys* ssp. *chia* var. *chia* ethanolic extracts, naturally growing in Mugla, were determined. The extracts of *A. chamaepitys* ssp. *chia* var. *chia* was slightly effective on *Streptococcus gordonii*. The extract has also important antibiofilm activities on all of the tested bacteria (Duran, 2015).

Salem (2017) used to test antimicrobial activity of *A. chamaepitys*, against 15 microorganisms (*B. subtilis* DSMZ 1971, *E. aerogenes* ATCC 13048, *E. faecalis* ATCC 29212, *E. faecium*, *E. coli* ATCC 25922, *K. pneumoniae*, *P. aeruginosa* DSMZ 50071, *P. fluorescens* P1, *S. enteritidis* ATCC 13075, *S. infantis*, *S. kentucky*, *S. typhimurium* SL 1344, *S. aureus* ATCC 25923, *S. epidermidis* DSMZ 20044). It is found that *A. chamaepitys* have higher antibacterial activity against *S. epidermidis*.

There is no data about *A. chamaepitys* subsp. *chia* antimicrobial activities except Sarac and Ugur (2007) and Duran (2015). We obtained different results in our research from other investigations with antimicrobial activity of different *A. chamaepitys* subspecies against test microorganisms.

Although other researchers have found that *Ajuga* species show a narrow antagonistic spectrum, in our data, *A. chamaepitys* subs. *chia* has been found to exhibit a broad-spectrum antagonistic effect against tested Gram (+), Gram (-) bacteria and yeast organisms. Thought that it is give different results on the same test microorganisms is due to differences of plant collected localization, ecological status, seasonal differences and variety of extraction methods.

CONCLUSIONS

Natural products are important source of new drugs which are having importance in modern medicine. The most important feature of our study is that all of the extracts had significant antimicrobial activity that inhibits serious bacterial and fungal pathogens. Comprehensive pharmacological studies are required to determine the components of this plant that have antimicrobial effects and their use in treatment. This is the first comprehensive report on the antimicrobial activity of *A. chamaepitys* subs. *chia* different extracts. This approach may also allow new kind of research in medicinal usage or development of drug research.

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Oral Presentation
Friday
Population Ecology

Cranial Osteology of *Lacerta trilineata* Bedriaga, 1886 and *Lacerta viridis* (Laurenti, 1768) (Sauria: Lacertidae) Populations Distributed in Thrace Region

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ABSTRACT

Lacerta trilineata Bedriaga, 1886 and *Lacerta viridis* (Laurenti, 1768) species are species that live sympathetically in the Thrace Region and show a wide spread. The taxonomic and biological characteristics of *Lacerta trilineata* and *Lacerta viridis* populations have been studied in detail with different methods, but a detailed study has not been found on the osteological characteristics of these species that show distribution in the Thrace Region.

In this study, the morphological measurements of *Lacerta trilineata* and *Lacerta viridis* species, which show sympatric distribution in Thrace Region, were taken. Cranial skeletal properties, including the bones covering the dermal skull, the palatal complex, the bones surrounding the brain sheath, and the lower jaw bones, were examined qualitatively and quantitatively using the transparent stained skeleton method.

In *Lacerta trilineata* and *Lacerta viridis* species, differences were found in the total number of teeth in the upper jaw, the number of teeth in the pterygoid, pineal foramina size, the way premaxillary entry into the nasal, the distal tip shape of the nasal, and the suture shapes between the palatine and pterygoids belongs to cranial osteology.

In this study, the osteological differences and similarities of the skull between *Lacerta trilineata* and *Lacerta viridis* species were revealed.

Keywords: *Lacerta trilineata, Lacerta viridis*, Thrace Region, Cranial Osteology

INTRODUCTION

Although the osteological differences in the classification of reptiles are most noticeable at the level of the order, they can be seen between families, genera, species and even subspecies (Romer, 1956; Kaya, 1996). In phylogenetic studies, the characters that have undergone the least change during the evolution process, that is, the most robust characters, are preferred rather than the characters of animals that are formed as a result of short-term adaptations. Osteological characters are one of the most appropriate and robust characters, and therefore skeletal elements constitute one of the most appropriate data for the prediction of kinship relations (Özeti, 1970).

The Anatolian populations of *Lacerta trilineata* Bedriaga, 1886 species were divided into different subspecies by Bodenheimer (1944), Mertens (1952), Peters (1964), Baran (1969) and Schmidt (1975). However, Schmidler (1986) stated that Lacertid populations in Anatolia belong to 3 species according to morphological and morphometric analyzes; He reported that *Lacerta trilineata* was distributed in the West, *Lacerta media* in the East, and *Lacerta pamphylica* in Southern Anatolia. Üçüncü et al. (2004) found that *Lacerta trilineata*, *Lacerta media* and *Lacerta pamphylica* populations distributed in Anatolia were divided into 3 species by comparing blood serum proteins with electrophoretic methods.

Godinho et al. (2005) studied the phylogeny and evolution of Lacerta genus with mtDNA and nuclear DNA sequences. In this study, *Lacerta trilineata* Aegean Region and Thrace; *L. viridis* Black Sea Region and Thrace; *L. pamphylica* Southern Anatolia; *L. media* has been reported to be distributed around the Eastern Anatolia Region. *Lacerta trilineata* and *Lacerta viridis* species belonging to the Lacertidae family live sympathetically in the Thrace Region. These species are abundant in suitable habitats and are not protected (LC) according to the IUCN redlist (Böhme et al. 2009; Isailovic et al. 2009).

Studies of skeletal chronology on lizards are also very few (Bedriaga 1886; Baran 1969; Peters et al., 1962; Çevik 1996). Osteological studies on *Lacerta media* type were carried out by Rastegar-Pouyani and Afroosheh (2011) and phylogenetic differences were demonstrated with this study. However, comparative osteological studies of *Lacerta trilineata* and *Lacerta viridis* species have not been found.
The aim of this study is; to reveal the osteological similarities and differences of the skulls of *Lacerta trilineata* and *Lacerta viridis* populations distributed in the Thrace Region (Gallipoli Peninsula).

MATERIALS AND METHODS

Osteological Analyses

In osteological analyzes, *L. trilineata* (ÇOMU-ZM 12/2009 Gelibolu, Çanakkale and ÇOMU-ZM 45/2010 Tekirdağ) and *L. viridis* (ÇOMU-ZM 16/2011 Kırklareli and ÇOMU-ZM 15 / 2011 Kırklareli) species were provided. Head + body length is 128.71 mm and 113.28 mm in *L. trilineata*; Specimens of 83.24 mm and 85.79 mm in size were used in *L. viridis*.

Osteological studies mainly consist of dry and stained skeletons. In detailed skeletal analyzes, the dry skeleton method is somewhat inconvenient, especially on small samples. Because the bones are damaged during the cleaning of the muscles, shrink when left to dry and move away from their normal shape, and especially the cartilage parts curl and lose their natural shape, causing errors in skeletal measurements. For these reasons, transparent stained skeletons were used in this study. Transparent stained total skeletons; It was prepared according to the Alizarin Red-S method of Davis and George (1947) and Taylor (1967), which was modified by Özeti (1970).

Qualitative osteological characters studied;

Premaxilla, Maxilla, Nasal, Prefrontal, Lakrimal, Frontal, Parietal, Postfrontal, Squamosum, Jugal, Vomer, Palatin, Pterygoid, Ectopterygoid, Quadrat, Parabasisphemoid, Basioccipital, Supraoccipital, Otoccipital, Dentale.

RESULTS

The parameters showing skull similarity and differences of *L. trilineata* and *L. viridis* samples are given in Table 1, and osteological characters pertaining to the skull are given in Figure 1 and Figure 2.

Dermatocranium

Premaxilla: Premaxilla is in contact with nasal dorsally and maxilla laterally. Premaxilla is in narrow contact with the vomer from the ventrally and with the maxilla anteroventrally. Premaxilla *L. trilineata* made a dagger-like entrance to nasals. In *L. viridis*, it is in triangular contact. All samples examined in the premaxilla have 9 pleurodont teeth.

Maxilla: Maxilla makes up most of the anterolateral part of the upper jaw. The number of teeth varies in the examples (Table 1). The numbers of labial foramina in the maxilla differ in the samples (Table 1). In *L.viridis*, labial foramina was seen in double rows.

Nasal: Nasals are dorsally in contact with the premaxilla, frontal and prefrontal, and laterally with the maxilla. The distal end of the nasals is sharper in *L. trilineata* than the proximal end.

Frontal: Frontal is in contact with the nasal anteriorly. It consists of two parts, front and back, and in all examples, the front is longer than the back. In *L. trilineata* and *L. viridis*, the posterior part is wider than the anterior part and all of it is in contact with the parietal. The front side of *L. trilineata* is more sutured from the back and the distal ends are sharp. The posterior part of *L. viridis* is more sutured than the anterior part and its distal ends have a more rounded entrance to the parietal.

Parietal: Anteriorly in contact with the frontal, laterally in contact with the postfrontal. In all samples it is in contact with the parietal postfrontal with a suture. There is occipital shield in the posterior part of the parietal. It is in contact with the supratemporal parietal postero-laterally. Pineal foramine is located interparietally. Interparietal is large and pentagonal. The lateral part of *L. trilineata* is also more pointed. The pineal foramine of *L. viridis* is larger.

Prefrontal: Anteroventral to the maxilla, dorsal to the frontal and lateral to the lacrimal. It taperes towards the front of the orbital fossa.

Lacrimal: It is the small bone that contacts the prefontale dorsal, anteroventrally to the maxilla.

Postfrontal: The postfrontals form the posterior corner of the orbital fossa. It is in suture contact with the parietal. It is in contact anteriolaterally with the postorbital and posteriolaterally with the squamosal.

Postorbital: It forms the posterior margin of the posrorbital orbital fossa. It acts as a link between jugal and postfrontal. It is in contact with the postfrontal dorsally and ventrally with the jugal.

Squamosal: It is a concave bone. It makes contact with the postorbital anteriorly, postfrontal, and anterodorsally.

Quadrate: Quadrat is one of the posterolateral elements in the skull. It carries a crest that divides it into two concave parts, and the lateral pit is large. The pterygoid is in contact with the quadrat.

Jugal: The jugal is in contact with the postorbital dorsal, anteriorly with the maxilla, and laterally with the ectopterygoid. It is seen as a triangle. Labial foramina was seen in *L. trilineata.*

Palatal Complex

Vomer: Vomer are the foremost elements in contact with the nose. It is a pair of bones in contact with each other at the anterior end and there is a "priform space" in between. The vomers touch the anterior edge of the palatine posteriorly. The posteromedial part of the vomers is concave.

Palatine: Palatine contacts anteriorly with the vomer, posterior with the pterygoid and laterally with the maxilla. There is a priform space between the palatines. In *L. viridis*, the suture degree between the palatines and the pterygoid is less and the tip is more rounded. In *L. viridis*, the degree of suture is higher.

Pterygoid: The pterygoid consists of two separate bones. They approach each other from the front and there is a priform space in between. It is prominently Y-shaped. It contacts the palatine anteriorly. It is in contact with the ectopterygoid laterally. Its distal end is in contact with the quadrat. There are opposing teeth on it. Especially in *L. viridis* specimens there are more teeth in the left pterygoid bone. The tooth numbers of the samples are given in Table 1.

Ectopterygoid: Ectopterygoid has three places of contact. It contacts the maxilla laterally in front, laterally with the jugal in the posterior, and anteriorly with the maxilla.

Neurocranium

Supraoccipital: Neurocranium forms the posterodorsal border. It is a saddle-shaped bone. It forms the dorsal edge of the foramen magnum.

Basioccipital: It forms the posterior base of the brain sheath. Occipital condyle forms its ventral part and foramen magnum.

Parabasisphenoid: It forms the anterior base of the brain bowl in ventral view. It is a cult-shaped bone that extends into the priform space.

Otooccipitals: It forms the back of the brain. It comes in dorsal contact with the supraoccipital and ventrally with the basiocipital. It comes into contact with the back of the parietal and squamosal. It forms the lateral edge of the foramen magnum.

Mandibular

Dentale: The number of teeth and tooth loci were examined in dental. There are differences between the examples and they are specified in Table 1.

Table 1. Similarities and differences between the skull bones of *Lacerta trilineata* and *Lacerta viridis*

Parameters	*Lacerta trilineata* (12/2009)	*Lacerta trilineata* (45/2010)	*Lacerta viridis* (16/2011)	*Lacerta viridis* (15/2011)
Number of teeth in premaxilla	9	9	9	9
Number of teeth in maxilla	19-19	17-17	17-19	18-18
The number of teeth in the upper jaw (premaxilla + maxilla)	47	43	45	45
Tooth Structure	Pleuorodont	Pleuorodont	Pleurodont	Pleurodont
Tooth locus in the maxilla	47 Tooth locus 1 Empty	43 Tooth locus 1 Empty	45 Tooth locus 1 Empty	45 Tooth locus No empty locus
Number of labial foramina in the maxilla	5-7	6-5	9-8 in double row	7-7 in double row
Proximal connection of the prefrontal to the orbit	Pointed	Pointed	Pointed	Pointed
Nasal protrusion of the posterior end of the premaxilla	It has a dagger-like entrance.	It has a dagger-like entrance.	It is in contact in a triangle shape.	It is in contact in a triangle shape.
Distal end of nasals	Pointed	Pointed	Round	Round
Connection of frontal and nasals	More sutured compared to parietal connection	More sutured compared to parietal connection	Less sutured compared to parietal connection	Less sutured compared to parietal connection
Suture degrees of the anterior and posterior ends of the frontal	Anterior is more sutured	Anterior is more sutured	Posterior more sutured	Posterior more sutured
Attaching the parietal to the postfrontal	Sutured	Sutured	Sutured	Sutured
The location of the pineal foramen in the parietal	In the inter-parietal	In the inter-parietal	In the inter-parietal	P In the inter-parietal and ineal foramen larger
Contact of the palatine bone with the pterygoid	The suture degree is higher with the pterygoid	The suture degree is higher with the pterygoid	Less suture degree and rounded tip with pterygoid	The degree of suture with pterygoid is higher than with other *L.viridis*
Connection of palatine with vomer	In contact	In contact	In contact	In contact
The shape of the pterygoid and the number of teeth	Prominent Y-shaped 9-7	Prominent Y-shaped 12-8	Prominent Y-shaped 13-9	Prominent Y-shaped 14-6
Supraoccipital	Saddle shaped	Saddle shaped	Saddle shaped	Saddle shaped

Teeth in the posterior protrusion of the maxilla yes / no	Yes	Yes	Yes	Yes
Dentale tooth number and tooth loci number	There are 19-23 teeth. There are 42 teeth, 42 tooth loci and 3 empty loci in total	There are 24-22 teeth. There are 46 teeth, 46 tooth loci and 1 empty locus in total	There are 20-21 teeth. There are 41 teeth, 41 tooth loci and 3 empty loci in total	There are 21-22 teeth. There are 43 teeth, 43 tooth loci and 1 empty locus in total

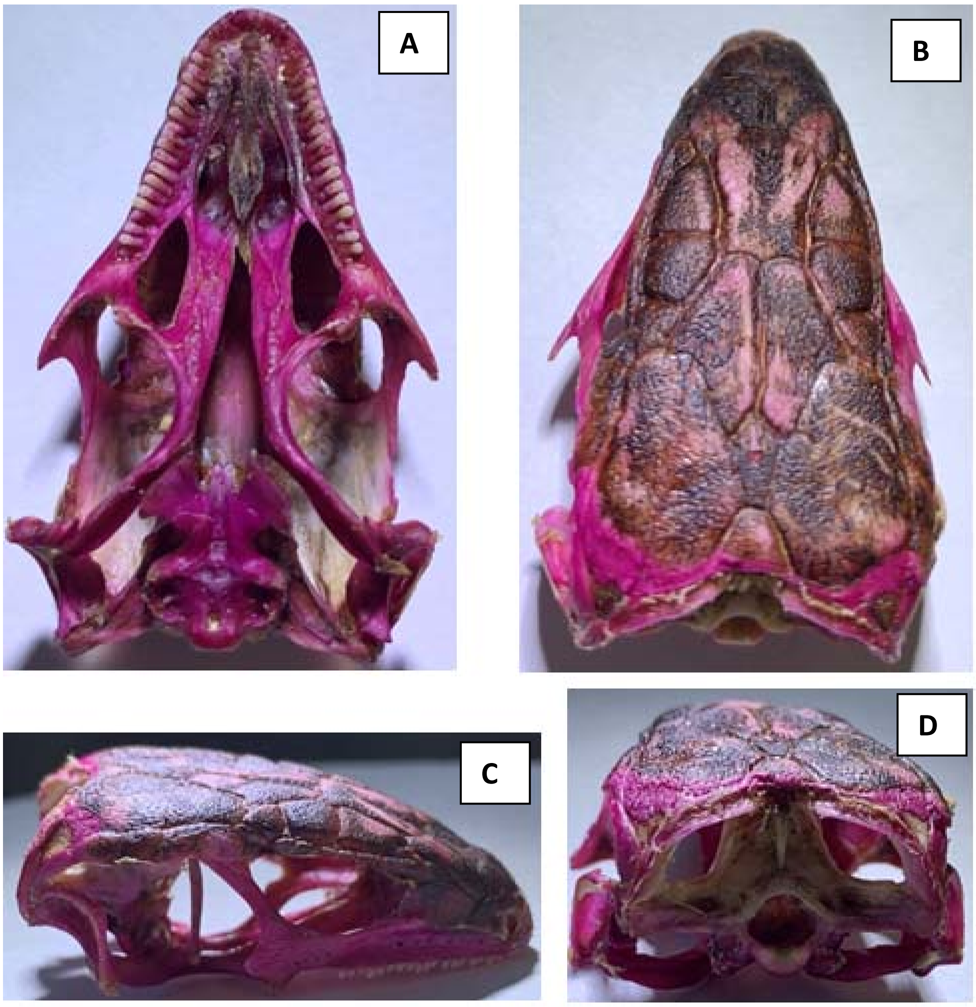

Figure 1. Dorsal (B), Ventral (A), Lateral (C) and Posterior (D) views of the skull of *Lacerta trilineata*

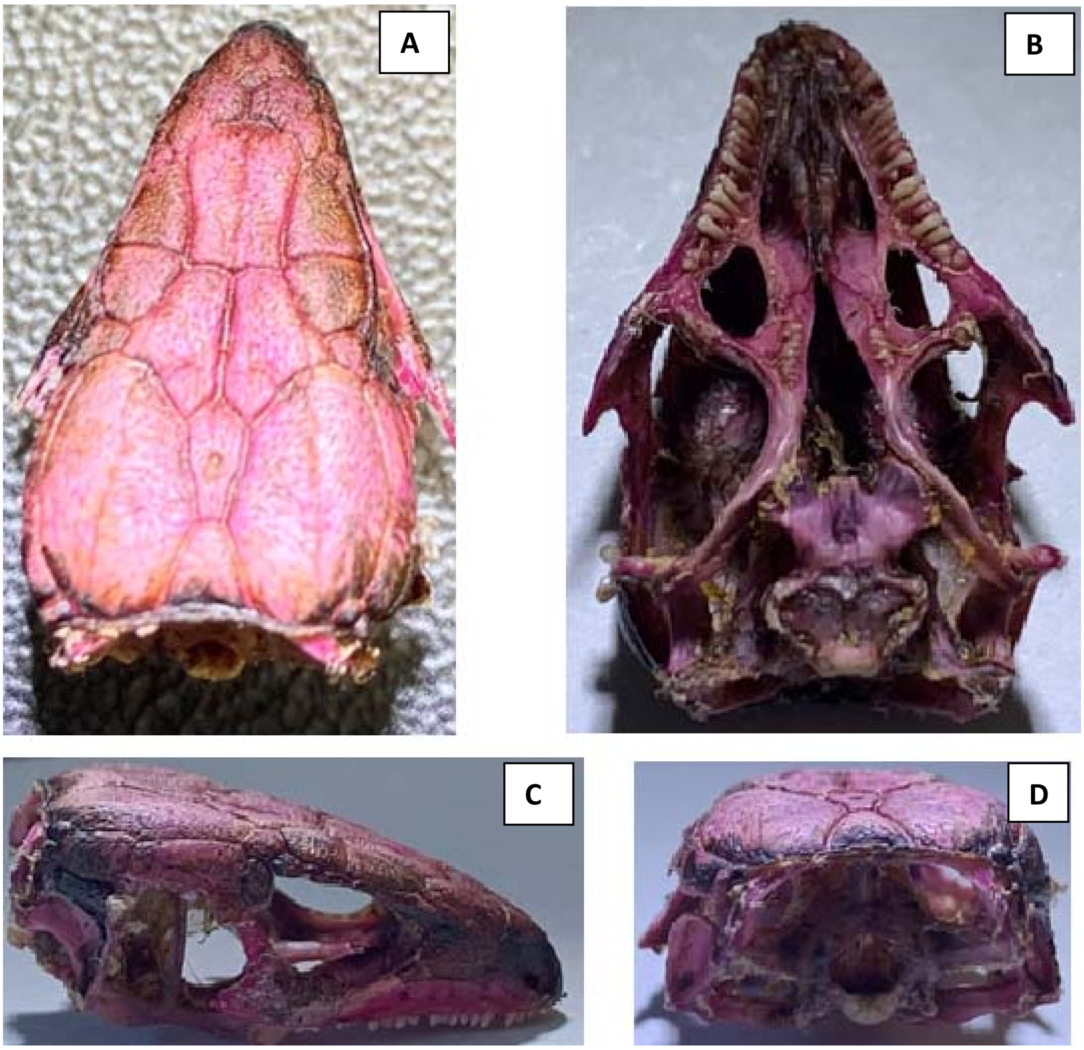

Figure 2. Dorsal (A), Ventral (B), Lateral (C) and Posterior (D) views of the *Lacerta viridis* skull.

DISCUSSION

The first fossil remains of the green lizard from the Lacerta group were unearthed in the late Miocene (MN 13). Comparison of premaxilla, maxilla, frontals, parietals, jugals, quadrates, pterygoids, dentaries and vertebrae with all available green lizard species shows that these fossils are indistinguishable from *Lacerta trilineata*, the data can be used as a potential calibration point for further studies, the comparative cranial elements selected in Lacertids It has been stated that it will contribute to the knowledge of osteological anatomy (Cernansky & Syromyatnikova, 2019). It has been reported in previous studies that *L. trilineata* can be very difficult to distinguish osteologically from *L. viridis*, since both are very variable (Cernansky, 2010).

Differences have emerged between the skull bones of *L. trilineata* and *L. viridis* samples that we examined within the scope of cranial osteology. 1- The number of teeth in the maxilla varies. 2- The number of teeth in the upper jaw is different. 3- The number of labial foramina in the maxilla varies, and in *L. viridis* species, the labial foramina is in double rows. Rastegar-Pouyani and Afroosheh (2011) reported that the labial foraminas in *L. media* have double rows. 4- Premaxilla in the genus *L. trilineata* entered as a dagger to the nasal. It was stated by Rastegar-Pouyani and Afroosheh (2011) in *L. media* that the nasal entrance of the premaxillary is in the form of a dagger. 5- Frontal consists of two parts. The front section is longer. The connection of *L. viridis* with the frontal nasal is more sutured than *L. trilineata*. 6- Anterior and posterior contact situations of the frontal differ. In *L. trilineata* species, the anterior part is more sutured, in *L. viridis* species the posterior part is more sutured. 7- Pineal foramina is found inter-parietal in all species. The pineal foramina opening is larger in *L. viridis*. Bruner and Costantini (2009) reported that interparietal involves pineal foramen in *Lacerta bilineata*. 8- The number of teeth on the pterygoid bone varies. Although *L. viridis* specimens have small skulls, there are more teeth on the left bone. Pterygoid teeth are generally considered to be a feature that occurs in Lacertids with large and intact skulls (Arnold 1989; Barahona & Barbadillo 1998; Arnold et al. 2007; Costantini et al. 2010). It is important to have sufficient sampling to use the variability observed in palate dentition in phylogenetic analysis (Skawinski et al.2017). 9- The number of teeth in dental implant varies.

This study revealed that the osteological differences of the skull between *L. trilineata* and *L. viridis* species are quite obvious.

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Oral Presentation
Friday
Population Ecology

First Report on the Herpetofauna of Belezma Biosphere Reserve, Province of Batna, Northeastern Algeria

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ABSTRACT

The present work reports the first herpetological checklist for Belezma biosphere reserve that lies in the province of Batna, northeastern Algeria. Time-constrained surveys for amphibians and reptiles were conducted at 24 sites that represent all major habitat types of the biosphere reserve. Both diurnal (9–16h) and nocturnal surveys (18–23h) were conducted during spring, summer, and autumn of the years 2015–2019. A total of 20 species were recorded. Amphibians are represented by four species, all belonging to order Anura, with two families, and four genera. The reptiles consist of 16 species belonging to two orders, nine families, and 16 genera. Chelonians include two species while Squamates comprise 14 species represented by Ophidians (five species) and Saurians that is the most speciose taxa with nine species. The herpetofauna of Belezma biosphere reserve include two Vulnerable (i.e. *Mauremys leprosa* and *Testudo graeca*) and one Near Threatened species (i.e. *Daboia mauritanica*), which reveals the relevance of this biosphere reserve for conservation. This work provides baseline information for future research and management actions in the study area.

Keywords: Amphibians, Reptiles, Biodiversity, Checklist, North Africa.

INTRODUCTION

Nowadays, research on amphibians and reptiles in Algeria is stagnant. Due to the low interest of Algerian researchers towards this fauna and the inaccessibility of the terrain for foreign herpetologists, its major aspects are still unknown. The earliest studies on Algerian herpetofauna were conducted during the second half of the 18th century (Poiret, 1789). Since the late 1880's, North Africa, and particularly Algeria, has witnessed a growing interest in herpetology (e.g., Boettger, 1885; Boulenger, 1891). During the 20th century, various herpetological research projects have been developed in Algeria among which those with the aim of compiling species lists, providing illustrated keys and identification guides, and mapping species distribution (e.g., Doumergue, 1901; Boulenger, 1919; Seurat, 1930; Guibé, 1950; Gauthier, 1967; Schleich *et al.*, 1996). There have since been few scattered comprehensive records, such as the works of Rouag and Benyacoub (2006) on the reptiles of El Kala biosphere reserve and Mouane *et al.* (2013) on the herpetofauna of the oriental Erg.

Belezma biosphere reserve (hereinafter abbreviated as BBR) is located in the province of Batna, northeastern Algeria. Amphibians and reptiles of Batna province have been described mainly by general listings based on nationwide maps of species distribution (e.g., Welch, 1982; Schleich *et al.*, 1996), except for one study conducted by Chirio and Blanc (1997) on the taxonomy and distribution of reptiles in the Aurès Mountains that include the southern part of the province. To date, there are few published studies on the herpetofauna of BBR, which focus on ecological aspects of particular species of reptiles (e.g., Bischoff and Bosch, 1991; Bouam *et al.*, 2016), however, an exhaustive checklist of the herpetofauna inhabiting BBR has never been published. There are few published lists of amphibians and reptiles of other protected areas of Algeria. For instance, Mamou (2016) inventoried the herpetofauna of the Djurdjura national park, situated in the northern part of Algeria, and listed 15 species of which three amphibians and 12 reptiles, while Rouag and Benyacoub (2006) analysed the reptile fauna of El Kala biosphere reserve, located in the extreme northeast of the country, recording 15 species comprised of four turtles, seven lizards, and four snakes.

Here I present the results of the first intensive herpetological surveys conducted in the BBR, which will allow to suggest further conservation and management actions for this protected area, and provide a starting point to encourage future research within the province's territory.

MATERIALS AND METHODS

Study site

Belezma biosphere reserve, established in June 2015 by the UNESCO, is located in northeastern Algeria, specifically in Batna province, between coordinates 35°30'N–35°41'N and 05°54'E–06°18'E (Figure 1). It encompasses an area of about 26,250 ha, covered by over 5,315 hectares of Atlas cedar, an emblematic tree species of the region, which includes almost one third of the cedar forests of Algeria. The biosphere reserve has a rolling topography ranging between 915–2,136 m above sea level and consists of a mosaic of habitats including Mediterranean forests and shrublands, cliffs, and watercourses.

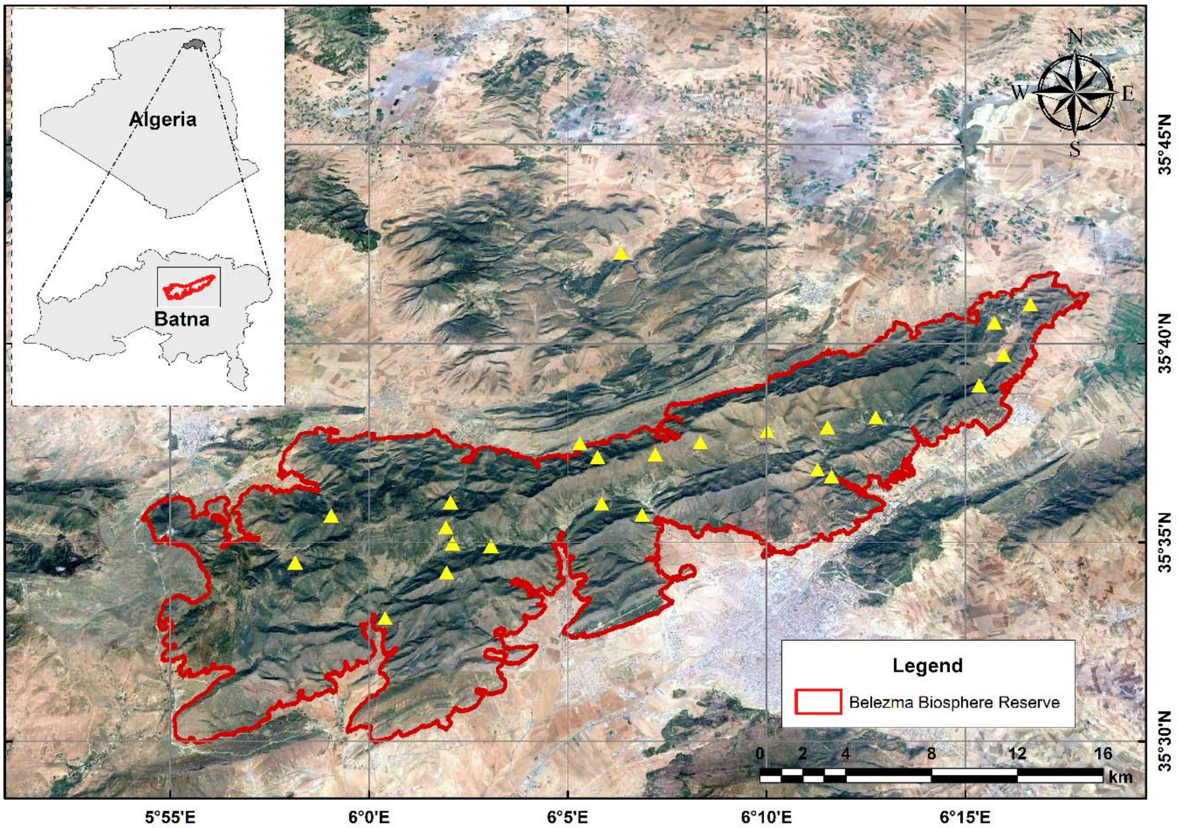


Figure 1. Location of Belezma biosphere reserve, province of Batna, northeastern Algeria. Sampling localities (△ within and outside the reserve are also indicated.

BBR has a typical Mediterranean mountain climate: dry and hot in summer, cold and wet in winter; it ranges from cool sub-humid to semi-arid climate. Rainfall is irregular and varies from one year to another. Climatic data during the period of 1982–2015 shows that the warmest month was July with an average temperature of 24°C, and that January was the coldest month with an average temperature of 3°C, whereas May and September were the wettest months with 50 and 49 mm respectively. July was always dry, with an average rainfall of 15 mm. The average annual rainfall is approximately 424 mm.

Data collection

Time-constrained surveys for amphibians and reptiles were conducted while visually searching for amphibian and reptile species in the open and under stones, bushes or other natural cover. Once a specimen was found, it was either visually identified, or captured and photographed to later confirm its identification, then released in the same place where it was captured. Both diurnal (9–16h) and nocturnal surveys (18–23h) were conducted throughout the study area from April to October of the years 2015–2019, including three seasons (i.e., spring, summer, and autumn) susceptible of being the activity period for all the amphibian and reptile species inhabiting the BBR. During this period, 24 localities representative of all the major habitat types of the BBR as forests, maquis, open areas, watercourses (mainly wadis), and rocky areas were surveyed (Table 1). Additional information resulted from opportunistic observations of any species in surveys of other taxonomic groups.

Table 1. Sampling localities in Belezma Biosphere Reserve, province of Batna, northeastern Algeria.

Locality	Geographic coordinates	Altitude (m a.s.l.)	Type of habitat
1	35°38'57" N, 6°15'21" E	1,048	Maquis
2	35°39'43" N, 6°15'58" E	1,057	Open area
3	35°40'60" N, 6°16'38" E	1,016	Rocky area
4	35°40'32" N, 6°15'44" E	1,037	Pine forest
5	35°37'13" N, 6°7'12" E	1,664	Cedar forest
6	35°37'9" N, 6°5'45" E	1,467	Maquis
7	35°37'30" N, 6°5'18" E	1,405	Open area
8	35°36'40" N, 6°11'38" E	1,064	Maquis
9	35°36'50" N, 6°11'17" E	1,078	Wadi
10	35°38'9" N, 6°12'45" E	1,106	Maquis
11	35°37'54" N, 6°11'32" E	1,248	Rocky area
12	35°37'48" N, 6°10'1" E	1,282	Open area
13	35°37'31" N, 6°8'20" E	1,468	Rocky area
14	35°35'42" N, 6°6'52" E	1,261	Maquis
15	35°36'59" N, 6°5'51" E	1,578	Cedar forest
16	35°36'1" N, 6°2'3" E	1,401	Wadi
17	35°35'23" N, 6°1'56" E	1,731	Cedar forest
18	35°34'59" N, 6°2'6" E	1,681	Maquis
19	35°34'55" N, 6°3'4" E	1,438	Maquis
20	35°34'15" N, 6°1'57" E	1,611	Cedar forest
21	35°33'6" N, 6°0'24" E	1,285	Wadi
22	35°32'46" N, 5°56'55" E	1,788	Cedar forest
23	35°35'41" N, 5°59'3" E	1,619	Maquis
24	35°42'17" N, 6°6'20" E	1,062	Rocky area

The forest habitats were classified into the following categories: Cedar forest: it consists mainly of *Cedrus atlantica* trees, with the occurrence of sharp cedar (*Juniperus oxycedrus*) and sometimes green holm oak (*Quercus ilex*) (Figure 2A); Pine forest: the Aleppo pine (*Pinus halepensis*) is accompanied by *Rosmarinus officinalis*, *Globularia alypum*, *Genista microcephala*, *Genista cinerea*, *Cistus salviifolius*, and *Cistus monspeliensis* (Figure 2B). The maquis are typical Mediterranean shrublands, consisting of mainly oak trees (*Quercus ilex* and *Quercus rotundifolia*) and short evergreen shrubs, which are usually dominated in the study area by Phoenician juniper (*Juniperus phoenicea*) and mastic (*Pistacia lentiscus*) (Figure 2C, D).

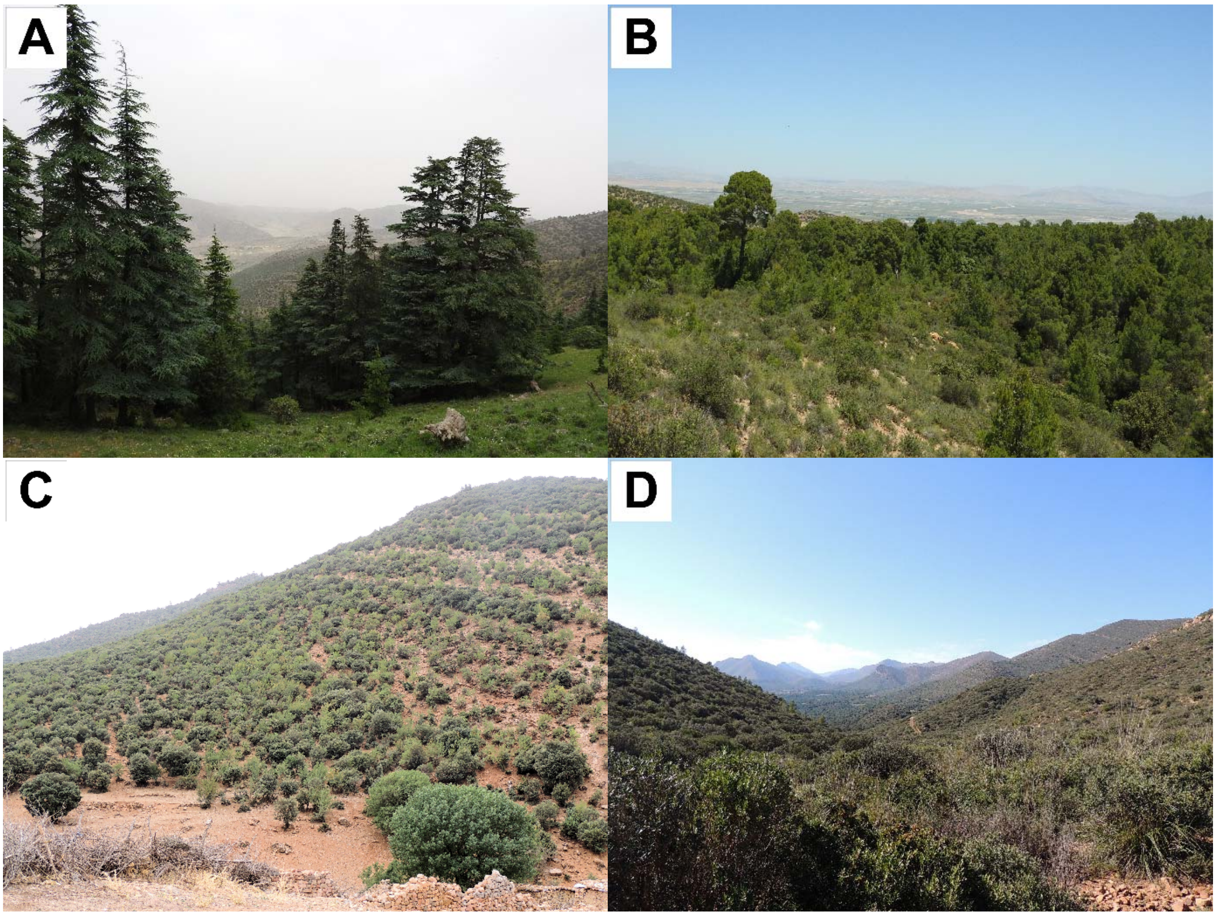


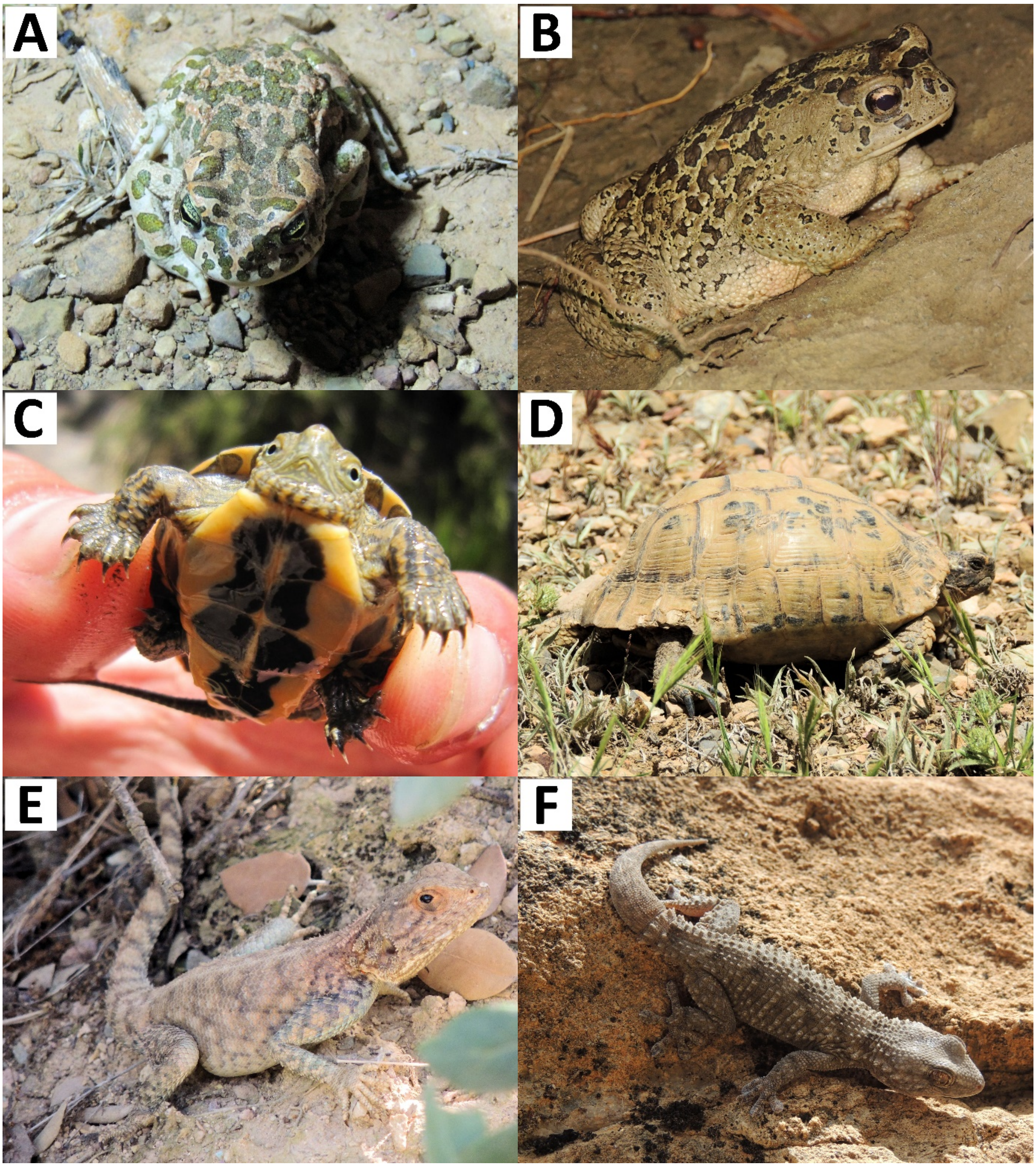
Figure 2. Forest habitat types of Belezma biosphere reserve: A) Cedar forest; B) Pine forest; C, D) Maquis-type vegetation.

RESULTS

A total of 20 herpetofauna species were recorded in the BBR, among which four amphibian and 16 reptile species (Table 2; Figure 3). All four recorded species of amphibians were anurans, and are distributed in three families and four genera. The most species-rich family was Bufonidae with two species. The two remaining families (i.e., Alytidae and Ranidae) are represented by one species each. Among reptiles, turtles are represented by two species in two families while lizards consisted of nine species in five families, and snakes included five species in two families. Among the Saurians, Lacertidae is the most speciose family with five species (55% of lizard species richness). The Saurian families, Agamidae, Chameleonidae, Gekkonidae, and Scincidae are represented by a single species each. The recorded snake diversity is dominated by members of the family Colubridae with four species, followed by Viperidae with one species.

Table 2. Systematic list of amphibians and reptiles recorded in Belezma biosphere reserve, province of Batna, northeastern Algeria. Habitats: Cedar forest (CF), Pine forest (PF), maquis (M), open areas (OA), Wadis (W), and rocky areas (RA). Locality numbering relates sampling localities in Table 1.

Taxon	Localities	Habitats
Class: Amphibia		
Order: Anura		
Family: Alytidae		
Discoglossus pictus Otth, 1837	9, 16, 21	W
Family: Bufonidae		
Bufotes boulengeri (Lataste, 1879)	10, 13, 14	M, RA
Sclerophys mauritanica (Schlegal, 1841)	1, 9, 10, 11, 13	M, W, RA
Family Ranidae		
Pelophylax saharicus (Boulenger, 1913)	9, 16, 21	W
Class: Reptilia		
Order: Testudines		
Family: Emydidae		
Mauremys leprosa (Schweigger, 1812)	9	W
Family: Testudinidae		
Testudo graeca Linnaeus, 1758	1, 9	M, W
Order: Squamata		
Suborder: Sauria		
Family: Agamidae		
Agama impalearis Boettger, 1874	2, 3, 8, 11	M, OA, RA
Family: Chameleonidae		
Chamaeleo chamaeleon (Linnaeus, 1758)	1, 12	M, OA
Family: Gekkonidae		
Tarentola mauritanica (Linnaeus, 1758)	3, 24	RA
Family: Lacertidae		
Acanthodactylus erythrurus (Schinz, 1833)	4, 8, 14	M, PF
Ophisops occidentalis (Boulenger, 1887)	2, 3, 4, 8, 11, 18, 19	M, PF, RA
Podarcis vaucheri (Boulenger, 1905)	5, 15, 17, 18, 19, 24	CF, M, RA
Psammodromus algirus (Linnaeus, 1758)	4, 5, 7, 8, 10, 15, 17, 20, 24	CF, M, OA, PF, RA
Timon pater (Lataste, 1880)	6, 7, 8, 15, 20	CF, M, OA
Family: Scincidae		
Chalcides ocellatus (Forskal, 1775)	5, 8, 18	CF, M
Suborder: Serpentes		
Family: Colubridae		
Hemorrhois hippocrepis (Linnaeus, 1758)	10, 13	M, RA
Macroprotodon mauritanicus Guichenot, 1850	14, 15	CF, M
Malpolon monspessulanus (Hermann, 1804)	8, 12, 15	CF, M, OA
Natrix maura (Linnaeus, 1758)	9, 21, 23	M, W
Family: Viperidae		
Daboia mauritanica Gray, 1849	2, 14, 23	M, OA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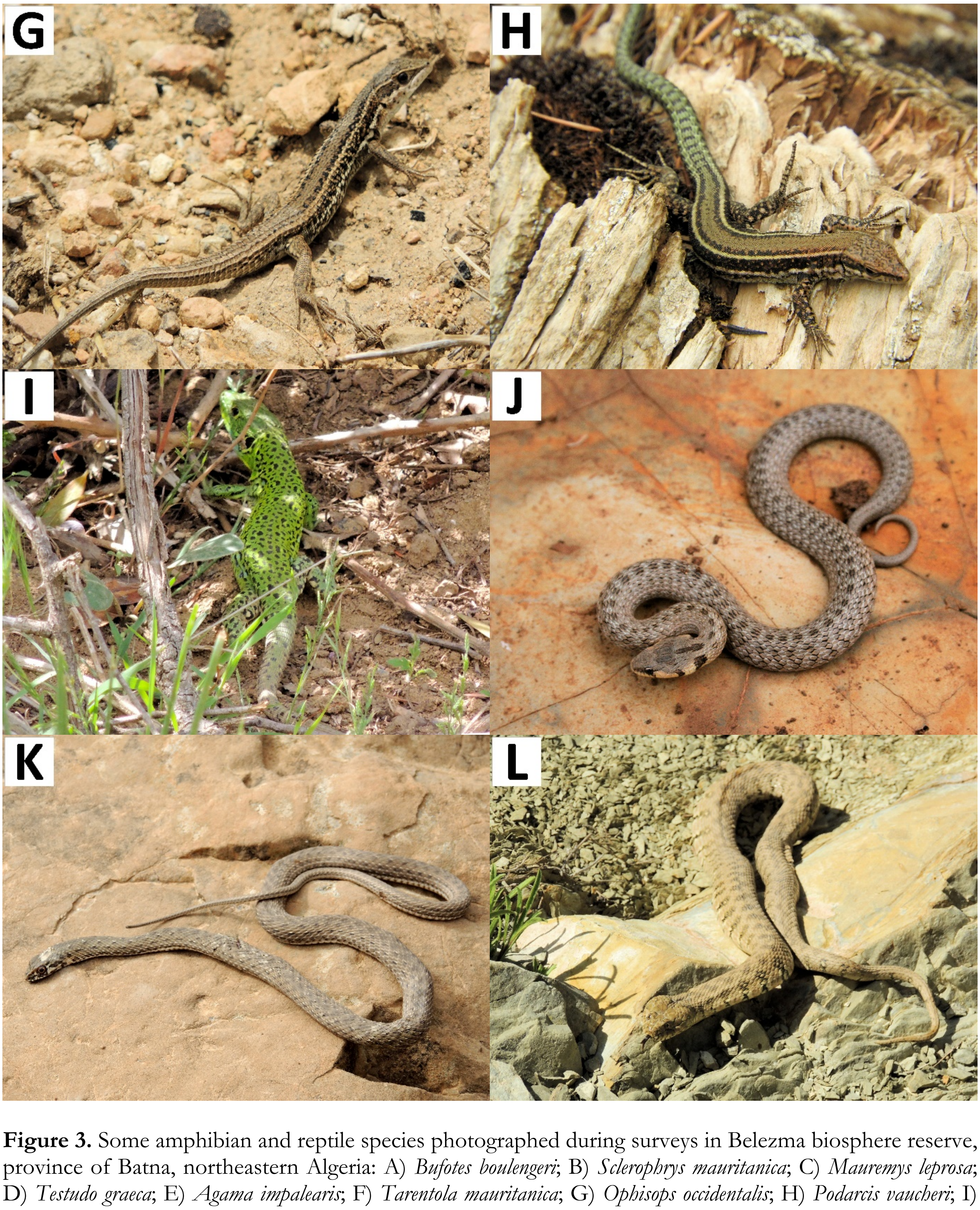

Figure 3. Some amphibian and reptile species photographed during surveys in Belezma biosphere reserve, province of Batna, northeastern Algeria: A) *Bufotes boulengeri*; B) *Sclerophrys mauritanica*; C) *Mauremys leprosa*; D) *Testudo graeca*; E) *Agama impalearis*; F) *Tarentola mauritanica*; G) *Ophisops occidentalis*; H) *Podarcis vaucheri*; I) *Timon pater*; J) *Macroprotodon mauritanicus*; K) *Malpolon monspessulanus*; L) *Natrix maura*.

DISCUSSION

The amphibian community of the BBR represents 28.57% of the amphibians recorded in Algeria (Frost, 2020). Most of the recorded amphibians were new additions to the province herpetofauna. The most notable of these observations is that of *Bufotes boulengeri*, because there is little data on its distribution in Algeria (Samroaui *et al.*, 2012). The 16 reptile species recorded in the BBR represent 39% of the 41 species registered in the Aurès region, which includes considerable localities of Biskra and Khenchela provinces and the southern part of the province of Batna (Chirio and Blanc, 1997). The majority of the observed reptiles present wide distribution along this region (Boulenger, 1891; Schleich *et al.*, 1996; Chirio and Blanc, 1997). However, some species are restricted to few localities. *Testudo graeca* was recorded only in the study area and in the western part of Khenchela province (Chirio and Blanc, 1997). Also worth mentioning, the record of *Daboia mauritanica* in this study represented the rediscovery of this species in Batna province, 129 years after it was last recorded by Lataste (Boulenger, 1891). This latter species is categorized as Near Threatened by the International Union for Conservation of Nature "IUCN" (Miras *et al.*, 2006). Moreover, the two turtle species recorded in the BBR (i.e., *Mauremys leprosa* and *Testudo graeca*) are both categorised as Vulnerable by the IUCN (van Dijk *et al.*, 2004a,b). All the other amphibian and reptile species catalogued in this study are considered to be of Least Concern by the IUCN (Cox *et al.*, 2006).

The majority of amphibian and reptile species recorded in the study area are ubiquitous, observed in more than one type of habitat, however, some species were found exclusively in aquatic habitats (i.e., *Discoglossus pictus*, *Pelophylax saharicus*, and *Mauremys leprosa*), or in rocky areas (i.e., *Tarentola mauritanica*) (Table 2). It is expected that amphibians might have a dependency for hydrological resources, because of the existence of larval stages in life history of this group. Most of the recorded species preferentially occupy maquis and cedar forests, which corroborates with the environmental profile of the region.

The number of amphibian species was compared with that of other protected areas studied in Algeria, the BBR presents the highest species richness of amphibians (4 species; current study) than the Djurdjura national park (3 species; Mamou, 2016). The study area also has a greater reptile species richness (16 species) than that of the other two studies on protected areas in Algeria. The BBR presents 16 reptile species, while El Kala biosphere reserve encompasses 15 species (Rouag and Benyacoub, 2006), and the Djurdjura national park with 12 species (Mamou, 2016). However, these two protected areas present distinct physiognomies, the Djurdjura national park is situated in a mountainous area characterized mainly by oak and cedar forests while El Kala biosphere reserve is represented by a mosaic of ecosystems: evergreen sclerophyllous forests, lakes, mountains and coastal ecosystems.

Despite the several impacts of human-induced fires on the general landscape of the BBR in recent years, which resulted in the suppression and fragmentation of primary vegetation, the remaining of its original structure is still maintaining essential environmental conditions that allow the preservation of the amphibian and reptile species of this protected area. In this light, this checklist of herpetofauna of the BBR is an important contribution to the knowledge of the area biodiversity, and to its sustainable management.

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Oral Presentation
Friday
Biogeography and Global Climate Change Effects on Biodiversity Areas

Is the Substrate an Important Factor in the Investigation of Gypsophile Endemism?

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ABSTRACT

Gypsum habitats are called 'harsh environment' for plant growth. The flora of these habitats shows a high level of speciality, as they have stress-causing nutrient imbalances, toxic elements, negative structural and textural properties for most plants. To further the study of gypsophily and to offer new data for the leaf chemical composition, the phytochemical composition of the 9 species from Turkey was compared. Nine of these species were collected for the first time for the study of gypsophily, and five of them are considered as gypsophiles (restricted to gypsum). Differences were explored with multivariate analyses (RDA) and mixed models approach (REML). Narrow gypsum endemics segregated from gypsovags in their chemical composition according to RDAs (mainly due to higher C/N ratios and ash content in the former). It is suggested that regionally dominant gypsophiles might fit the 'specialist' model, being species specifically adapted to gypsum, whereas both gypsovags and narrow gypsum endemics might fit the 'refuge' model, being stress tolerant species that find refuge on gypsum soils from competition. This research confirms previous results in Turkey and around the world and has also crucial contributed to the gypsophily research in Turkey.

Keywords: Edaphic endemism, gypsophily, phytochemical composition, phytoaccumulation, Turkey.

INTRODUCTION

Sedimentary rocks formed chemically as a result of evaporation of water are called evaporites. Evaporites are formed in areas where high temperature, low humidity and precipitation is less than evaporation (Warren, 2006). Gypsum soils are a terrestrial evaporite since they are located in arid or semi-arid regions depending on climatic conditions.

Geological formations containing gypsum are common in the world. The country with the highest number of gypsophytes is Iran (with 91 taxa) and followed by Turkey (70) (Pérez-García et al., 2018). It is possible to find gypsum soils that cover a large area in the Central Anatolia region. Gypsum areas in Turkey are in the form of massive gypsum deposits and small geological islands. In vegetative habitats, steppe vegetation is a secondary vegetation type. These extreme habitats are the hot biodiversity points of terrestrial ecosystems with their rich endemic flora (Escudero et al., 2015).

The close relationship between plants and special geological substrates has long been known (Kruckeberg, 1986). Gypsum habitats with significant geobotanical effects such as drought, limited nutrient and ion toxicity represent a stressful environment for plants growing on it. Plants regulate the concentration of nutrients in the cell. Gypsum habitats, which are extreme for plants, have an unbalanced nutrient concentration in the soil. Especially Ca, S and Mg excess caused by gypsum substrate causes deficiency of basic nutrients such as N and P. Plants must find mechanisms to regulate intracellular concentration in order to cope with the excessive concentration of substrate-derived nutrients in the soil. Such mechanisms form the basis of plant adaptation in gypsum soils.

Ecologically, the physical and chemical properties of the soil are particularly effective in plant life and distribution of plants. The most important factor in seeing endemism in the areas where the gypsum soils between Polatlı and Sivrihisar arises from the edaphic properties. Endemism in these habitats with gypsum soils is called 'gypsophile endemism'.

Specialized flora was observed more prominently in gypsum habitats in arid and semi-arid regions. It has been known that some plant species prefer gypsum soils (gypsophily) since Linnaeus was identified as *Gypsophila* (Merlo et al., 2019). However, the underlying causes of gypsophily have not been fully clarified (Bolukbasi et al., 2016; Mota et al., 2017).

The researchs on edaphism have led to proposal of several models to explain the occurence of special floras. These models have focused on different aspects such as the origin, age, genetic base, and ecological preferences of endemic plants. There are two factors that determine the limited and the local distubition: tolerance to extreme aridity and soil peculiarities and the inability to compete with other plants. Obligate gypsophytes are characterized by a prostrate growth habit, poor branching and xeromorphic foliage including reduced leaf size, while the stature of gypsum tolerant plants is significantly reduced when compared to counterparts on non-gypsum soil. Root system of species growing on and off gypsum sites are often more developed on gypsum soils than neighboring soils.

Geochemical conditions provide important clues in understanding the mechanism of action of limiting factors. In such areas, some elements are found in trace amounts, while other elements are in quite a large amount. Gypsum soils can be given as a good example to this richness. Since the content of calcium (Ca) and sulfur (SO4, sulfate) is very high in gypsum soils, these values are also observed in high amounts in the plant. As the Ca concentration increases, the Mg concentration decreases, which causes Ca/Mg antagonism. Likewise, high amount of Ca and S limits the intake of other nutrients and these elements are seen in trace amounts in the plant. Plant species that grow on gypsum must have a flexible metabolism to survive in these extreme conditions without damage.

Studies on gypsophile flora should focus on approaches that cover both physical and chemical hypotheses, as in other types of edaphism. One of these approaches divides plants living in gypsum soils into three according to their chemical or nutritional strategies: narrow gypsum endemics, regionally dominant gypsophiles (wide gypsophiles) and gypsovags. Amaong these plants, wide gypsophiles show more tolerance to chemical and physical limiting factors of gypsum stress.

The chemical hypothesis is mainly describing gypsophiles as the Ca and S accumulator, while the physical hypothesis does not carry any functional parameters that can be measured in determining whether a plant is gypsophile. The most obvious advantage of the nutritional hypothesis is the possibility of measuring the element content of plants in different geographical regions of the world where the gypsum is abundant and thus comparable.

The dolomite and dolomite claystones in the lacustrine units representing the Sivrihisar Neogene (Upper Miocene-Pliocene) basin constitute the most common lithology community with gypsum (Karakaş and Varol, 1994). In the region between Polatlı and Sivrihisar, sedimentary rocks with evaporite occupy a very large area. The study area is mostly composed of gypsum areas dominated by evaporitic sedimentary rocks and undifferentiated terrestrial clastics.

In this study, it was aimed to determine the content of gypsophily by determining the contribution of the substrate factor of gypsophile endemism by comparing the chemical content of narrow gypsum endemics, regionally dominant gypsophiles and gypsovag that grow in gypsum habitats between Polatlı-Sivrihisar.

MATERIALS AND METHODS

Species and study area

Nine species were selected for analysis: five gypsophiles (two widely distributed gypsophiles and three narrow gypsum endemics) and four gypsovags (Table 1; Figure 1). Populations were selected as close as possible in each region to minimize environmental variability. To contribute to the interpretation of the gypsophile endemism both endemic, non-endemic and wide, narrow species were selected. Two different biogeographical regions in the Central Anatolia have been determined for the research area (Table 2). In both regions, samples were collected from gypsophiles growing in massive gypsum soils and gypsovags growing both in gypsum soils and marly calcareous soils.

Four meteorological stations, Polatlı, Ankara, Sivrihisar and Eskişehir were chosen to evaluate the climatic conditions (Table 3). Annual mean temperatures are similar around 10.5-12.0 °C. The maximum temperature of the hottest months (July-August) is around 29.0 and 31.0 °C, while the minimum temperature of the coldest month (January) is around -3.0 and -4.0 °C. The study area is under the influence of semi-arid very cold Mediterranean climate.

Table 1. Details of studied taxa, study sites and sampling dates (Plant abbreviations are given in parentheses)

Taxon	[a]Sampling sites	Date of sampling	Altitude (m)	Geodesic coordinates
Acantholimon riyatguelii Yıldırım **(Ar)**	Sivrihisar (E)	26.05.2016	938	N 39° 22' 10,0" E 31° 29' 09,1"
Alyssum niveum Dudley **(An)**	Sivrihisar (E)	31.05.2015	895	N 39° 22' 26,9" E 31° 30' 14,1"
Anthemis kotschyana Boiss. var. *gypsicola* H.Duman **(Ak)**	Sivrihisar (E)	23.05.2015	820	N 39° 35' 44,5" E 31° 47' 16,1"
Gypsophila viscosa Murray **(Gv)**	Sivrihisar (E)	23.05.2015	812	N 39° 35' 44,5" E 31° 47' 16,1"
Sideritis gulendamiae Duman & Karavelioğulları **(Sg)**	Sivrihisar (E)	28.06.2015	988	N 39° 57' 53,2" E 31° 48' 22,7"
Aethionema dumanii Vural & Adıgüzel **(Ad)**	Sivrihisar (E)	26.05.2016	938	N 39° 22' 10,0" E 31° 29' 09,1"
	Ayaş (A)	28.04.2016	1186	N 40° 05' 32,3" E 32° 26' 14,7"
Aethionema turcica H.Duman & Aytaç **(At)**	Polatlı (A)	25.05.2016	725	N 39° 34' 41,7" E 31° 55' 32,9"
	Ayaş (A)	10.06.2016	1186	N 40° 05' 32,3" E 32° 26' 14,7"
Helianthemum oelandicum subsp. *incanum*	Sivrihisar (E)	31.05.2015	895	N 39° 22' 26,9" E 31° 30' 14,1"
(Willk.) G.López **(Ho)**	Ayaş (A)	10.06.2016	1186	N 40° 05' 32,3" E 32° 26' 14,7"
Onobrychis argyrea Boiss. **(Oa)**	Polatlı (A)	25.05.2016	774	N 39° 34' 36,9" E 31° 55' 09,7"
	Polatlı (A)	26.05.2016	766	N 39° 37' 51,5" E 31° 56' 54,6

Table 1. Details of studied taxa, study sites and sampling dates (continued)

Taxon	Taxonomic family	[b]Species type	[c]Substrate	[d]n	Endemism	[e]IUCN categories
Acantholimon riyatguelii Yıldırım	Plumbaginaceae	N	G	5	+	CR
Alyssum niveum Dudley	Brassicaceae	N	G	5	+	EN
Anthemis kotschyana Boiss. var. *gypsicola* H.Duman	Asteraceae	N	G	5	+	EN
Gypsophila viscosa Murray	Caryophyllaceae	W	G	5	-	-
Sideritis gulendamiae Duman & Karavelioğulları	Lamiaceae	W	G	5	+	NT
Aethionema dumanii Vural & Adıgüzel	Brassicaceae	GV	G M-C	5 5	+	CR
Aethionema turcica H.Duman & Aytaç	Brassicaceae	GV	G M-C	5 5	+	CR
Helianthemum oelandicum subsp. *incanum* (Willk.) G.López	Cistaceae	GV	G M-C	5 5	-	-
Onobrychis argyrea Boiss.	Fabaceae	GV	G M-C	5 5	+	LR (lc)

[a]A=Ankara; [a]E=Eskişehir, [b]N=narrow gypsum endemics; [b]W=widely distributed gypsophile; [b]GV=gypsovag, [c]G=gypsum soil;
[c]M, C=marly-calcareous soil, [d]n: number of sampled individuals, [e]CR=Critically endangered; [e]EN=Endangered; [e]NT=Near threatened; [e]LR (lc)=Least concern

Table 2. Details of studied soil samples, study sites and sampling dates

Study sites	[a]Area	[b]Substrate	[c]n	Date of sampling	Altitude (m)	Geodesic coordinates
Demirciler Village, Sivrihisar	E	G	5	23.05.2015	805	N 39° 35' 44,5" E 31° 47' 16,1"
Aşağıkepen Village, Sivrihisar	E	G	5	31.05.2015	895	N 39° 56,1'0,4" E 32° 49' 52,2"
Aşağıkepen Village, Sivrihisar	E	G	5	28.06.2015	988	N 39° 57' 53,2" E 31° 48' 22,7"
Acıkır, Polatlı	A	G	5	25.05.2016	725	N 39° 34' 41,7" E 31° 55' 32,9"
Sivrihisar	E	G	5	26.05.2016	938	N 39° 22' 10,0" E 31° 29' 09,1"
Beylikköprü Village, Polatlı	A	M-C	5	26.05.2016	766	N 39° 37' 51,5" E 31° 56' 54,6"
Aysantı Beli, Ayaş	A	M-C	5	10.06.2016	1186	N 40° 05' 32,3" E 32° 26' 14,7"

Table 3. Bioclimatic synthesis of study sites

	Yük (m)	P (mm)	M	m	PE	Q	S	Precipitation regimes
Polatlı	875	361.1	30.4	-3.4	60.2	37.28	1.98	SWAS
Ankara	894	401.0	30.3	-3.0	62.8	42.01	2.07	SWAS
Sivrihisar	1070	391.6	29.0	-3.2	62.0	42.54	2.13	SWAS
Eskişehir	801	344.3	29.7	-4.1	45.9	35.64	1.54	SWAS

P: total annual rainfall, M: max temperature average of the warmest month (°C) , m: min temperature average of the coldest month (°C) , PE: summer rainfall (mm), S: drought indice S=PE/M

Figure 1. The species used in study (a. *Acantholimon riyatguelii*, b. *Alyssum niveum*, c. *Anthemis kotschyana* var. *gypsicola*, d. *Gypsophila viscosa*, e. *Sideritis gulendamiae*, f. *Aethionema dumanii*, g. *Aethionema turcica*, h. *Helianthemum oelandicum* subsp. *incanum*, ı. *Onobrychis argyrea*)

Preparation of plant and soil samples for analysis

Plant and soil samples were taken at the end of the vegetation period, since the phenological stage of the leaf affected its chemical composition (Aerts and Chapin, 1999). In addition, since topography is an important factor, plant samples were not taken from peaks or atypical areas where species are rare. Since the heterogeneity of the leaf may affect the nutrient concentrations of the leaf (Alonso and Herrera, 2001), heterogeneity has been avoided. Damaged and dried leaves were discarded.

Plant samples brought to the laboratory as individuals are washed with tap water and then with pure water to remove leaves (short shoots). The leaves were left to dry for about 12 hours in a 60 ° C oven. The dried leaf samples were grinded in the herb grinder and made ready for analysis. Soil samples taken from 0-30 cm depth were left to dry at room temperature. Later, it was made ready for analysis by passing it through a 2 mm (10 mesh) sieve.

Chemical analyses

Plant samples were burnt with HNO_3 (Kacar and İnal, 2010). Total N, total C and total S values in plant samples were determined by Dumas method (Leco CN 628, Germany) (Dumas, 1831). P, K, Ca and Mg concentrations in plant samples were measured on ICP-OES (Perkin Elmer DV 2100, Canada). The standard solutions obtained by dry combustion in the plant were sprayed into argon plasma and the required wavelength reading was made for the element to be determined (Kacar, 2012).

Soil pH and EC (electrical conductivity) were measured by diluting samples with distilled water to 1:2.5 and 1:5, respectively. Soil $CaCO_3$ content was determined with a Scheibler calcimeter (Richard 1954), while the amount of organic matter was calculated by considering the weight loss in the soil at the end of the combustion at 550 ° C at the oven (Kacar, 2012). The percentage of gypsum content in the soil was determined gravimetrically by comparing samples dried at 60 °C and 105 °C (Porta et al., 1986). P concentration was assessed by vanado-molybdate colorimetry (Becker, 1961). K concentration was determined by extraction of neutral ammonium acetate (1N CH3COONH4, pH: 7) (Jackson, 1958) and reading was done by flame photometer. Soil C and N concentrations were determined with an Dumas method, as indicated above for plant samples (Leco CN 628). Ca and Mg concentrations were determined by ICP-OES (Jackson, 1958).

Statistical analyses

Prior to analyses, the normality of data and the homogeneity of variances were evaluated with Kolmogorov-Smirnov and Levene's tests. Heteroscedastic data were analysed with Welch tests. The difference between the variables with $p < 0.05$ was found statistically significant. The following steps were evaluated statistically to explain the gypsophily. (i) Comparison of narrow gypsum endemics and gypsovags grown on gypsum, (ii) Comparison of regionally dominant gypsophiles and gypsovags grown on gypsum, (iii) The effect of the substrate on the differences in the phytochemical content of gypsovags.

Three different statistical approaches are focused on comparing narrow gypsum endemics and gypsovags grown on gypsum and comparing regionally dominant gypsophiles and gypsovags grown on gypsum. (I) Chemical contents in plant tissues and soil were compared using a multivariate approach. (II) Using the univariate approach, differences between plant functional groups and soil types were compared. (III) Using ANOVA, the differences between each plant species and soil types were examined.

Firstly, the differences in chemical composition have been handled as a whole with a multivariate approach, in which all chemical variables have been examined simultaneously. RDA (redundancy analysis) was applied using the R statistical package program. Ezekiel's adjustment was used in the calculation of the R^2 (total adjusted variance) coefficients. Multivariate analyzes were done in the R (version i386 3.0.2, 2013) vegan using the vegan package (Borcard et al., 2011).

The second approach focused on the differences between plant functional groups and soil types. The species were evaluated as groups, not on an individual basis. The differences in C, N, Ca, S, P, K, Mg, ash, C/N ratio were compared with REML (restricted maximum likelihood) analysis. REML analyzes were performed in R (version 2.14.1, 2012).

In the third approach, differences in phytochemical content of plant species were compared using ANOVA in SPSS 15.0 for Windows (SPSS, Chicago, IL, USA). Differences and substrate (gypsum, marly calcareous) were used as the explanatory factor in comparing differences in C, N, C/N, Ca, Mg, P, K and S concentrations in different types of gypsum and the chemical content arising from the mean difference in the substrate in the gypsum. Differences among individual species were evaluated using post-hoc Tukey tests (in the case of homogeneous variances) and Dunnett T3 tests (otherwise). Univariate analyses were run in SPSS.

RESULTS

Differences in chemical composition of narrow gypsum endemics and gypsovags growing on gypsum soils

Results of the RDA analysis showed that narrow gypsum endemics could be separated from gypsovags growing on high gypsum soils by the leaf chemical composition (Figure 2). The 'gypsum plant type' factor explained 14% of total adjusted variance and the RDA analysis was highly significant ($p < 0.001$). Narrow gypsum endemics tended to have higher ash, Ca, Mg, S, ash and C/N ratio, while gypsovags had higher N and K concentrations (Figure 3). This was particularly clear for the Brassicaceae *Alyssum niveum* (An), a narrow endemic that is differentiated from the rest of the plants in this group by its high ash, Ca, Mg, P and low N and C concentrations (Figure 2).

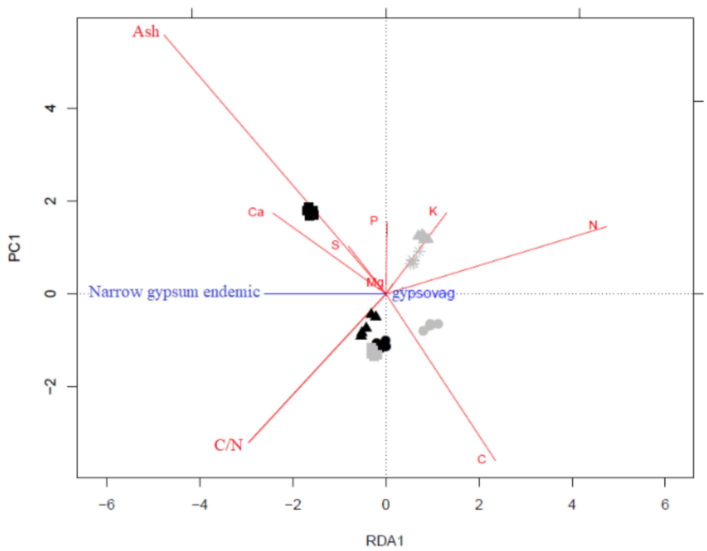

Figure 2. Triplot for the RDA model analysing the effect of 'gypsum plant type' on the leaf chemical composition of plants growing on gypsum ($p < 0.001$, $F = 6.47$, adjusted $R^2 = 0.14$). The 'gypsovag' type

(grey symbols) – opposite to 'narrow gypsum endemics' (black symbols) was used for comparison in the analysis and corresponds to the origin of both axes. Symbols: ▲=Ar, ■=An, ●=Ak, ✳=Ad, △=At, ▫=Ho, ○=Oa

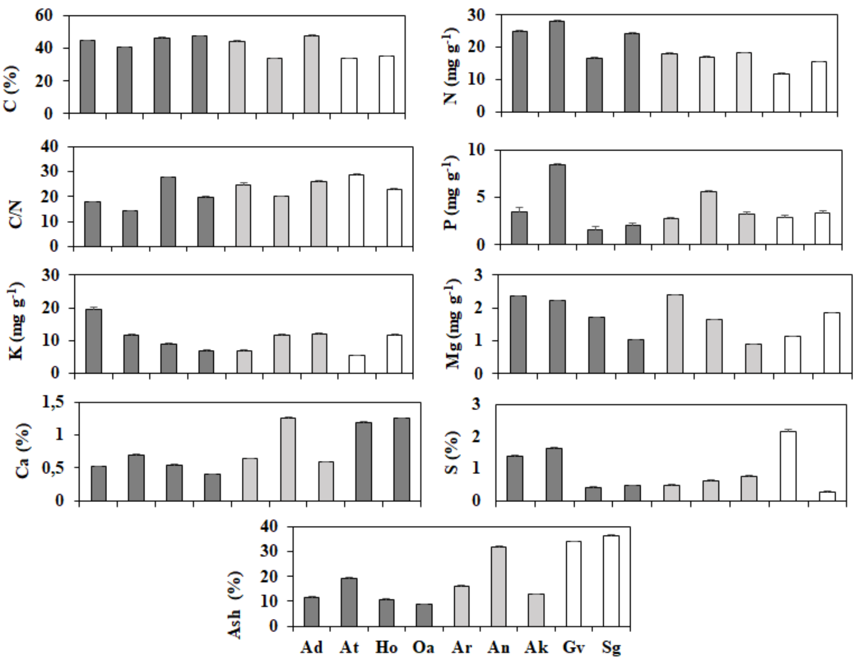

Figure 3. Comparison of the leaf chemical composition of the different species collected on gypsum soils. Values are means ± SE. Dark grey columns = gypsovags, light grey columns = narrow gypsum endemics, white column = wide gypsophiles

As the first approach in determining the differences between plant species and ecological types, after RDA (multivariate) analysis, REML (restricted/residual maximum likelihood) analysis was applied. With this approach, species were not evaluated on an individual basis. In the second approach, the differences between plant functional groups and subtrate types are mentioned as a whole. All REML analyzes were done in R version 2.14.1 (2012). Despite the significance of RDA models, the results of REML models showed that when the different chemical variables were analysed separately, differences between gypsovags and narrow gypsum endemics were not detected as significant (Table 4).

Table 4. Results of REML models of narrow gypsum endemics and gypsovags

Variables	Gypsum plant type		
	d.f.	F	*P*
N	5	4.00	0.102
C	5	0.52	0.502
C/N	5	0.93	0.379
Kül	5	0.96	0.373
Ca	5	2.90	0.090
Mg	5	0.13	0.738
P	5	0.00	0.987
K	5	0.20	0.672
S	5	0.90	0.387

* Degrees of freedom (d.f.), F ratios and P values are shown for $N = 5$ and $\alpha = 0.05$.

In the third statistical approach, homogeneity of variances was tested by Levene test. Based on way ANOVA test results, significant mean differences were detected between species (Ar, An, Ak, Ad, At, Ho, Oa) belonging to these plant groups (Table 5).

Table 5. Results of one-way ANOVAs testing of narrow gypsum endemics and gypsovags

Response variables	species		
	df	F	*p*
C	6, 28, 34	290.951	<0.001
N	6, 28, 34	344.428	<0.001
C/N	6, 28, 34	267.751	<0.001
Kül	6, 28, 34	692.548	<0.001
Ca	6, 28, 34	40231.254	<0.001
Mg	6, 28, 34	343929.580	<0.001
P	6, 28, 34	90.131	<0.001
K	6, 28, 34	95.308	<0.001
S	6, 28, 34	105.401	<0.001

* Degrees of freedom (d.f.), F ratios and P values are shown for $N = 5$ and $\alpha = 0.05$.

Since C, N, Ash, Mg, K and S are homogeneously distributed, Tukey multiple comparison test was applied. Dunnett multiple comparison test was used for non-homogeneous C/N, Ca and P variables.

Alyssum niveum (An) is different from Ar, Ad, Ho and Oa species in terms of K variable. There is a statistically significant mean differences in terms of Ca and Mg variables between all species representing narrow gypsum endemics and gypsovags.

Effect of the substrate on the chemical composition of gypsovags

N, C/N, kül, Mg, P, K and S were homogeneously distributed based on one way ANOVA. Result of one way ANOVAs testing, there is a statistical difference between at least one of the five species (Ad, At, Ak, Ho, Oa). The differences between species in terms of phytochemical content were found statistically significant for all chemical variables (Table 6). Tukey multiple comparison test was applied for C, N, C/N, kül, Mg, P, K and S. Dunnett multiple comparison test was used for non-homogeneous C and Ca variables.

The differences between the individuals growing on gypsum and marly calcareous soils of *Aethionema dumanii* (Ad) were found highly significant in terms of C, N, C/N, ash, Ca, Mg, K and S content except for the P variable. Individuals growing on gypsum and marly calcareous soils of *Aethionema turcica* (At) were found significant in terms of C, N, C/N, ash, Ca, Mg, P, K and S content. Also, the individuals growing on gypsum and marly calcareous soils of *Helianthemum oelandicum* subsp. *incanum* (Ho) were found significant in terms of C, N, C/N, ash, Ca and Mg content. Lastly, individuals growing on gypsum and marly calcareous soils of *Onobrychis argyrea* (Oa) were found significant in terms of C, N, C/N, ash, Ca, Mg, P, K and S content.

Table 6. Results of one-way ANOVAs testing of gypsovags

	species		
Response variables	df	F	*p*
C	7, 32, 39	158,438	<0.001
N	7, 32, 39	358,757	<0.001
C/N	7, 32, 39	594,170	<0.001
Kül	7, 32, 39	212,671	<0.001
Ca	7, 32, 39	11461008,576	<0.001
Mg	7, 32, 39	341622081,009	<0.001
P	7, 32, 39	64,616	<0.001
K	7, 32, 39	124,865	<0.001
S	7, 32, 39	125,293	<0.001

The analysis of differences in chemical composition of gypsovags on gypsum and marly calcareous soils indicated that plants on gypsum had significantly higher Ca, S, K and total ash concentrations and significantly lower C/N ratio and C concentrations than plants of the same species growing on marly calcareous. With the exception of these elements, the difference between species is small and shows similar characteristics. The gypsovags are marked with columns (*) where the difference is significant (Figure 4).

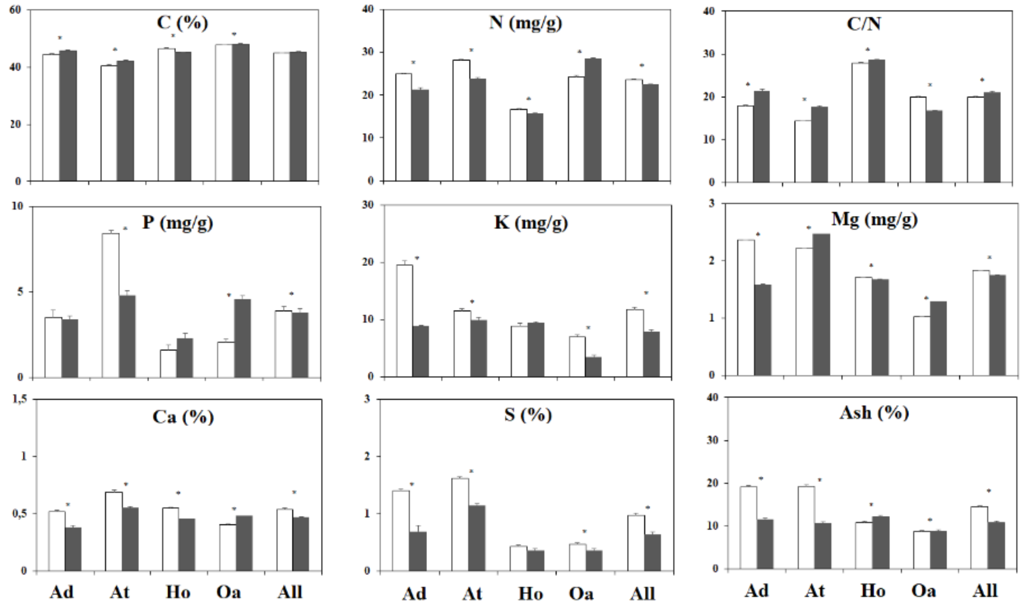

Figure 4. Comparison of the chemical composition of gypsovags growing on gypsum soils (white bars) and marly calcareous (grey bars). Individual species data are shown in combination with averages across all species ('All' columns). Values are means ± SE. See **Table 8** for details on location and chemical composition of the two types of soil (N = 5, α=0,05)

Differences in chemical composition of regionally dominant gypsophiles and gypsovags on growing on gypsum soils

The 'gypsum plant type' factor explained 70% of total adjusted variance and the RDA analysis was highly significant ($p < 0.001$) (Figure 5). Dominant gypsophiles tended to have higher ash, Ca, Mg, S and total ash while gypsovags had higher N, P and K concentrations. This was particularly clear for the *Sideritis gulendamiae* (Sg) and *Gypsophila viscosa* (Gv) dominant gypsophiles that are differentiated from the rest of the plants in this group by its high Ca, Mg, S and low C concentrations (Table 7; Figure 5). Regionally dominant gypsophiles, such as *Sideritis gulendamiae* (Sg) and *Gypsophila viscosa* (Gv), showed a better performance after emergence on gypsum than on normal soils, which also suggests that the chemical characteristics of gypsum soils may play an important role in the distribution of these species. The results reported here help complete our understanding of gypsophily, especially on the chemical adaptation and flexibility of gypsum plants. Depending on edaphism, high Ca, Mg, S, ash and and low C concentrations are effective in differentiation of these plant groups (Figure 5).

The most important factor in explaining gypsophily is phytochemical content. Ca and S concentrations, which are especially effective in gypsum soils, cause a distinction between regionally dominant gypsophiles and gypsovags. In particular, there is a significant mean difference in terms of Ca, Mg and S concentrations. These results strongly support that widely distributed gypsophiles and gypsovags do not show similar ecological strategies, as opposed to narrow gypsum endemics and gypsovags.

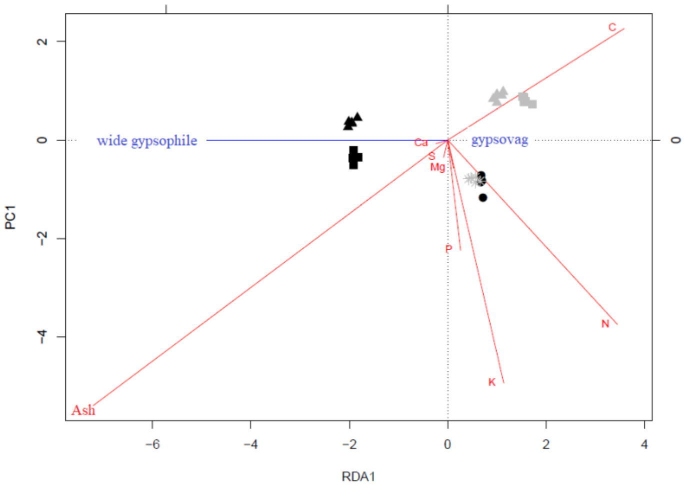

Figure 5. Triplot for the RDA model analysing the effect of 'gypsum plant type' on the leaf chemical composition of plants growing on gypsum ($p < 0.001$, $F = 67.39$, adjusted $R^2 = 0.70$). The 'dominant gypsophiles' type (grey symbols) – opposite to 'gypsovags' (black symbols) – was used for comparison in the analysis and corresponds to the origin of both axes. Symbols: ▲=Gv, ■=Sg, ✳=Ad, △=At, ▣=Ho, ◉=Oa

Table 7. Chemical composition of study taxa

Takson	Substrat[a]	Type[b]	Ca (%)	C (%)	C/N	N (mg/g)	Mg (mg/g)	P (mg/g)	K (mg/g)	S (%)	Kül (%)
Acantholimon riyatguelii	**G**	**N**	0.65 (0.00)	44.30 (0.41)	24.80 (0.66)	17.90 (0.33)	2.39 (0.00)	2.80 (0.05)	6.80 (0.44)	0.49 (0.03)	16.21 (0.19)
Aethionema dumanii	**G**	**GV**	0.52 (0.01)	44.60 (0.10)	17.92 (0.18)	24.90 (0.30)	2.37 (0.00)	3.50 (0.44)	19.50 (0.75)	1.40 (0.03)	11.54 (0.28)
	M-C		0.38 (0.02)	45.70 (0.33)	21.38 (0.42)	21.40 (0.38)	1.60 (0.00)	3.40 (0.21)	8.90 (0.13)	0.69 (0.10)	19.18 (0.23)
Aethionema turcica	**G**	**GV**	0.69 (0.02)	40.50 (0.34)	14.36 (0.09)	28.20 (0.15)	2.23 (0.00)	8.40 (0.17)	11.50 (0.39)	1.62 (0.03)	19.29 (0.25)
	M-C		0.56 (0.01)	42.20 (0.16)	17.67 (0.22)	23.90 (0.26)	2.47 (0.00)	4.80 (0.29)	9.90 (0.43)	1.14 (0.04)	10.65 (0.35)
Alyssum niveum	**G**	**N**	1.27 (0.01)	33.90 (0.31)	19.94 (0.14)	17.00 (0.14)	1.67 (0.00)	5.60 (0.17)	11.70 (0.28)	0.62 (0.04)	32.03 (0.33)
Anthemis kotschyana* var. *gypsicola	**G**	**N**	0.59 (0.00)	47.80 (0.36)	26.13 (0.23)	18.30 (0.18)	0.90 (0.00)	3.20 (0.23)	11.90 (0.29)	0.76 (0.03)	12.73 (0.33)
Gypsophila viscosa	**G**	**W**	1.19 (0.02)	33.90 (0.31)	28.75 (0.49)	11.80 (0.13)	1.15 (0.00)	2.90 (0.19)	5.40 (0.19)	2.15 (0.07)	33.94 (0.30)
Helianthemum oelandicum* subsp. *incanum	**G**	**GV**	0.55 (0.01)	46.60 (0.25)	27.91 (0.15)	16.70 (0.13)	1.71 (0.00)	1.60 (0.33)	8.90 (0.45)	0.42 (0.04)	10.80 (0.44)

	M-C		0.46 (0.00)	45.30 (0.01)	28.67 (0.12)	15.80 (0.06)	1.68 (0.00)	2.30 (0.27)	9.40 (0.22)	0.36 (0.02)	12.20 (0.23)
Onobrychis argyrea	**G**	**GV**	0.40 (0.01)	47.80 (0.10)	19.87 (0.23)	24.30 (0.39)	1.03 (0.00)	2.10 (0.14)	7.00 (0.31)	0.47 (0.02)	8.73 (0.21)
	M-C		0.48 (0.00)	48.10 (0.10)	16.82 (0.10)	28.60 (0.12)	1.29 (0.00)	4.60 (0.18)	3.50 (0.29)	0.36 (0.02)	8.87 (0.27)
Sideritis gulendamiae	**G**	**W**	1.26 (0.01)	35.20 (0.16)	22.87 (0.33)	15.40 (0.20)	1.84 (0.00)	3.40 (0.26)	11.50 (0.39)	0.29 (0.02)	36.53 (0.31)

[a]Type of substratum: G=gypsum soil; M-C=marly calcerous soil, [b]Type of specificity to gypsum substrates: W=widely distributed gypsophile; N=narrow gypsum endemics; GV=gypsovag, (*N*=5), *Mean values and SE are shown in parentheses.

Table 8. Physical and chemical analysis results of soil samples taken from gypsophile and gypsovag species

Study sites	pH	EC (dS/m)	Kireç (%)	Organik madde (%)	Jips (%)	P (ppm)	K (ppm)	C (%)	N (%)	Ca (ppm)	Mg (ppm)
Demirciler Village, Sivrihisar (G)	7.61	0.910	8.52	0.80	87	3.56	36.66	1.31	0.05	40182	1640
Aşağıkepen Village Sivrihisar (G)	7.56	0.825	23.45	1.04	69	2.60	31.93	3.70	0.03	58070	491
Aşağıkepen Village Sivrihisar (G)	7.63	1.275	17.26	1.15	60	12.26	106.25	4.50	0.05	62696	1733
Acıkır, Polatlı (G)	7.55	1.080	15.58	1.68	64	3.49	157.72	2.55	0.05	68981	346
Sivrihisar (G)	8.03	1.600	16.79	1.35	31	5.94	113.09	7.80	0.06	30045	2832
Beylikköprü Village (M-C)	7.52	0.807	55.92	2.13	0	2.74	99.54	7.98	0.07	7069	1024
Aysantı Beli, Ayaş (M-C)	7.71	1.501	7.57	1.81	0	6.22	444.03	1.69	0.08	15102	2443

DISCUSSION

The effect of the special geological substrate and the soils formed from it is highly significant on the distribution and performance of the plants. Gypsum habitats are one of the most important areas that explain this. In the scope of the article, the elucidation of gypsophile endemism in the gypsum soils between Polatlı and Sivrihisar was supported by phytochemical and statistical analyzes (Table 7, 8).

In this study, there is no clear distinction in terms of plant nutrients in the narrow gypsum endemics and gypsovags. This supports that they show similar ecological strategies. There may be no difference in phytochemical content, but it is possible to detect a distinction in accumulating Ca-OX compounds that might be clarified by further element composition analyzes. Because plants accumulate calcium oxalate crystals to reduce the toxic effect of calcium in habitats with a high calcium concentration from the substrate (Palacio et al., 2014). However, in this study, calcium oxalate accumulation may not be present since these plant groups have similar characteristics in terms of Ca or Ca-OX can also be effective even at low Ca concentration since it has antiherbivori properties.

According to the refuge model hypothesis shown by narrow gypsum endemics, these species are low-competitive and stress-tolerant plants that escape from competition. According to Grime's stress-tolerant strategy (S), the growth rate of these plants is slow. Therefore, narrow- gypsum endemics are highly affected by grazing and anthropogenic effects and are an important group of plants that should be given priority in conservation biology. Narrow gypsum endemics do not specialize in gypsum against the restrictions created by the gypsum soils, but they cannot compete with other species other than these extreme habitats due to their stress-tolerant nature.

In the gypsovags growing on gypsum and marly-calcareous soils, the difference was significant in terms of all elements. The concentrations of Ca, S, ash and K were higher in those grown in gypsum soils, while C/N and C concentrations were lower. With the exception of these elements, the difference between species is small and shows similar characteristics. In this case, gypsovags growing in gypsum soils show multiple nutritional strategies to cope with the atypical chemical content of gypsum soils. In addition, when the individuals of *Aethionema turcica* grown on gypsum compared to those grown in marly calcareous soils, Ca concentration was higher and Mg concentration was lower. Ca intake negatively affected Mg intake, causing Ca: Mg antagonism.

Observing morphological differences in the same species of gypsovags growing in gypsum and non-gypsum soils can be interpreted as an indicator of adaptation to gypsum soils. When the individuals grown on gypsum of the *Onobrychis argyrea* are compared morphologically with the individuals grown in marly calcareous soils, the plant height is shorter, the leaf surface area and leaf size are smaller.

Widely distributed gypsophiles are the most important plant group that explains the specialization of gypsum with its phytochemical content and in the enlightenment of adaptation to gypsum soils. In this study, widely distributed gypsophiles tend to show high concentrations in terms of Ca, Mg, S and ash ratio, while gypsovags tend to show high concentrations in terms of N, P and K. This is particularly clear in *Sideritis gulendamiae*, which is a wide gypsophile. In *Sideritis gulendamiae* and *Gypsophila viscosa*, ash has a low concentration in terms of C, while Ca, Mg, and S showed high concentrations.

Endemic species have been studied extensively in explaining gypsophily. However, *Gypsophila viscosa* is a non-endemic species with wide range of distribution. *Sideritis gulendamiae*, which is endemic, has specialized in gypsum with its high concentration of Ca, Mg and S, and has demonstrated with its specialist model. In Turkey, 8 of 58 different *Gypsophila* species are commonly found in gypsum substrates. Thus, *Gypsophila viscosa* also made a remarkable contribution in explaining gypsophily.

In the gypsum areas between Polatlı and Sivrihisar, the arid period is quite long with the arid-semi arid climate conditions and the drought severity is high. Gypsophile and gypsovags on gypsum develop adaptation with vegetative organ structures by replacing the above-ground organs to prevent or reduce water loss in the arid cycle. In *Gypsophila parva*, one of the annual gypsophile species, the leaves are reduced, short and linear. In gypsophiles such as *Verbascum gypsicola* and *Acantholimon riyatguelii*, the leaves show succulence.

The most important factor in explaining gypsophily occurring in gypsum habitats is phytochemical content. Ca and S concentrations, which are especially effective in gypsum soils, cause a distinction between widely distributed gypsophiles and gypsovags. This supports that wide gypsophiles and gypsovags do not show similar ecological strategies. Wide distributed gypsophiles, on the other hand, have the opportunity to spread to wider areas by avoiding competition, unlike narrow-spread gypsophiles. They are gypsum specialists who can penetrate the physical crust early in their lives and have physiological arrangements that can withstand chemical limitations of gypsum soils. Thus, they are qualified as gypsum specialists.

The gypsum habitats located in the geological island location not only test evolutionary questions but are also ideal models that allow extensive research on community ecology and ecosystem functions. Future studies involving gypsum ecosystems should combine the fields of ecology, evolution, physiology and genetics. There are many topics that have not yet been discovered or interpreted in gypsum habitats. We are very far from both in terms of our country and in the world in terms of determining the genes responsible for adaptations of plants grown in gypsum habitats, as well as determining the genotype and phenotypes of plants.

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Oral Presentation
Wednesday
Diversity of Animal species, Systematics and Phylogeny-1

Testing and Utility of Microsatellite loci in *Hyla orientalis*

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ABSTRACT

Microsatellites are one of the most widely used tools in population genetics and conservation biology. These markers have been developed for some amphibian species. Assessment of appropriate genetic markers for population genetic studies in amphibians is critical because amphibians are declining globally. Microsatellite loci are widely used in population and conservation genetic studies of amphibians. We tested amplification success and polymorphism in 19 (WHA1-20, WHA1-25, WHA1-103, WHA1-67, WHA5-22A, WHA1-104, WHA1-61, Ha-A11, HaB12, HaB5R3, Ha-A119, Ha-A119, Ha-A136, Ha-A110, Ha-A139, Ha-A116, Ha-T60, Ha-T66, Ha-T67 and Ha-T68) previously developed microsatellite loci, in *Hyla orientalis* species from Rize, Turkey. Eight individuals were used in this study. DNA was isolated according to the manufacturer's instruction. The PCR reactions were carried out in 25 µL reaction mixture, containing 12.5 µL master mix, 2.5 µL primer mix, 1 µL of DNA template and remaining concentrations was filled with RNase-free water. Forward primer fluorescently labeled with FAM, VIC, NED or PET. We succeed to amplify twelve microsatellite loci, but one of (WHA1-104) them were not genotyped in fragment analysis. According to microsatellite analysis, 66.67 % of the amplifying loci were polymorphic. The mean number of alleles, effective alleles, observed heterozygosity (H_O) and expected heterozygosity (H_E) were found as 2.92, 2.15, 0.39 and 0.37, respectively. Most of those loci were used in *H. orientalis* by other studies in the literature. Some of them were amplified in previous studies, but some of them were amplificated for the first time for *H. orientalis* in this study (like Ha-A11, Ha-136 and Ha-B5R3). Our results provide additional genetic support for the existing literature. It is important to evaluate and reveal useful microsatellite loci in target species for future conservation studies, aiming to address taxonomic uncertainties, or to study genetic variability and differentiation among populations.

Keywords: Amphibia, Microsatellite, *Hyla orientalis*

Oral Presentation
Wednesday
Diversity of Animal species, Systematics and Phylogeny-1

Mitochondrial D-loop Heteroplasmy in Anatolian Domestic Pigeon Breeds

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ABSTRACT

Domestic pigeons have approximately 350 different breeds today, selected by breeders throughout time for their different characteristics. This intense artificial selection gave rise to a great phenotypic diversity. There are many local breeds and others, distinct in morphology and behaviour, have been present for a long time in Anatolia. However, there is no genetic and phylogenetic studies with regard to them. Thus, this study aimed to understand phylogenetic relationships among these breeds. For this purpose, the mitochondrial partial D-loop (850 bp) was sequenced in 96 different individuals mostly from western Anatolia. Results showed that individuals have distinct lengths D-loop fragments (between 835 and 1019 bp) due to length heteroplasmy in the 61 bp long VNTR at the end of the D-loop whose repeat number changes from 2 to 7 and; in the T stretch between the positions 382-391, having 10 or 9 thymines. According to these findings, 30 unique D-loop haplotypes were defined. Bayesian phylogenetic analysis of the D-loop haplotypes could not differentiate between major breed groups. Although D-loop is a candidate marker in many animal species for phylogenetic studies due to high-level of polymorphism, because of the heteroplasmy seen in the pigeon breeds, it is not an informative marker for a reliable phylogeny.

Keywords: Columba livia domestica, domestic pigeon, *D loop*, heteroplasmy, phylogeny

Oral Presentation
Wednesday
Diversity of Animal species, Systematics and Phylogeny-1

Geometric Morphometric Analysis of Dorsal Head Shape Variation in Anatolian *Bufo* Toads

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ABSTRACT

Geometric morphometrics (GM) is a useful tool to investigate shape differences, compare morphological structure among and within species, and to discover biologically significant morphological variations remained hidden. The use of geometric morphometrics for studying phenotypic variations in herpetology has dramatically increased in the last decades. Its applications in herpetology have shed new light to the notable diversity observed among amphibians and reptiles. In the previous studies based on traditional morphometry, different variations were reported between *B. bufo* and *B. verrucosissimus* in terms of head size and shape. Here, we tested dorsal head shape variation among *B. bufo* and two genetical lineages of *B. verrucosissimus* in Anatolia using two-dimensional landmark-based GM methods for the first time. For this, we collected dorsal head photos of a total of 41 specimens (20 ♂, 21 ♀), then digitized the positions of 13 fixed landmarks and 30 sliding semilandmarks to record shape variation. Afterwards, the dataset was transferred into R environment and statistical analyses were carried out using '*geomorph*' and '*Morpho*' packages. According to the results, a statistically significant correlation was found for the head shape of groups ($P < 0.05$). As a result of multivariate analyses, convincing separation was observed between northern *B. verrucosissimus* group and southern *B. verrucosissimus* - *B. bufo* groups in the morphospace. Pairwise comparison of Procrustes coordinates presented identical findings, as well. Briefly, we uncovered the shape variations on the parotoid divergence, nasal and orbital regions. The northern *B. verrucosissimus* specimens have overtly smaller nasal region than the other groups. Besides, divergent parotoid glands are more specifically observed in the southern *B. verrucosissimus* specimens as against the other groups. Our outputs, also, verified some relevant studies carried out with traditional morphometric methods in the literature. Therefore, this study contributed to explaining head shape variation between the species using GM methods.

Keywords: Landmark, PCA, Parotoid, *Bufo verrucosissimus*, Geometric Morphometrics

Acknowledgement: This study was supported by TUBITAK under project number 114Z823.

Oral Presentation
Wednesday
Biodiversity, Landscape, Tourism-1

Perceptions of Facebook Users on The Reinstatement of Consumptive Tourism in Botswana

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ABSTRACT

The paper evaluates the perceptions of Facebook users regarding the reinstatement of consumptive tourism in Botswana. Controlled hunting has always been embraced in Botswana since time immemorial. Hunting was done at subsistence level as part of some communities' culture. Furthermore, trophy hunting was a major component of consumptive tourism in Botswana and it contributed to the country's GDP as well as community social upliftment programs. Hunting was however, suspended in 2014 as a wildlife conservation measure. This move was applauded internationally by staunch conservationists and put Botswana on a pedestal of a leader in sustainability issues. However, in 2019, the government took a decision to lift the temporary ban on hunting and this was met with an uproar especially from the international community. The paper employs thematic analysis to determine the perceptions of 'pro-hunting Facebook users' and the 'antihunting Facebook users'. The results revealed that the anti-hunting group perceive animal rights as priority to human life as thy perceived people to be encroaching on animal habitat. Hence this group dis not have regard for the ecological and social negative impacts that have come as a result of the hunting ban. On the other hand, the pro-hunting group were of the view that the 'west' were using bullying tactics and twisting facts against Botswana disregarding the country's sovereignty. Hence a 'them' and 'us' scenario. The paper concludes that biodiversity for tourism requires striking a balance between social equity, ecosystem integrity and economic growth inline with sustainable development. However, achieving this will always be an uphill battle since proponents of the three dimensions of sustainable development sometimes fail to reach a compromise.

Keywords: Botswana, Consumptive Tourism, Facebook, perceptions

Oral Presentation
Wednesday
Biodiversity, Landscape, Tourism-1

Classification of Perennial Plants and Utilization Possibilities in Landscape Architecture

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ABSTRACT

With rapid urbanization, people are rapidly moving away from the natural environment and their longing for nature increases day by day. People need to meet this need in the artificial environment where they live, in urban open green areas. It is observed that woody species are predominantly used in landscape projects in urban open areas. Perennial plants, which are defined as herbaceous plants that live for more than two years and generally bloom every year, are used very limitedly in urban landscape applications in our country, although they contain many features such as their contribution to the urban ecosystem, their abilities to reflect nature in the city, their long vegetation period and their contribution to the implementation of planting design principles. However, the inclusion of perennial plants in landscape designs in urban areas and the use of natural species, especially in countries with rich plant resources such as our country, will be very important in terms of both protecting biodiversity, improving the ecosystem and contributing to the country's economy.

In this study, the classification of perennial plants was made, their use in Landscape Architecture and their contribution to urban areas were examined with the help of the literature and suggestions were made.

Keywords: Perennial plants, planting design, herbaceous plants

Oral Presentation
Wednesday
Biodiversity, Landscape, Tourism-1

Investigation of Recep Tayyip Erdoğan University Main Campus Green Areas in Terms of Ecosystem Services

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ABSTRACT

Due to the increasing world population and global climate change natural resources has faced the danger of depletion. As a result this, natural resources conservation and ecological studies have gained great importance. Ecosystem services, which we have started to hear from the beginning of the 21st century, which means the benefits people derive from ecosystems, have provided people with many benefits from natural processes or natural resources in daily life, thus making life a better quality.

In this study, the ecosystem services provided by the green areas of Rize Recep Tayyip Erdoğan University Zihni Derin Campus (Central Campus) were determined. In the study, first of all, the plant assets and the total amount of green areas in the campus were determined, then the ecosystem services provided from these areas were classified and examined.

Keywords: Ecosystem Services, Green Areas, Urban Spaces, Rize

Oral Presentation
Wednesday
Diversity of Plant species, Systematics and Phylogeny-1

Genome wide analysis and characterization of *Phaseolus vulgaris* GPAT gene family under different abiotic stress conditions

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ABSTRACT

Lipids are major components involved in the structure of the cell membrane and it has also important roles in plant growth and development. sn-Glycerol-3-phosphate 1-O-acyltransferase (GPAT) involved in the biosynthesis of glycerolipids has two types, sn-1 and sn-2. While sn-1 type GPATs take part in lysophosphatidic acid (LPA) synthesis, sn-2 type GPATs take part in the synthesis of monoacylglycerol (2-MAG). *Phaseolus vulgaris* is the most widely cultivated legume plant worldwide. *P. vulgaris* GPATs (PvGPAT) have not been adequately characterized. The aim of this study is to determine the expression levels of GPAT genes in P. vulgaris leaf tissue under salt and drought stress and to perform genome-wide analysis of GPAT gene family members using bioinformatics tools. In the common bean genome, 12 PvGPAT genes with molecular weights of 50.2 kDa to 60.4 kDa, amino acid numbers between 376 and 539, theoretical isoelectric point ranged in 8.41 and 9.46, and instability index between 31.84 and 51.38 were detected. As a result of gene structure analysis, the estimated number of exons and introns was between 2 and 12, respectively. Phylogenetic analyses were performed among GPAT proteins of *P. vulgaris*, *Arabidopsis thaliana* and *Glycine max* species. It has been found that *A. thaliana* and *G. max* GPAT proteins have phylogenetic relationships with common bean ones. PvGPAT4 and PvGPAT10 genes were found to be segmentally- duplicated genes. The differences in the expression levels of GPAT genes in common bean leaves were determined under salt and drought stress. According to this analysis, while PvGPAT5 had the highest expression increase under salt stress, PvGPAT8 had the lowest expression level. On the other hand, it was not significantly increased any gene levels under drought stress. The highest expressed gene was PvGPAT12 under both salt and drought stress. The results of the present study will provide important information about GPAT gene family members in common bean and shed light on future studies.

Keywords: Salt stress, drought stress, lipids, Glycerol-3-phosphate 1-O-acyltransferase, gene expression.

Oral Presentation
Wednesday
Diversity of Plant species, Systematics and Phylogeny-1

Molecular Biodiversity of *Salix alba* L. and *Salix excelsa* J.F. Gmelin Populations in Turkey

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ABSTRACT

Salix alba and *Salix excelsa* morphologically very close species are always sharing the same habitats across the most rivers of Turkey. In the study, twenty three *Salix* populations (*S.alba/excelsa*) were gathered from 10 rivers (Kızılırmak, Göksu, Aksu, Melendiz, Seyhan, Ceyhan, Susurluk, Çoruh, Fırat and Aras). One chloroplast DNA (*mat*K) and two nuclear ribosomal DNA (*ITS* and *ETS*) regions were used to understand the molecular biodiversity and relationships of sixty nine *Salix* individuals. External transcribed spacer (*ETS*) was determined as the most informative and diverse region for *Salix* populations. Inconsistency between the two constructed phylogenetic trees (cpDNA and nrDNA) was explained by the hybridization due to chloroplast capturing between individuals. Incomplete lineage sorting of *Salix alba/excelsa* has also play significant role in ongoing evolution process of both species. As a conclusion, taxonomically, *S.alba* and *S.excelsa* can be considered as conspecifics with very similar morphology and molecular background.

Keywords: Molecular Phylogeny, *Salix alba*, *Salix excelsa*, Barcode, Turkey.

Acknowledgement: This study has been funded by the Scientific and Technical Research Council of Turkey (TUBITAK) with project TOVAG 213O154 "Molecular Phylogeny of Turkish *Salix* L. species and genetic characterization of two economically valuable willow species (*Salix alba* and *Salix excelsa*) for tree breeding purposes" and supported by Middle East Technical University (METU) with project BAP-01-08-2012-013 "Türkiye Söğüt Türlerinin Moleküler Filogenetiği".

Oral Presentation
Wednesday
Diversity of Plant species, Systematics and Phylogeny-1

Taxonomical Notes on *Paronychia kurdica* Boiss. Complex Based on nrDNA ITS in Turkey

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ABSTRACT

Paronychia kurdica Boiss. (Asteraceae) is perennial herbaceous plants with stems branched at base, leaves and sepals without aristas and unproductive shoots are rare. This species is represented with 3 subspecies and two related varieties in our country. In this study, the *P. boissieri* Rouy. taxon, known as its morphologically close relative with all subspecies of the *P. kurdica*, was evaluated molecularly according to the nrDNA ITS data. The analyses demonstrated that all taxa listed under *P. kurdica* and *P. boissieri* were clustered in the same clade with full support (100) value. The results do not supply any resolution at subspecies level *P. kurdica* complex though the taxa have morphological characters for separation. Furthermore, the results revealed that *P. kurdica* and *P. boissieri* should be conspecific. The analysis also shows that *P.macrosepala* Boiss. and *P. kurdica* are sister species.

Keywords: ITS, nrDNA, Paronychia, Turkey

Acknowledgement: This study was supported by TUBITAK with project number 111T820.

Oral Presentation
Wednesday
Environmental Toxicology-1 & Microbial Biodiversity-1

Orchid Originated from Root *B. popilliae* 5O8 Isolate's Bioremedant Properties and Effect of *Zea Mays* Germination on Copper Being

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ABSTRACT

Heavy metal pollution is becoming an increasing environmental problem and human health threat. Determination of bioremedant and plant-growing strains. Removal of heavy metals with plants and bacteria 5O8 isolate was characterized using conventional test methods.. The presence of indole acetic acid (IAA) activity was determined spectrophotometrically. Heavy metal tolerance was first investigated by solid agar method. Dilution method was applied using Mueller Hinton Broth liquid medium to determine the maximum value that can be produced in the presence of copper. Culture method was used in the densitometer environment in order to determine the reproductive properties of bacteria in the presence and absence of Cu in different pH ranges and in the media. Germination experiments were carried out with Cu. 5O8 is a gram positive spore bacillus, it can grow well at broad temperature (10-45 ° C), pH (4.0-9.0) and ≤ 10% salt. Nitrate nitrite reduction but could not hydrolyze amylase, urease, lecithinase and gelatine. Plant growth promoting properties were examined, it was observed that strong siderophore, ACC deaminase, ammonium production and phosphate solubility. It was found that it was able to grow in the presence of CuCl2 (≤2.5 mM), AgNO3 (≤1 mM), ZnSO4 (≤0,5 mM) and PbNO3 (≤10 mM). It was observed that germination was good in the presence of bacteria and copper. This study shows that field studies can be done using bacteria and plants. Microorganisms could be used in making organic fertilizers. New bioaccumulator plant is considered by grafting

Keywords: *B. popilliae*, Metal tolerance, Germination.

Oral Presentation
Wednesday
Environmental Toxicology-1 & Microbial Biodiversity-1

Determination of Physico-Chemical Water Quality Values of Pazar Stream

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ABSTRACT

Water is one of the most important foods in the world. This study aimed to evaluate the annual physico-chemical parameters of Pazar Stream. Measurements were as follows; water temperature 11.9 ºC, pH 7.32, dissolved oxygen 10.1 mg/L, turbidity 48.91 NTU, electrical conductivity 76.75 µS/cm, BOD5 1.15 mg/L, bicarbonate 43.1 mg/L, carbon dioxide 1.78, calcium 6.9 mg/L, magnesium 2.67 mg/L, total hardness 28.22 mg/L, total alkalinity 26.13 mg/L, NO2-N 0.0019 mg/L, NO3-N 0.57 mg/L, and suspended solid matter 56.51 mg/L. When the results are evaluated, it has been determined that all physical and chemical properties of Pazar Stream are class I according to national standards specified in the legislation and it is not polluted in terms of nitrite and nitrate.

Keywords: Water quality, Pazar Stream, Physico-chemical

Oral Presentation
Wednesday
Environmental Stress on Biodiversity

Determination of Astrobiological Compatibility of Plants with Different Photosynthesis Metabolisms: UV Radiation, Salt and Boron Tolerance

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ABSTRACT

Years of astrobiological studies generally cover the cultivation of living organisms and plant species in space. Often the aim is to meet the nutritional needs of astronauts to produce plants with high nutritional value and adapt to the space environment. In this study, seeds of plant species with different photosynthetic metabolisms were subjected to space-like conditions. In the experiments on salt tolerance, 5000, 10000 and 15000 ppm NaCl applications were made and the salt tolerance experiments were terminated because of the problems in the development of the plants under these conditions. In addition, Lactuca sativa L. cv. Experiments were initiated to observe the adaptation of plants with different photosynthesis mechanisms. 055 (C3 metabolism) and Sedum album L. (CAM metabolism) plants were tested for UV radiation, salt and boron tolerance, but it was found that these plants could not adapt to space-like conditions. In the later parts of the study, Zea mays cv. Dekalp 6630 maize and Phaseolus vulgaris cv. Experiments with rooster seeds continue.

Keywords: Astrobiology, UV, Salinity, Tolerance, Boron, Photosynthesis, Metabolism

Acknowledgement: We would like to thank TUBITAK for financially supporting the study within the scope of TUBITAK 2209-A project.

Oral Presentation
Wednesday
Environmental Stress on Biodiversity

Effects of Culture Media and Culture Conditions on Seed Germination of *Physalis minima* L.

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ABSTRACT

This biotechnological approach was designed to determine the most effective media, plant growth regulators (PGRs) and culture condition for the germination of *Physalis minima* L. seeds via plant tissue cultures. During seed germination experiments, Murashige and Skoog medium (MS) and Linsmaer and Skoog medium (LS) were preferred as basal media. As sterilization method, 5% sucrose application for 24 h followed by 37% hydrogen peroxide (H_2O_2) application for 30 min was used. Viability of seeds with and without sterilization was calculated using the 2,3,5 triphenyl tetrazolium test. The effects of completely dark and 16/8 photoperiod applications on germination of seeds were investigated. 0.25 and 0.5 mg/L GA_3, 6-BA and zeatin were individually employed in the course of seed germination trials. LS and MS media without any PGR were used as controls. LS media containing 0.5 mg/L GA_3 was found to be the most effective PGR tested with 28 germinations in terms of the germinated seed after the 1 month later in 16/8 photoperiod culture conditions. At the end of the six culturing period, the highest shoot length was obtained from MS medium supplemented with 0.25 mg/L GA_3 with 16.91 mm per germinated seed after the one month. Unlike these entire results MS medium added 0.5 mg/L zeatin was gave the most efficient leaf number with 3.65 per germinated seed. It was determined that the used culture media and conditions were effective on germination of *P. minima* seeds *in vitro* with these results

Keywords: *Physalis minima*, GA_3, Zeatin, 6-BA, Seed germination, Tissue culture

Oral Presentation
Wednesday
Environmental Stress on Biodiversity

Genome Wide Analysis of Glutathione S-Transferase Gene Family in *Phaseolus vulgaris* under Drought and Salinity Stress

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ABSTRACT

Glutathione S-transferases (GST) found in many developed organisms are enzymes that play an important and key role in the protective against reactive oxygen species. GSTs take part in mechanisms that develop against biotic and abiotic stresses and especially protect plants under various stress conditions. The aim of this study is to identify some special characters by performing genome-wide analysis of the GST gene family in *Phaseolus vulgaris*. Fifty-five Pv-GST proteins were identified in the *P. vulgaris* genome. These proteins range in molecular weight from 15.02 kDa (Pv-GSTU-24) to 47.99 kDa (Pv-EF1BG-2). Also, amino acid numbers are between 132 (Pv-GSTU-24) and 420 (Pv-EF1BG-1). Theoretical isoelectric points vary between 5.03 (Pv-GSTL-2) and 9.61 (Pv-GSTT-2). The number of exons predicted in Pv-GST genes is at least 2, at most 10, and the average number of exons is 4. The number of introns is at least 1 and at most 9, and the average number of introns is 3. As a result of phylogenetic analysis, Pv-GST proteins and GST proteins of *Arabidopsis thaliana* and *Glycine max* plants were clustered in 3 main groups (A, B and C). Expression profiles of Pv-GST genes in different tissues of common bean under drought and salinity stress were determined using RNAseq data. The results of this study will provide important information for understanding the molecular structure of the GST gene family in *P. vulgaris*.

Keywords: Cis acting elements, Glutathione S-transferas, Ka/Ks ratio, positive selection, RNAseq.

Oral Presentation
Wednesday
Environmental Stress on Biodiversity

Comparative Effects Of Melatonin On Callus Formation And Proliferation Via Leaf Explants In *Alfalfa (Medicago sativa* L.)

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ABSTRACT

Melatonin is significant component that influences many adaptive functions and developmental processes in plants. In this study, effect of melatonin on the callus formation and regulation of the somatic embryogenesis in *alfalfa Muş* and *Sazova* ecotype under 0,125 mg/ml and 1 mg/ml dosage was investigated. Calli, obtained from leaf explants, were grown on Murashige and Skoog (MS) medium supplemented with 0,125 or 1 mg/ml melatonin, and subsequently were cultured in the light on slighlty modified Murashige and Skoog medium for days. Melatonin induced formation of calli with significantly greater mass and numbers of callus, especially when explants were cultured in the dark on modified Murashige and Skoog medium. The addition of the same concentration melatonin improved the somatic embryo ability of cultures on medium containing low amount of 2,4-D or kinetin. The positive effects of melatonin on callus growth and somatic embryo formation in the light were significantly increased when calli were exposed to a 16-h photoperiod. When compared the control callus concentration of 0,0125 mg/ml melatonin was found to be optimum level for callus formation which was a good indicator of somatic embryogenesis. The healthy calli were detected within first 15. days of 1 mg/ml melatonin dosage. In addition, three callus initiation media were tested to determine effects of medium constituents on somatic embryogenesis of *alfalfa*. *Sazova* the highest embryogenic callus formation was observed on 0,0125 mg/ml melatonin + 1 mg/ml 2.4-D medium (81,74%). *Muş* the highest embryogenic callus formation was observed on 0,0125 mg/ml kinetin + 1 mg/ml melatonin medium (85,41%). This study demonstrated, under *in vitro* conditions, that the application of melatonin can significantly enhances the positive effects of callus formation on *alfalfa*; it was also verified that the concentration of melatonin could be important parameter to be considered in adjusting the plant growth regulation content in media for this plant.

Keyword: Melatonin, *Alfalfa*, somatic embryogenesis.

Oral Presentation
Wednesday
Diversity of Plant species, Systematics and Phylogeny-2

Phylogenetic and Phenotypic Studies of *Coffea* and *Psilanthus* Genus

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ABSTRACT

Currently, 140 coffee species, from *Coffea* and *Psilanthus* genus, are recorded in the world, including the two cultivated species*, Coffea arabica* and *Coffea canephora.* A large part (60%) of these wild species are classified as endangered in the IUCN list and 45% are not conserved in any *ex-situ* collection. In parallel, their phylogenetic relationships are complex and not yet fully elucidated, only few biochemical, genetic and phenotypic studies have been conducted so far. While, wild coffee species could be critical for the sustainability of coffee production facing to climate changes.

First, to better understand their phenotypic diversity, we studied 36 species from the collection of Kianjavato in Madagascar. We found contrasted phenotypes like the ratio of internode mass to leaf mass, the length of the maturation phase as well as different reproductive strategies suggesting a complex pattern of traits variability probably linked to local adaptation. Second, a phylogenetic analysis with 52 species was performed based on full genome sequencing. Assembly of plastid genomes and 28,800 nuclear SNPs revealed complex relationships between geographical groups due to retention of ancestral chloroplast polymorphism and by interspecific hybridization without chromosomal doubling. In particular, *C. canephora* shows a complex evolutionary history probably linked to an ongoing process of sub-speciation. Finally, we constructed the Wild Coffee Species database (http://publish.plantnet-project.org/project/wildcofdb_en), to store the information for 140 coffee species, for which 84 contain a photo gallery and 82 contain sequencing data.

These studies provide insight into the understanding the evolution of *Coffea* diversity related to the chloroplast and nuclear genomes and complex patterns of phenotypic trait variability. This shows also the importance of *ex-situ* conservation for research and for future breeding.

Keywords: Phylogeny, Phenology, *Coffea*, *Psilanthus*, *ex-situ* collection.

Oral Presentation
Wednesday
Diversity of Plant species, Systematics and Phylogeny-2

Analysis of Morphologıcal, Micromorphologica and Molecular Systematic Properties of *Rubus* L. (Rosaceae) Species in Rize Province

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ABSTRACT

Eight *Rubus* taxa distributed in Rize were compared based on morphologic, micromorphologic and molecular data. Plant materials were collected during field studies in 2019. The collected samples were identified according to Flora of Turkey and kept as herbarium specimens. Stem, leaves and the flowers of *Rubus* taxa were examined as morphologically and micromorphologically under stereo microscope and SEM. Plant genomic DNAs were isolated from fresh leaves by suitable methods. Then the ITS regions were amplified by PCR and sequenced. The stem, leaf trichomes, trichome types and thorn structure were found to be distinctive among these eight taxa when micromorphological images were examined. As a result of morphological findings, *Rubus* represented eight distinct taxa in terms of leaf, fruit, thorn, shape, petal, leaf and leaflet size, structure, number and shape of fruit grains, leaf adaxial and abaxial surface, trichome amount of petal surface, color of fruit and sepals and leaf edge structure. Molecular data showed that the total length of the ITS region of the examined taxa ranged from 709 to 731 bp. A phylogenetic tree based the ITS sequences showing the relationships of eight taxa was obtained using Bioedit and CLUSTAL W. According to phylogenetic tree *Rubus hirtus* Walds&Kit and *Rubus tereticaulis* PJ. Mueller are the closest relatives however, *Rubus sanctus* Schreber is the more distant species in *Rubus*.

Keywords: ITS, *Rubus*, Morphology, Micromorphology, Phylogenetic Tree.

Oral Presentation
Wednesday
Diversity of Plant species, Systematics and Phylogeny-2

Importance of Using Multisampling for Plant Molecular Phylogenetic Studies: A Case Study on *Nonea bakuensis* (Boraginaceae) Endemic to Azerbaijan

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ABSTRACT

During the past three decades, molecular phylogenetic studies have significantly influenced our views of organismal relationships from the species level to kingdoms. However accurate identification of the specimens subjected in molecular phylogenetic studies and their number have long been emphasized. This study aims to clarify phylogenetic position of *N. bakuensis* with multisampling based on nrDNA ITS used by previous researchers in the genus and emphasize the importance of using of more than two specimens for molecular phylogenetic studies. *N. caspica* distributed from the Central Asia to Europe was morphologically split into four varieties (var. *bakuensis*, var. *diffusa*, var. *picta* and var. *turkestanica*). Later *N. caspica* var. *bakuensis* endemic to Azerbaijan was upgraded to species level as *N. bakuensis* based on morphological assessments. Subsequent researchers supplied additional evidences obtained from nutlets micromorphology and molecular data for its specific level. In this study, three different ITS accessions of *N. bakuensis* are newly generated. The sequences added to previously generated data for the new phylogenetic analyses. Maximum Parsimony and Bayesian Inference were used for the phylogenetic reconstruction. The results show that all accessions of *N. bakuensis* are grouped at two distinct clades in contrast to previous study but support treating it as distinct species. Moreover present findings revealed non monophylogenetic origin of *N. bakuensis* and emphasize the importance of using of more than two specimens for molecular phylogenetic studies.

Keywords: Caucasia, *Cryptanthera*, phylogeny, taxonomy

Acknowledgement: I thanks to Vugar KARIMOV to share samples with me and to Kamil COŞKUNÇELEBİ for his suggestions to improving of the earlier version of this study.

Oral Presentation
Wednesday
Diversity of Plant species, Systematics and Phylogeny-2

The globulin and leaf protein profiles of *Medicago sativa* for the determination of protein content among varieties in Turkey

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ABSTRACT

Seed storage proteins classified into four groups on the basis of their solubility as albumins (water-soluble), globulins (soluble in dilute saline), prolamins (soluble in alcohol/water mixture) and glutelins (soluble in dilute acid or alkali solution). The globulins are widely distributed type of storage protein present in both dicots and monocots. In alfalfa (*Medicago sativa*), the major seed storage protein is medicagin which is a legumin-like globulin and it comprise thirty percent of proteins from cotyledons of mature seeds. On the other hand, alfalfa is the most nutritious source as forage due to its high protein content. In this study, it was determined the profile of globulins and total protein of leaves in seventy four varieties of alfalfa, because the similarities or differences of the expressed proteins in a plant gives information about its physiology and genetics. To examine the protein profiles, firstly, alfalfa leaves were obtained, and then the total proteins from leaves and the globulins from mature seeds were extracted. The extracts were separated in SDS-PAGE. As a result, the total protein bands were greatly consistent for all the alfalfa varieties. When the protein profiles of alfalfa varieties were compared, there was only the amount differences in the leaf proteins obtained from the varieties. Globulin protein profiles demonstrated only slightly differences in polypeptide composition within each of the three major classes of storage protein. The total fragments of globular protein bands verified among the tested plants from 66 kDA to 14 kDa. However, only kalender variety was detected two more extra bands among the tested samples. This study is the first report on the variation of genetic Turkish alfalfa varieties by using seed storage and total protein analysis techniques.

Keywords: Seed storage proteins, globulins, alfalfa, leaf proteins, *Medicago sativa*

Oral Presentation
Thursday
Diversity of Animal species, Systematics and Phylogeny-2

Preliminary Indications of the Determined Aphid Species on *Populus* spp. from Karaman, Muğla and Antalya Provinces of Turkey

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ABSTRACT

Aphid species are economically, ecologically and agronomically important insect group as they have characteristic life cycle and foraging behavior in terms of close relationships with their host plants, ant species and ladybirds. They cause nonnegligible amount of damages to plant growth and production by sucking floem and transmitting plants viruses. Aphids sometimes lead to gal formation, colour differentation and deformation in leaf, these symtomps are easily recognized on *Populus* species. Preliminary findings of the study conducted in Karaman, Antalya and Muğla provinces to determine aphid species on host plants including *Populus* spp. indicated that they caused high amount of gall formation on these species. So far about 150 samples have been collected from study area. As a result of the evaluation of the sampled specimens, *Chaitophorus indicus, Chaitophorus melanosiphon, Chaitophorus populialbae, Chaitophorus tremulae, Pemphigus immunis, Pemphigus protospirae, P. spyrothecae* and *P. vesicarius* have been determined. While *Chaitophorus* species basically feed freely on leaf of the *Populus* spp., *Pemphigus* species caused specific shape of gall formation. Among these defined species, the most existed species are *P. immunis* and *P. vesicarius. P. spyrothecae* had the highest population density. Although these are preliminary evaluation of the planned study, findings strongly showed that there are going to be defined more aphid species on *Populus* spp. as study area are geographically and climatically large and heterogeneous.

Keywords: Aphid, *Chaitophorus, Pemphigus, Populus*

Acknowledgement: Authors thank to TUBİTAK (Project number: 119Z250) for supporting this study.

Oral Presentation
Thursday
Diversity of Animal species, Systematics and Phylogeny-2

Efficiency of DNA Barcoding in the Identification of Endemic Salmo Species from Turkey

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ABSTRACT

DNA barcoding is one of the most popular approaches to define biodiversity. Using DNA sequence of cytochrome c oxidase subunit I (COI), we test the efficiency of DNA barcoding methodology in identification of *Salmo* species from Turkey. The mitochondrial cytochrome oxidase subunit I (652-bp) is evaluated on 74 individuals representing eleven species of Salmo and nine haplotypes were totally identified. The mean interspecific distance (0.07) is 14-fold higher than the mean intraspecific distance (0.005) and and there is a barcoding gap (0.26-0.32%) between maximum intraspecific and minimum nearest neighbour distance for *Salmo* species. The neighbour-joining tree result in eight genetic groups, with approximately 73% success rate. Therefore, we conclude that COI-based DNA barcodes are an effective approach to identify *Salmo* species.

Keywords: *Salmo*, DNA Barcoding, COI, Turkey.

Acknowledgement: This research was supported by Recep Tayyip Erdoğan University, Scientific Research Projects Coordination Unit (Research Project Number: 2015.53008.103.01.01).

Oral Presentation
Thursday
Diversity of Animal species, Systematics and Phylogeny-2

Field-Sampling Based Inventories of Invertebrates (Arthropoda and Mollusca) from Caves in West Black Sea Region of Turkey

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ABSTRACT

Caves harbor unique faunal elements and present research potential in various aspects of biodiversity research, such as taxonomy, ecology, and biogeography. However, current Turkish cave fauna knowledge is scarce, especially in representative inventories. Aiming to shed light on this obscurity, we have sampled invertebrates from 19 caves around Bartın, Bolu, Düzce, Karabük, and Zonguldak provinces have been sampled in the summer and autumn periods between October 2019 and September 2020. The following taxa were sampled: Arachnida (Araneae, Acari, Opiliones, Pseudoscorpiones, and Scorpiones), Myriapoda (Chilopoda and Diplopoda), Hexapoda (Collembola, Diplura, Orthoptera, Plecoptera, Diptera, and Coleoptera), Isopoda (Oniscidea), and Gastropoda (Clausilidae, Daudebardiidae and Zonitidae). Species richness of cave communities ranged between 6 and 16 by considering

troglophiles and troglobites. Findings led us to a preliminary list of taxa with re-discoveries of relict-endemic taxa historically reported from the West-Mid Black Sea coast of Turkey, range extensions for others known from elsewhere, and new taxon candidates.

Keywords: Biospeleology, Systematics, Community Ecology

Acknowledgement: This study is a direct output of two projects carried out by the General Directorate of Natural Heritage, Ministry of Environment and Urbanization.

Oral Presentation
Thursday
Diversity of Plant species, Systematics and Phylogeny-3

Pollen Morphology of Some Apocynaceae Genera from Turkey

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ABSTRACT

In the present study, pollen morphology of five genera of Apocynaceae (*Cionura* Griseb., *Cynanchum* L., *Gomphocarpus* R. Br., *Vincetoxicum* Wolf and *Periploca* L.) were investigated and compared among the examined taxa to contribute to their taxonomy. The plant materials were collected from natural habitats in Turkey, dried according to standard herbarium techniques and deposited at the Herbarium of Recep Tayyip Erdoğan University, Department of Biology (RUB) and Herbarium of Faculty Pharmacy, University of Istanbul (ISTE). Pollen materials were isolated from fixed materials and all observations were performed using by light microscope. The genus *Periploca*, a member of the subfamily Periplocoideae, is distinguished from the four studied genera in the subfamily Asclepiadoideae by the presence of ovate or elliptical tetrads shedding onto spoon shaped translators. Asclepiadoideae members are characterized by five pollinaria composed of a pair of pollinia and caudicles attached to a central corpusculum. The shape of the pollinia is obovate in *Cionura*, ovate in *Cynanchum*, oblanceolate in *Gomphocarpus* and varied from ovate, elliptical, and obovate, to clavate in *Vincetoxicum*. In the present study, pollen variations of some Apocynaceae genera were examined and compared with taxonomic perspective for the Turkish representatives. It has been determined that the pollen morphology is variable within the family and the presence of tetrads or pollinia, the shape of tetrads, the shape and orientation (erect or pendulous) of pollinia are distinguishing traits among the examined taxa.

Keywords: Apocynaceae, pollen morphology, pollinium, taxonomy

Oral Presentation
Thursday
Diversity of Plant species, Systematics and Phylogeny-3

A palynomorphological and anatomical study about *Frankenia* (Frankeniaceae) genus in Turkey

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Abstract

In this study two species of *Frankenia* genus *F. salsuginea* and *F. hirsuta* species were analysed based on the anatomy and palynomorphology. The genus *Frankenia* (Frankeniaceae) is represented in the flora of Turkey by three species. These are: *F. hirsuta*, *F. salsuginea* and *F. pulverulenta*. The plant materials were collected from Konya province and stored in 70% ethyl alcohol. The paraffin method was applied for cross sections of vegetative organs. If paraffin method was not successful, we then cut the cross sections using a razor blade by hand or a cryostat. On average, 10 preparations were made for each type of section and 30 cell groups were measured. The pollen morphology of *Frankenia* genus was analysed by Wodehouse method using light microscope and also using scanning electron microscope. The anatomical analysis showed that the cross sections of stem had an epidermis layer in outermost surface. Cortex which characterized with parenchymatic cells was 5 layered. The collenchymatic tissue had 7 layered. The pith covered by parenchymatous cells. The leaves of studied species had between two epidermis layers with mesophyll tissue. Mesophyll was bifacial and more developed in *F. salsuginea*. The pollen grains were tricolpate and isopolar. Pollen shapes of studied species were prolate. The sculpture of pollen grains was scabrate-perforate in examined species. The anatomical and palynological characteristics of *F. hirsuta* and *F. salsuginea* were described in this study and determined whether these characters are important in the taxonomy of the genus.

Keywords: Anatomy, *Frankenia*, leaf, pollen, sea heath.

Oral Presentation
Thursday
Diversity of Plant species, Systematics and Phylogeny-3

Distribution, Ecology and Anatomy of *Groenlandia densa* in Turkey

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ABSTRACT

Groenlandia J.Gay is a monotypic genus belonging to the Potamogetonaceae family. The only species in the genus is *Groenlandia densa* (L.) Fourr. which is a submerged rhizomatous macrophyte. The species can be easily separated from the other members of the family by its inflorescence consisting of two opposite flowers and having conspicuously opposite leaves. The species mainly prefers streams and is geographically distributed in Turkey, in the Caucasus, in Europe and in North Africa. Although it is a common species, its populations are declining due to climate change and human-caused hydrological changes. In many European countries, species subject to complete extinction. We performed field studies between 2011 and 2020 to collect herbarium specimens and samples for anatomy studies. As a result of our own field studies and examination of herbarium samples, *G. densa* has been recorded from 72 different wetlands in Turkey. Although the species was found at different elevations, it is mainly sampled from wetlands above 800 meters. It has a low water temperature optimum value and a low pH preference. Electrical conductivity and the salinity range of the waters in which it is growing are both low. When the stem anatomy of the species is examined, stele-type was found as oblong, endodermis cells were O-shaped. Interlacunar and subepidermal bundles were not recorded. In addition, pseudohypodermis has not been observed in many samples. The low water parameter values mentioned in the results section are due to the fact that the species is found in wetlands at higher elevations. *Groenlandia densa* prefers clear streams according to both our own observations and previous studies and is sensitive to pollution.

Keywords: Potamogetonaceae, anatomy, water quality, macrophytes

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Oral Presentation
Thursday
Diversity of Plant species, Systematics and Phylogeny-3

Floral Morphology of Section *Persicaria* (*Polygonum* - Polygonaceae) in Turkey

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ABSTRACT

The floral morphology of the section *Persicaria* (Miller) DC. (*Polygonum* L.-Polygonaceae) in Turkey has been studied in detail and the variations among the studied taxa was taxonomically revealed. The plant materials were collected during the vegetation period from different areas of Turkey in 2020, dried and stored in the Herbarium of Biology Department at Recep Tayyip Erdoğan University (RUB). All examinations were performed on the herbarium materials. Detailed photographs were taken from the flowers using a Leica S6D stereo microscope with digital attachments and the morphological traits were evaluated using these digital photographs. It was determined that the perianth color (white, pink, or greenish), the length of perianth, presence of the glands and its distribution on the perianth and peduncle, the inflorescence (dense or lax), the length of stamens (exerted or inserted) and the length of styles (long or short) are important characters to separate the taxa in sect. *Persicaria*. In this study, variations of the flower morphology in sect. *Persicaria* was evaluated in detail for the first time by using stero microscope. The findings showed that the flower morphology vary in the examined taxa and also supply taxonomical support delimiting the taxa at generic or subgeneric level.

Keywords: Flower morphology, *Persicaria*, *Polygonum*, Turkey.

Acknowledgement: This study is financially supported by TÜBİTAK (Project number: 219Z024).

Oral Presentation
Thursday
Microbial Biodiversity-2

Isolation and identificaton of Thermophilic Actinomycetes and investigation of their effect in composting

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Abstract

Thermophilic Actinomycetes were isolated by using dilution plate technique from compost mixtures (first mixture:fertilizer, activated sludge and wheat straw; second mixture: wheat stalk, soil, fertilizer). Different temperatures (45, 40, 55, 60) and various selective media (Gauze's medium No.2, Starch casein agar, Triptone yeast exstract Agar and Nutrient Agar) were used in isolation. Enzyme tests (starch, cellulose and chitinase) were used in the selection of isolates to be used as an enhancer in compost formation. Enzyme tests performed on 129 isolates revealed the presence of 56 isolates having positive results in the starch test and 20 isolates in the cellulase test. Among the isolates, only 2 of them were positive against chitinase degradation. 14 of the isolates had the ability to degrade both starch and cellulose. Isolates having positive results in the tests were inoculated in ISP media (ISP 2-7 agar), Nutrient agar, modified Bennett's agar, trypticase soy agar, and Czapek's agar to evaluate morphological similarities. Interpretation of morphological similarities indicated 16 isolates with distinct morphologies and these were identified with 16S rRNA sequence analysis. All isolates were identified as *Streptomyces* with nucleotide differences varying between 0-18nt. Based on enzyme tests and 16S rRNA sequence analyses, 3 isolates coded as N4A13, T4A05 and N3C07 were selected for use as compost enhancer.

Keywords: Compost, *Streptomyces*, Thermophilic Actinomycetes, 16S rRNA analysis

Acknowledgement: This work was supported by TUBITAK, Project No. 118O231.

Oral Presentation
Thursday
Microbial Biodiversity-2

Isolation and Molecular Characterization of Nitrogen-Fixing *Azotobacter* spp. from Wheat Rhizosphere

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ABSTRACT

Reductions in agricultural production have been increasing due to unplanned urbanization, increasing food demand and rapidly growing world population. Therefore, it is important to ensure food safety with the increase in productivity of crops. In this study, 35 soil samples were collected from the wheat (*Triticum aestivum* L.) rhizosphere in three different regions of Şanlıurfa province. In total, 18 strains of the nitrogen fixing *Azotobacter* spp. were identified using maximum likelihood, maximum parsimony and bayesian posterior phylogenetic analysis. Of these 18 strains, seven were identified as *A. chroococcum*, six as *A. beijerinckii*, three as *A. tropicalis* and two as *A. vinelandii*. We also tested the strains identified for the tolerance to different concentrations of salt, nitrogen-fixing abilities and biofilm formation. All strains were resistant to 2% salt concentration. All *A. chroococcum* strains except the SBS7 strain were resistant up to 8% NaCl concentration. *A. beijerinckii* strains showed the least resistance and strains were resistant to salt at a maximum concentration of 4%. The highest nitrogen fixation was observed in *A. chroococcum* strains. Colony diameters varied between 1 and 3 mm in nitrogen fixation test of strains. The highest biofilm formation was observed in both *A. chroococcum* and *A. vinelandii* strains. Except *A. chroococcum* SBS7 strain, all *A. chroococcum* and *A. vinelandii* strains produced high levels of biofilms. *A. tropicalis* strains produced moderate level of biofilm. The lowest biofilm formation was observed in *A. beijerinckii* strains.

Keywords: *Azotobacter*, Nitrogenase, Biofilm, Wheat, Şanlıurfa

Oral Presentation
Thursday
Diversity of Animal species, Systematics and Phylogeny-3

A Large Knowledge Gap of Farmland Bird Populations of Turkey

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ABSTRACT

Turkey is an important country including three important biodiversity hotspots namely Caucasus, Irano-Anatolian, and Mediterranean. It also draws attention with substantially high bird biodiversity. Agricultural areas constitute more than 40 percent of Turkey. Given that the broad agricultural landscape that owns, it is not surprising that it would be valuable for farmland bird communities. Bird populations, particularly farmland species have been showed severe long term decline across Pan-European countries. Rapid land cover and land use changes are thought to be some of the potential causes of this negative population trend of birds. In this study, I investigated land cover change of the farmland landscape categories between 2000 and 2018 in Turkey. I used the data provided from European Environment Agency producing from Corine Dataset for this purpose. I searched the literature to interpret the national status of two farmland bird species, Turtle dove and Skylark, that show a severe decline across Europe. I showed that the farmland landscape that most reduced is the category of Pastures which includes also Meadows and Other Permanent Grasslands Under Agricultural Use with the percent of 3.2. I discussed the importance of Turkey in relation to farmland bird biodiversity and the need for regular broad-scale national censuses for dealing with large sized knowledge gap of bird populations in Turkey.

Keywords: Farmland birds, land cover change, Turkey

Oral Presentation
Thursday
Diversity of Animal species, Systematics and Phylogeny-3

Effects Of *Lantana Camara* On Small Mammals Biodiversity in Groenkloof Nature Reserve, South Africa

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ABSTRACT

Invasive alien plant species such as *Lantana camara* have negative impacts on biodiversity, ecosystem services and human well-being. Ecological impacts of this species are relatively well understood, but its impacts on small mammals are poorly documented, in spite of the fact that small mammals play a major ecological role in areas such as nutrient cycling. We investigated the impact of *L. camara* on small mammals population of the Groenkloof Nature Reserve, an urban protected area in South Africa. Here we quantified the impacts of *L. camara* on common biodiversity indicators (species richness, abundance and diversity of small mammals). Data were collected around 6 treatments with varying degrees of *L. camara* invasion density and time from previous clearing, as well as a control area with on history of invasion. Small mammal trapping was done using polyvinyl chloride live traps (similar to the commonly used Shearman brand) and a mark recapture technique. The results showed the highest species richness and diversity in the treatment that has been cleared for less than two years. Furthermore, the control area had higher small mammal species richness and diversity than all the invaded areas, which suggests that invaded areas were not suitable habitats for small mammals.

Keywords: Biodiversity, Biological, Invasive, *Lantana camara*, Small mammals

Oral Presentation
Thursday
Aquatic (Marine and Freshwater) Biodiversity-1

New records of *Atherina boyeri, Carassius gibelio* and *Gambusia holbrooki* in Gökçeada (Çanakkale, Turkey)

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ABSTRACT

Since island ecosystems are isolated from the mainland, they can be used as natural experimental sites mainly to monitor the changes in fauna and flora, and understand the pressures on the ecosystem. This study reports three new occurrences of non-native fish species that may threaten the inland water ecosystem of Gökçeada - Turkey's largest island and evaluate possible entry routes of these fishes. Fish samples were collected from five reservoirs and four streams using a backpack electro-shocker between April 2019 and May 2020. Two invasive freshwater fish species, *Carassius gibelio* and *Gambusia holbrooki*, and marine origin *Atherina boyeri* were found for the first time for Gökçeada inland waters. It was determined that *C. gibelio* is distributed in Aydıncık and Zeytinli-DSİ Reservoirs and *G. holbrooki* in Dereköy and Uğurlu Reservoirs and Büyükdere Stream. *A. boyeri* was collected from Tepeköy Stream supporting the Zeytinli-DSİ Reservoir. Individual numbers and standard length and weight distributions of each species are respectively; *C. gibelio*, 30 individuals, 10.7-13.9 cm, 35.12-86.68 g; *G. holbrooki*, 26 individuals, 2.5-4.4 cm, 0.44-2.71 g; *A. boyeri*, 2 individuals, 4.1-5.3 cm, 0.81-1.40 g. The occurrence of *C. gibelio* has been interpreted as it may have been introduced unintentionally to Gökçeada during common carp (*Cyprinus carpio*) stockings. *Gambusia holbrooki*, which is used to control mosquitoes, may have been introduced to Gökçeada for the same purpose. The occurrence of *A. boyeri* may be due to either its stocking into Zeytinli-DSİ reservoir or being used of the fishing nets, which is also used in the sea. It is necessary to monitor the stock status of non-native species detected in Gökçeada inland waters, especially their interactions with common carp and other aquatic biota.

Keywords: Island ecosystems, non-native fish, inland water, stocking.

Acknowledgement: This study was supported by the Research Fund of Çanakkale Onsekiz Mart University (Project No: FBA-2019-3007). The authors thank Müfit Özuluğ, Ersin Doğaç, Çiğdem Gürsoy Gaygusuz and Ümit Acar for their contributions to the study.

Oral Presentation
Thursday
Aquatic (Marine and Freshwater) Biodiversity-1

Soft-Bottom Molluscs Biodiversity in the Turkish Western Coast of the Black Sea

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ABSTRACT

The aim of this study was to determine the biodiversity of benthic molluscan species seasonally by taking into account soft bottom habitat, their structures, distribution depending on the depth in the western Black Sea coasts of Turkey. Benthic samples were collected by RV Karadeniz Araştırma of the Recep Tayyip Erdoğan University. Samplings were carried out in 15 different transects consists of 5 depths, triplicated (10m, 30m, 50m, 70m, 100m) by using 0,1 m^2 capacity box core. Soyer's Frequency Index (%F), dominance (%D), diversity index (H'), evenness index (J') and Bray-Curtis similarity index were used to determine frequency of the species in each station.

A total of 52 molluscan species belonging to 2 classes were identified. The species abundance showed depth-wise variations. The most dominant and constant species was recorded as *Chamelea gallina*. Dominance (%D) index, diversity index (H') and evenness index (J') was detected in the range of 0-0.375; 0-0.367; 0-0.99, respectively.

Keywords Black Sea, Macrobenthic communities, Soft-Bottom Molluscs Diversity.

Acknowledgement: This research supported by "TUBİTAK 116Y150" project.

Oral Presentation
Thursday
Aquatic (Marine and Freshwater) Biodiversity-1

A Study on Freshwater Gammaridea (Crustacea, Amphipoda) Fauna in Lakes and Ponds of Ordu and Surrounding Provinces (Turkey)

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ABSTRACT

In order to determine the freshwater Gammaridea fauna in the lakes and ponds in Ordu province and its surroundings between May 2018 and June 2020, samplings were carried out in a total of 25 localities, including 7 dam lakes, 1 artificial pond, 1 inside the cave, 3 ponds, 2 animal irrigation ponds and 11 lakes. As a result of the samplings, 9 species (*Gammarus anatoliensis, Gammarus balcanicus, Gammarus effultus, Gammarus komareki, Gammarus pulex pulex, Gammarus topkarai, Gammarus odettae, Pontogammarus sp.*) from 2 genera (*Gammarus, Pontogammarus*) belonging to 2 families (Gammaridae, Pontogammaridae) were identified. *Gammarus odettae* and *Pontogammarus sp.* are new records for the freshwater Gammaridae fauna of Ordu province.

Keywords: Amhipoda, Gammaridea, fauna, Ordu, Turkey.

Oral Presentation
Thursday
Microbial Biodiversity-3

Against Fungal Disease Agents In Kaçkar Mountains National Park Boxwood Forest, Biological Control With *Trichoderma* Species

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ABSTRACT

Kaçkar Mountains National Park is located between Firtina and Hemşin stream, which consists of 52,970 hectares of land, a part of which extends to Erzurum and Artvin provinces, a large part of the Çamlihemşin district of Rize. In many boxwood trees (*Buxus sempervirens*) in the mixed flora of the valley and especially in the forest formation of 1.5-2.0 ha. within the borders of Meydanköy, the boxwood trees in the pure boxwood stand have faced a serious risk of drying for the last 10 years. However, due to the deterioration of the forest cover flora and the decrease in the structural resistance of the boxwood, invasive moss, lichen and algae also accelerated the drying. Finally, saprophyte micro and macro organisms have invaded dead or dying boxwood trees. *Trichoderma* genus microfungi, which are an important biocontrol agent of use all over the world and especially in vegetable seedling, are known as a useful fungus genus that can be a dominant flora in soils with different ecosystems.

In our study, three different *Trichoderma* strains (*T. harzianum*, *T. lixii* and *T. atroviridea*) were used for biological control. It was mass cultured at 28°C for 15-20 days in both commercially supplied (PDA medium) and compost prepared medium in the laboratory environment. *Trichoderma* strains spores were harvested by washing with sterile physiological water. Than the spores were blended in a ratio of 1:1 and sprayed on the trunk and roots of all trees containing life water. The application was repeated three times in 2019-October, 2020 May and 2020 August. As a result, it was observed that the natural flora of the forest was formed, the burns on the boxwood leaves were reduced and the drying stopped. There is no specially labeled fungicide (drug) for the control of the *cylindrocladium* genus. It has been accepted and suggested by the scientific community that the most appropriate method in combating the disease is biological control. *Trichoderma* spp. mixtures have been determined to be an important biocontrol agent against to boxwood fungal disease.

Keywords: Boxwood, *Trichoderma*, *Cylindrocladium*, Biocontrol agents

Oral Presentation
Thursday
Microbial Biodiversity-3

Preference of Biofilm Mode of Growth of *Vibrio* Species

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ABSTRACT

Vibrio spp. naturally reside in aquatic habitats and establish symbiotic or pathogenic relationships with eukaryotic organisms. *Vibrios* attach to surface of zooplanktons and colonize shellfish. Infections of *vibrios* most frequently occur through ingestion of contaminated water or undercooked seafood. Microorganisms can form biofilms on inert and living surfaces. Since microbial cells in biofilms are protected by extracellular matrix that act as diffusion barriers, biofilm mode of growth has been considered a selective strategy for the prolonged survival of microorganisms against nutrient limitation, disinfectants, oxygen radicals, predators, and antibiotics. As in the case of other microorganisms, biofilm formation in marine environments under adverse conditions might be advantageous for the colonization and extended survival of *Vibrio* species, particularly clinical strains. *V. cholerae* and some other *Vibrios* were found to produce more biofilms when temperatures dropped below 25°C under *in vitro* conditions. Besides *in vitro* conditions, *V. cholerae* were found to form biofilms in host and natural habitat. Biofilms are thought to be associated with chronic infections in other pathogens and biofilm-forming cells are more infectious than planktonic cells. *Vibrio* species might prefer biofilm mode of growth on/in eukaryotic hosts under harsh conditions until they encounter host.

Keywords: *Vibrio* spp., biofilms, infectious, survival.

Oral Presentation
Thursday
Diversity of Plant species, Systematics and Phylogeny-4

Notes on *Anastrophyllum minutum* (Schreb.) Schust in Turkey

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ABSTRACT

Recently, a result of the detailed field studies showed that many remarkable bryophytes have been recorded in Turkey, but more studies are needed to complete bryophytes flora of Turkey. Many bryologists have been studying on bryophytes of Turkey. One of the regions where studies on bryophytes were most intensive is Black Sea region. However, there are still regions that have not been studied in the black sea region. One of them is the Kümbet plateau. The bryophyte sample collected from Kümbet plateau in Turkey in 2019. The specimen examined stereomicroscope and light microscope. Identifications were determined by consulting various floras and keys. *Anastrophyllum minutum* (Schreb.) Schust. is recorded for the second time from Turkey. It first time recorded from Trabzon province, Şalpazarı district, İnişdibi village in 2016. This species new to Giresun province. It only known from Trabzon and Giresun provinces. This record has expanded its distribution area in the black sea.

Keywords: Biodiversity, *Anastrophyllum minutum*, Kümbet plateau, Turkey

Acknowledgement: We are very grateful to the Çanakkale Onsekiz Mart University (FBE-2019-2950) for financial support.

Oral Presentation
Thursday
Diversity of Plant species, Systematics and Phylogeny-4

Notes on *Scapania obscura* (Arn. & Jens.) Schiffn. in Turkey (Scapaniaceae, Hepaticae)

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ABSTRACT

Turkey has three main floristic regions: Euro-Siberian, Mediterranean and Irano-Turanian. The Euro-Siberian region, one of the most important phytogeographical regions, is situated in the north of Turkey. In Turkey, bryofloristic studies are very intensive in the Aegean Region, Mediterranean Region, Central Anatolia Region, Marmara Region and Black Sea Region. Although a large part of the Black Sea region was studied in terms of bryophytes the Anzer valley has not been studied yet.

We collected bryophytes from Anzer Valley, Rize province in 2019. The samples were examined with stereomicroscope and Binocular microscope. The bryophyte samples were identified using the relevant literature. *Scapania obscura (*Arn. & Jens.) Schiffn is recorded for the second time in Turkey. And also with this record, this species is reported for the first time from Rize and Eastern Black Sea region of Turkey.

Keywords: Biodiversity, *Scapania obscura*, Anzer Valley, Turkey.

Acknowledgement: We are very grateful to the Recep Tayyip Erdoğan University (Project Number: FBA- 2019-1005) for financial support.

Oral Presentation
Thursday
Diversity of Plant species, Systematics and Phylogeny-4

Survival Struggle of Local Endemic *Paeonia mascula* subsp. *bodurii* in Çanakkale

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ABSTRACT

Paeonia mascula subsp. *bodurii* is a local endemic taxon, that is in EN category, struggles to survive and only distributes within Çanakkale province. In this study, the population and mature individuals numbers, its distribution, reasons for being narrowly distributed, and characteristics of reproductive biology were determined in order to contribute to the struggle for survival of the taxon.

2048 adult individuals were found in the current censuses in the populations and the total extent of occurrence was found to be 0.3 km^2. In the reproduction biology studies of the taxon, the pollen viability percentage as 66.21% and the fertilized seeds in the fruit as 31.44% were calculated. Germination percentage was found to be 70% in ex-situ experiments. In the field observations, it was concluded that the pollination was through insects. The threatening factors are determined as Wind Power Plant projects established around the habitats, mining activities, road construction works, deforestation and illegal plant gathering from nature.

Despite the good rate of germination, the low number of individuals reaching fertility due to the negative environmental conditions limits the growth of the populations. The narrow distribution of the plant is related to problems of reproduction and healthy life duration.

As a result of the researches, it was found that the plant being in the CR B2b (i, ii, iv) c (iii) IUCN category is necessary for the species to be successful in the struggle for survival.

Keywords: Çanakkale, IUCN, conservation biology, local endemic, *Paeonia mascula* subsp. *bodurii*

Oral Presentation
Thursday
Diversity of Plant species, Systematics and Phylogeny-4

A View to Floristic Richness of Gallipoli Peninsula (Çanakkale)

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ABSTRACT

The Gallipoli Peninsula is located in the European part of Turkey with the Aegean Sea to the west and the Dardanelles strait to the east. Geologically the peninsula is made up of Tertiary formations mainly from Eocene period. The altitude changes from sea-level to 520 meters. The topography of peninsula is inclined in the north-west direction with plateaus and split by deep valleys covering the upper parts. Gelibolu Peninsula has an ecological and floristic Mediterranean climate and flora shows the characteristics of the Marmara transition type between the Black Sea and Mediterranean climates encounter. Some part of the peninsula (in Eceabat district) was declared as a National Park in 1973 because of its importance in the battle of Gallipoli.

In this study, we aimed to interpret the flora data of the peninsula from different perspectives up to now. Considering previously publications and the field excursion carried out by us, in Gallipoli Peninsula; belonging to 80 families, 313 genera and 524 taxa were found. 14 taxa of these are endemics. According to IUCN categories, there are 1 critically endangered, 2 vulnerable, 1 endangered, 10 least concern.

Considering the previous works and this study, it is striking that the flora is substantially the same, but recreation, industrial afforestation and post-fire afforestation applications have caused some changes in the basic vegetation within 100 years.

Keywords: Flora, Gallipoli Peninsula, Çanakkale, National Park.

Oral Presentation
Thursday
Diversity of Plant species, Systematics and Phylogeny-4

Comparative Analysis of the Flora of Mud Volcanoes Alyat (Azerbaijan)

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ABSTRACT

The study of the adjacent territories flora to the mud volcanoes was carried out in the summer-autumn of 2016-2018 in 2 regions of Azerbaijan. In Absheron region, the mud volcano is located 39-41 km west of Baku (Pirekyashkul, 256 m a.s.l,) and in Garadagh region. In both surveyed territories, mainly semi-desert vegetation predominates. As a result of our studies, it was found that the flora of the adjacent territory to the mud volcanoes Pirekyashkul and Alyat is characterized by a rather low species composition (18 and 5 species, respectively). The collected floristic material was identified according to the Flora of Azerbaijan and herbarium work, including analysis of herbarium specimens deposited at the BAK. In addition, The Euro+Med PlantBase was used for the identification of species. Thus, species distributing on the adjacent territory to Pirekyashkul mud volcano belong to 6 families, of which Chenopodiaceae (*Climacoptera crassa*, *Petrosimonia brachiata*, *Salsola dendroides*, *Salsola nodulosa*, *Suaeda microphylla*, *Suaeda dendroides)* and Asteraceae (*Anthemis candidissima, Carduus cinereus*, *Filago germanica*, *Scorzonera laciniata*, *Tragopogon pusillus*) include the largest number of species (34% and 28% of the total number of species, respectively). A significantly few number of species-3 are represented in the family Poaceae (*Anisantha rubens*, *Bromus lanceolatus*, *Eremopyrum orientale*) and Plantaginaceae - 11% (*Plantago notata, Veronica polita*). Other families by 1 species (5%) - *Erodium cicutarium* and *Psylliostachys spicata*. On the territory of the volcano in Alyat was observed distinctive features from previous, where only 5 species were found belonging to two families. Chenopodiaceae family is represented by 4 species (Salsola dendroides, Salsola nodulosa, Suaeda microphylla, *Halocnemum strobilaceum*), Tamaricaceae only 1 species (R*eaumuria alternifolia*).

Keywords: Mud volcano, vegetation, Alyat, Azerbaijan.

Oral Presentation
Thursday
Diversity of Plant species, Systematics and Phylogeny-4

Historical Background of Biodiversity of Erzurum Province and its Contribution to the Turkey's Biodiversity

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ABSTRACT

Turkey shows a notable diversity of habitats, rainfall, temperature, topography and geological history, which is reflected in its richness of animal and plant life. Its biogeography is therefore of considerable interest. Topographical and climatic heterogeneities of Erzurum province have been reflected to its biological diversity and it can be considered as rich in terms of the geography where it is located. In this study, a brief of the historical biogeographic analysis is presented with emphasis on the fauna and flora components of Erzurum. Erzurum was determined to have biological diversity on the average of Turkey.

Keywords: Biodiversity, Erzurum, historical background.

Oral Presentation
Thursday
Aquatic (Marine and Freshwater) Biodiversity-2

Biodiversity and SHE Analysis of Recent Foraminifera from The Benthic Zone of Marine Ecosystem in Ilıca Bay (Izmir, Eastern Aegean, Turkey)

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ABSTRACT

The biodiversity in different ecosystems are quite high in Turkey. Turkey is surrounded by three seas and marine biodiversity is also quite high. The marine biodiversity is one of the issues that need to be developed and investigated. The aim of this study is to investigate the biodiversity of foraminifera, one of the important microorganism groups living in benthic zone in marine ecosystem. The investigated coastline approximately of 9 km in length is touristic area Ilıca Bay which is located at the west of the country. The sediment samples including benthic foraminifera were taken from the floor of different depths of the sea at 7 locations from west to east along the coast.

In the laboratory the foraminifera of each sediment samples were separated under binocular microscope for taxonomically species identification. In the scope of biodiversity analysis, quantitative data were obtained by determining the number of species for each sample, the number of individuals for each species and the total number of foraminiferal individuals. A total of 88 benthic foraminifera species were determined in 7 locations of the study area. The numbers of foraminifera species range between 11 and 53, total numbers of foraminiferal individuals range between 31 and 309. The values of biodiversity indices which represent the species diversity and species richness increase from west to east along the investigated coastline. SHE analysis of diversity based on S=species richness, H=Shannon-Wiener Index, E=evenness values have supported the results of biodiversity analysis. The relatively high diversity values were observed in middle parts of the coastline. However the species evenness decrease in same direction. Consequently foraminiferal biodiversity is moderately high in Ilıca Bay which is a highly populated settlement specially in summer seasons. The marine pollution based on the touristic and domestic wastes may have also negatively affected foraminiferal diversity.

Keywords: Ilıca Bay, SHE analysis, biodiversity, benthic foraminifera, species diversity.

Oral Presentation
Thursday
Aquatic (Marine and Freshwater) Biodiversity-2

Benthic Foraminiferal Biodiversity of Demre Coasts (Antalya, Turkey)

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ABSTRACT

Foraminifers are one of the important organism groups of benthic zone of marine ecosystem, therefore the benthic foraminiferal biodiversity is one of the issues that need to be developed and investigated. The study area of this research is located at Demre at the west of the Antalya Gulf, southwest of Turkey. The sediment samples including benthic foraminifera were taken from 10 locations of the coastline which is approximately of 5 km in length from west to east. The focus of the research is the benthic foraminiferal biodiversity analysis. Each sediment samples were investigated under binocular microscope and the foraminifera in them seperated for taxonomically species identification. A total of 5 distint benthic foraminifera species were determined in 10 locations of the coastline area. The quantitative data such as the number of species for each sample, the number of individuals for each species and the total number of foraminiferal individuals were determined for each sample.

The numbers of foraminifera species range between 2 and 5, total numbers of foraminiferal individuals range between 3 and 10. The species diversity and species richness increase in the middle parts, however the species evenness high and relatively stable in same direction along the coastline. Consequently foraminiferal biodiversity is very poor along the Demre coast. Demre is one of the important touristic districts, so the marine pollution based on the touristic and domestic wastes may have also negatively affected foraminiferal diversity.

Keywords: Demre, biodiversity, benthic foraminifera, species diversity.

Oral Presentation
Thursday
Aquatic (Marine and Freshwater) Biodiversity-2

Length-Weight Relationship of *Neogobius melanostomus* and *Gobius niger* species from the Eastern Black Sea, Turkey

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ABSTRACT

Length and weight parameters are highly crucial for fisheries science, and population stock assessment studies. The knowledge on length and weight relationship of fishes from varied geographical areas, allows researchers to understand growth and condition differences of same species. In this study, in order to determine length-weight relationships, a total of 169 *Neogobius melanostomus* (female 100, male 69) and 427 *Gobius niger* (female 165, male 262) were collected between April 2017 and March 2018 by using bottom trawls from 0-60+ m depth contour in the Southeast Black Sea coast. Total length for all individuals of *Neogobius melanostomus* was between 9-24.6 cm (average= 15.09±0.26 cm), and total weight was between 8.83-250.34 g. Total length for females was between 10.3- 23.1 cm (average= 15.12±0.30 cm) and total weight was 12.71-187.49 g. Whereas total length was between 9-24.6 cm (average= 15.04±0.48) and total weight was 8.83-250.34 g. for male individuals. The length-weight relationship is $W=0.0069. L^{3.24}$, $R^2=0.98$ for all individuals. For males and females was $W=0.0071. L^{3.24}$, $R^2=0.98$, $W=0.0067. L^{3.24}$, $R^2=0.98$, respectively and positive allometric growth was detected in all individuals, males and females. For all individuals of the *Gobius niger* species, the total length changes between 5.7-13.5 cm (average= 10.03±0.06 cm) and the total weight changes between 1.91-24.78 g. Total length for females was 6.3-12.7 cm (average= 9.59±0.08 cm) and total weight was between 2.06-21.44 g. Whereas in males, total length was between 5.7-13.5 cm and total weight was between 1.91-24.78 g. (average= 10.31±0.07 g). The length-weight relationship for all individuals, males and females of *Gobius niger* were $W=0.0112. L^{2.97}$, $R^2=0.93$, $W=0.0124. L^{2.93}$, $R^2=0.91$, $W=0.0069. L^{3.01}$, $R^2=0.93$, respectively and negative allometric growth was detected in all individuals and female individuals while positive allometric growth was detected in male individuals. The results obtained were discussed with previous studies in the region.

Keywords: Length-weight relationships, coastal fish, Eastern Black Sea, Gobidae, Bottom trawl.

Oral Presentation
Thursday
Aquatic (Marine and Freshwater) Biodiversity-2

The Occurrence of Caulobacteraceae Members in the Different Marine Regions of Turkey

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ABSTRACT

In this study, the occurrence of Caulobacteraceae members was evaluated in the seawater samples collected from Gökçeada Island coasts, Güllük Bay, coastal areas of the Sea of Marmara, ships' ballast waters coming from various marine areas to the Sea of Marmara, Turkish Strait System (TSS: The Sea of Marmara, Istanbul Strait/Bosphorus, Çanakkale Strait/Dardanelles) at different periods between 2002 and 2018. The bacteria species were identified by using the automated micro identification system VITEK 2 Compact 30. *Brevundimonas diminuta* and *B. vesicularis* were identified belonged to the family. *B. diminuta* was isolated from the Aegean Sea and Sea of Marmara. *Brevundimonas vesicularis* was isolated from the Aegean, Marmara, and Mediterranean Seas. No data was found on the Black Sea marine region. Both species were reported as useful strains for different biotechnological applications. *Brevundimonas diminuta* was reported as an active species on glutaryl-7-aminocephalosporanic acid acylase production for semisynthetic cephalosporins which are one of the most consuming antibiotics around the world. *Brevundimonas vesicularis* was reported as an effective species for poly-β-hydroxyalkanoate production. Also, it can be also used as a bio-sorbent for lead and it is capable of bioremediation of Ni (II) and Cu (II). Although they are not important pathogens they were accepted as global opportunistic pathogens.

In conclusion, it is recommended to conduct more scientific researches on Caulobacteraceae family in other marine regions and it is important to have more data for biotechnological progress and health concerns in marine areas.

Keywords: *Brevundimonas diminuta, Brevundimonas vesicularis*, Caulobacteraceae, marine areas, Turkey.

Oral Presentation
Thursday
Aquatic (Marine and Freshwater) Biodiversity-2

Seasonal Changes of Fish Diversity and Species Composition in Borçka Dam Lake (Lower Çoruh River Basin, NE Turkey)

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ABSTRACT

As an important component of the global biodiversity, freshwater fish species play a major role in ecosystem functioning and human well-being. In order to understand the seasonal variation of fish species composition and biodiversity in Borçka Dam Lake (Lower Çoruh River Basin, NE Turkey), 26 surveys were monthly conducted in the study araea between February 2016 and November 2017. A total of 3402 specimens from 15 different fish species belonging to 9 genus and 4 families were determined, among which, Cyprinidae had the largest different species number (11 species, 66.7%), followed by Salmonidae (3 species, 20.0%), Siluridae (1 species, 6.7%), and Gobiidae (1 species, 6.7%). The fish abundance in numbers was the highest (N=1239, 36.42%) in summer, followed by in spring (N= 819, 24.07%), autumn (N= 757, 22.25%), and the lowest (N=587, 17.25%) in winter. In the study area, the dominant fish species was *Alburnus derjugini* in all seasons. According to Cluster and MDS analysis which were performed using the amount of fish species obtained from monthly samplings, two seasonal groups (S1: Winter-Spring, S2: Summer-Autumn) were identified. MDS stress value was 0.08 showing that there was a good ordination between the groups. The mean values of Margalef's richness index (D), Pielou's evenness index (J), and Shannon index (H´) were calculated as 1.614±0.239, 0.53076±0.153 and 1.22894±0.329 for S_1 group, also as 1.888 ± 0.239, 0.718±0.092 and 1.723±0.196 for S_2 group, respectively. A statistically significant difference was found between D, J, H´ values of S1 and S2 groups ($p<0,05$). This difference is thought to be mainly due to the water temperature and biological characteristics of the fish species. It is considered that illegal fishing activities should be brought under control and pollution of the reservoir should be prevented in order to protect and maintain the fish biodiversity and sustainability of fish populations in the reservoir.

Keywords: Freshwater fish biodiversity, species composition, richness and evenness, Borçka Dam Lake, Çoruh River Basin.

Oral Presentation
Thursday
Aquatic (Marine and Freshwater) Biodiversity-2

Comparison of Fatty Acid Composition in Edible Muscle Tissue of Three Native Trout Species: *Salmo rizeensis*, *Salmo coruhensis*, and *Salmo caspius*

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ABSTRACT

The aim of present study was to compare fatty acid composition of Rize trout (*Salmo rizeensis*), Black Sea trout (*Salmo coruhensis*), and Caspian trout (*Salmo caspius*). These species were obtained from Ballı stream, Sarayköy stream (both are coastal streams in northeastern Anatolia, the Black Sea basin), and Toros stream (a drainage of Kura River, Caspian Sea basin), respectively. Gas chromatography/mass spectrometry (GC-MS) was used to identify fatty acid composition of samples. The composition of fatty acids showed that total monounsaturated fatty acids (∑MUFA) in *S. rizeensis* and *S. coruhensis* were the highest, followed by saturated (∑SFA) and polyunsaturated (∑PUFA). However, the dominant fatty acid group in *S. caspius* was SFA, followed by MUFA and PUFA. The differences among SFA, PUFA/SFA, EPA+DHA, ∑n3, ∑n6 and ∑n6/ ∑n3 values of trout species were statistically significant ($P<0.05$). The most dominant fatty acids in all species were palmitic acid (C16: 0) in SFAs, oleic acid (C18: 1n9c) in MUFAs, linoleic acid (18:2n6c), EPA (C20: 5n3) and DHA (22: 6n3) in PUFAs. It was determined that the n6/n3 and PUFA/SFA ratios were greater than those recommended by the Department of Health of the UK. Moreover, the atherogenic (AI) and thrombogenic (TI) indices of samples were in accordance with the limit values reported by international organizations. This study determined that all three trout species are a good nutritional source for human consumption in terms of EPA, DHA and n-3 PUFA contents.

Keywords: Fatty acid, trout, *Salmo rizeensis*, *Salmo coruhensis*, *Salmo caspius*.

Oral Presentation
Thursday
Biodiversity, Landscape, Tourism-2

Could biodiversity parameter results be misleading?

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ABSTRACT

Could biodiversity parameter give us misleading results? Could the biodiversity parameters measured in a degraded habitat be higher than the biodiversity parameters measured before degradation? What does that means? Why are the biodiversity indices such as, Shannon-Wiener or Simpson diversity, measured in a degraded ecosystem sometimes calculated higher than those measured in a natural ecosystem with the same characteristics? Is time an important criterion in biodiversity measurements?

The answers to these questions are explained with the principles of presence and absence of species (1), increase and / or decrease in population densities of the species (2) and non-interactions (3).

In this study, the degradation of the habitat as a result of an ecological factor that is later included in a natural ecosystem and thus the stages of change within and between species are described.

Keywords: Insect, habitat degradation, anthropogenic effects, Aydin and Kazak principles.

Oral Presentation
Thursday
Biodiversity, Landscape, Tourism-2

Comparison of Insect Biological Diversity Parameters in Natural and Degraded Habitats in Gölcük Nature Park Forest (Isparta, Turkey)

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ABSTRACT

The study was carried out to compare the biodiversity parameters of the insect species in the natural and the unnatural habitats in the Gölcük Nature Park of Isparta Province between 2018 and 2019. Two natural and two unnatural habitats (impact of tourism) were selected to realize the mentioned aim. Totally 40 pitfall traps were set up (10 for each habitat) to sample the species of Coleoptera order. Species richness were found higher in the natural habitats than the unnatural ones. Diversity index (both Shannon-Wiener and Simpson) were calculated higher in the natural habitats and as expected, dominancy inversely proportional to diversity was measured lower in the unnatural habitats. Shannon Evenness, population density due to individual of the species showed mostly evenly distributed on the graphs in natural habitats. The Sörenson Coefficient results showed that selected natural and unnatural habitats groups were found similar to each other. The results of the study showed that human activity plays an important role in habitat destruction. It has been revealed that species richness and diversity are negatively affected in habitats with human impact.

Keywords: Coleoptera, Shannon-Wiener, Simpson, Sörenson, evenness.

Oral Presentation
Thursday
Biodiversity, Landscape, Tourism-2

Connectivity is Vitally Important in a Fragmented Forest Ecosystem to Sustain Biodiversity: An Analysis for Rize

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ABSTRACT

Forests are the leading ecosystems that are under threat due to the pressure of global change. Being under pressure for a forest ecosystem means fragmented and isolated habitats, decrease in biodiversity and change in the landscape. In recent years, restoring landscape connectivity by minimizing landscape fragmentation has been recognized as a key strategy to conserve biodiversity. Well-connected habitat networks are thought to both protect existing populations and help adaptation under climate change. It is therefore priority to understand how best to maintain and develop connectivity in fragmented landscapes at multiple spatial scales for effective conservation of forest biodiversity. In this study, fragmentation analysis was performed using area, edge and isolation metrics in the forest matrix in the Rize landscape and connectivity corridors were interpreted to manage the impact of this fragmentation on species and habitats. The fragmentation analysis was carried out on 3 classes as broad-leaved, coniferous, and mixed using land cover/land use data with the years 1990-2018. The connectivity corridors between these classes were analysed using core area data and resistance maps. According to the results, it was observed that fragmentation in broad-leaved and coniferous classes and an increase in mixed forest class. In the connectivity analysis it was observed that the limiting effects arising from human activities increased more in 2018 compared to 1990. The results of this study showed that in a fragmented forest matrix, connectivity corridors can be identified and reconstructed the conditions necessary for the survival of biodiversity.

Keywords: Forest ecosystem, landscape connectivity, fragmentation, biodiversity.

Oral Presentation
Thursday
Biodiversity, Landscape, Tourism-2

Detecting Barriers Between Protected Areas to Restore Ecological Connectivity

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ABSTRACT

Protected areas have two tasks on a global scale: First, to protect biodiversity and second, to ensure the continuity of ecosystem services. Identifying potential links between protected areas in a region and barriers between these links or restoration points is very important for the effective development and implementation of conservation strategies within the scope of biodiversity. In this study firstly, potential connectivity corridors between 10 different protected areas were determined to support the biological diversity in the Rize landscape, then the barriers that could block the ecological flows in these corridors were determined by using 100 m, 500 m, 300 m radii. Least Cost Path and Cost Weighted Distance methods were used for both analyses. The most suitable corridors have been identified between Kaçkar Mountains National Park-Grade 1 Natural Sites-Wildlife Protection and Development Area and Firtina Creek. Improvement scores were calculated by considering the radii determined for the barriers. As a result, the highest improvement scores at 100 m, 500 m, 300 m radii were calculated as 21.1, 4.49 and 7.0, respectively, and according to these scores, it showed that there were barriers between Karadere, Handüzü Nature Park, Uzungöl Special Environmental Protectıon Area and Kaçkar Mountains National Park. The method used in this study is important in terms of generating protection strategies for protected areas in the Rize landscape. The results of this study willguide not only protected areas in Rize landscape, but also conservation priority planning studies.

Keywords: Protected areas, barriers, restoration opportunities, improvement score, biodiversity.

Oral Presentation
Friday
Effects of Biodiversity to Human Health-1

Antibacterial Activity of Orange (*Citrus aurantium*) and Stinging Nettle (*Urtica dioica*) Extracts Against Selected Fish Pathogenic Bacteria

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ABSTRACT

Antibiotic treatment has been preferred against bacterial diseases in aquaculture for many years. Continuous application of antibiotics can cause the development of antibiotic-resistant bacteria and may adversely affect the natural environment and human health. Plant-based approaches are also widely used in the aquaculture industry to minimize the use of antibiotics. This study was aimed to evaluates the antioxidant potentials and the *in vitro* antimicrobial activities of water extracts of, and orange and stinging nettle against fish pathogenic bacteria. The antioxidant effects were determined by DPPH assay. Results are evaluated as percent inhibition. Extracts were tested *in vitro* against selected Gram-negative (*Vibrio harveyi, Vibrio vulnificus, Vibrio anguillarum, Vibrio campbellii, Pseudomonas putida* and *Aeromonas veronii*) and Gram-positive (*Bacillus thuringiensis*) bacteria. Disk diffusion method was applied in three parallel to determine the antibacterial activity and results were evaluated by measuring the diameter of the inhibition zone. The extracts showed 75-80% DPPH inhibition value. The stinging nettle extract demonstrated the zone diameters between 18.4-13.1mm, while orange demonstrated 14.6-9.5 mm. The results show that orange and stinging nettle extracts have the potential to be used as an antibacterial agent in aquaculture and as an antioxidant agent in processing technology.

Keywords: Plant extracts, antioxidant potential, antimicrobial activity, pathogenic bacteria.

Oral Presentation
Friday
Effects of Biodiversity to Human Health-1

Melissopalynological and Physico-Chemical Properties of Ayder (Camlihemsin/Rize) Honeys

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ABSTRACT

Total number of pollen, pollen identification, sugar content and moisture were analysed in 41 honey samples produced in Ayder Plateau in August 2012. A total of 36 taxa were identified in honey samples. *Castanea sativa* Miller. pollen was detected in all samples in a dominant amount. The total number of pollen (TPN-10 g) in 10g honey ranged between 3438-87056. It has been determined that honey samples were normal and underrepresented pollen. The amount of moisture in the samples varies between 16.4-20.9%. In honey samples, Fructose ranges from 14.05 to 52.82%, while Glucose ranges from 14.31 to 49.24%.

Keywords: Ayder Plateu, honey, pollen analysis, TPN-10g, sugar analysis.

Oral Presentation
Friday
Conservation Biology, Policy And Strategies & Protected

New Data on Rare Beetle *Chrysochares asiaticus* (Pallas, 1771) (Coleoptera: Chrysomelidae) from Turkey and a Call for Conservation

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ABSTRACT

A small population rare beetle *Chrysochares asiaticus* (Pallas, 1771) (Coleoptera: Chrysomelidae) was found at Aras River bank at Iğdır province, Tuzluca district, 2 km south of Halıkışla village where corner of Turkey and Armenia border. This finding is a confirmation presence of *C. asiaticus* in Turkey. The distribution range of beetle is Central Asia, southeast of the European part of the Russia, the Caucasus and most eastern part of Turkey (Kars). The beetle is large, showy, and impressive color; body elongated-oval, head, pronotum and legs metallic greenish blue, elytra purple-red and metallic blue. In this investigation, the adult stage of beetle was observed when feeding on mainly leaves of *Cynanchum acutum* L. and occasionally on *Lactuca serriola* L. The *C. acutum* is two different opposite important roles in ecosystem such as invasive weed and medicinal plant depending on distribution region. The first adults were observed in the beginning of June (2020), the number of individuals is increased toward in the end of June between beginning of July. The copulation of beetle take places on food plants. This species population is restricted along in the river bank at sandy habitat in this location. According to Red Book of Krasnodar Territory, the regional population of beetle is categorized as "Near Endangered" – "Near Threatened" status. The research location along Aras River bank looks like a good protected refuge land for *C. asiaticus*, having a good riparian vegetation and somewhat away from agricultural lands. The aim of this presentation is to introduce this rare beetle *C. asiaticus*, raise awareness for protecting species as well as habitat.

Keywords: *Chrysochares*, Aras Valley, Iğdır, habitat, conservation, host plants, Turkey.

Oral Presentation
Friday
Conservation Biology, Policy And Strategies & Protect

Determination of Mammalian Diversity with Their Conservation Status in Kamilet Valley (Arhavi, Artvin): The Preliminary Results

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ABSTRACT

The aim of the study is to determine the mammal species distributed in Kamilet Valley based on field observations. Determining the geographical distribution of the species has an important place to prepare the ground of the biogeography, conservation biology, and biodiversity studies, related to both target species and global biodiversity. Thus, the outputs of this study are primarily to contribute to the mammalian fauna of Kamilet Valley and after then are intended to draw attention to the ecological importance of the area. Field studies were conducted using direct and indirect observation methods. Direct observations were made by means of camera traps and indirect observations were made by detecting the traces of animals. The coordinates of the observation points were recorded with the Global Positioning Device and then those were embedded into the map. As a result of the field observations, 6 species from 5 families, namely Ursidae (1), Canidae (2), Suidae (1), *Cervidae* (1), and Felidae (1) were detected in the area. The presence of the brown bear, *Ursus arctos* and the Eurasian lynx, *Lynx lynx* in the study area was determined through indirect observations by identifying their footprints. The golden jackal, *Canis aureus* and the beech marten *Martes foina*, the European roe deer, *Capreolus capreolus*, and the wild boar, *Sus scrofa* were detected in the area by both direct observations via camera trap and indirect observations by identifying their footprints. The conservation status of all observed species were determined according to the IUCN, the BERN, the CITES, and the MAK. The study area falls within the Caucasus Biodiversity Hotspot which is one of the 200 ecological regions of special importance worldwide. The preliminary results of this study point out that the study area has a rich mammalian diversity, and the findings support how ecologically important the location of the area is.

Keywords: Mammalia, diversity, Kamilet Valley, Turkey, conservation

Acknowledgement: This study was supported by the Coordinatorship of Scientific Research Projects of Artvin Çoruh University (No. 2019.F90.02.01)

Oral Presentation
Friday
Conservation Biology, Policy And Strategies & Protect

Endangered Species: Sturgeons Conservation and Management Strategies

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ABSTRACT

In the Northern hemisphere, sturgeons have existed for nearly 200 million years and are represented by 2 families and 27 species in the sea and freshwater. Sturgeons are also known as living fossils and have reached the present day without genetic changes in the evolutionary development of the world. Therefore, they are biologically very important species. Additionally, they have an economic value because of their delicious meat and caviar.

In the middle of the 20th century, sturgeons were in danger of extinction for many reasons, so they have been protected by signing CITES protocol with 164 countries including Turkey. Even though five species of sturgeons had reported in the Black-sea, recent studies indicated that three species remain only. In the Black Sea, sturgeons should be protected because of biologic species diversity and taken precautions due to their economic importance. Thus, some practices are needed such as improvement of natural breeding areas, supporting natural stocks, and establishing rootstocks with breeding practices.

In this study, we evaluated both the protection of the sturgeons natural stocks and breeding stock studies in the aquaculture environment in Turkey. In addition, the sturgeons production strategies and importance of biodiversity in Black-sea have been clearly stated.

Keywords: Black Sea, endangered species, sturgeon.

Oral Presentation
Friday
Invasive Species & Biodiversity of Parasites and Their Hosts-1

Sitona Germar (Coleoptera: Curculionidae) Species and Ecological Observations in Alfalfa Areas in Iğdır Province, Turkey

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ABSTRACT

This study was conducted to determine alfalfa pest species of *Sitona* Germar (Coleoptera: Curculionidae) and their ecology in 2018-2019 in Iğdır Province where alfalfa cultivated in wide range. The field investigations were performed covering in 39 locations, 64 fields using sweeping net and 6107 adults collected, totally. In addition, biological stages of species were observed in field in different seasons of the years. In the results of investigations, six species *Sitona humeralis* Stephens, 1831, *S. concavirostris* Hochhuth, 1851, *S. bicolor* Fåhraeus, 1840, *S. longulus* Gyllenhal, 1834 *S. callosus* Gyllenhal, 1834 and *S. puncticollis* Stephens, 1831 were determined. Of these species, *S. humeralis* is having dominated and highest population rate with 81.4%. The density rate of other species is detected as 12.2%, 5.0%, 1.0%, 0.3% and 0.1%, respectively. Based on ecological observations, *S. humeralis* hibernate in egg, larva and adult stages. The females laid eggs in soil around alfalfa root crowns in April, the larva stages observed during May-July, pupae in August. The new generation adults started to emerge from soil in late August, but some of the individuals waiting until mid-October without emerge from soil. In this way, aestivation duration continues towards in the middle of October. The adults emerge their location from end of October, feed on leaves of alfalfa, mating and laying eggs occur in this period. The weevil complete their life cycle in one year under ecological of Iğdır.

Keywords: *Alfalfa*, *Sitona*, ecological observation, Iğdır.

Acknowledgement: This study was supported by Scientific Research Fund of Iğdır University. Project Number: 2018-FBE-A14.

Oral Presentation
Friday
Invasive Species & Biodiversity of Parasites and Their Hosts-1

New data on *Astragalus* L. feeder Sitonini Gistel (Coleoptera: Curculionidae: Entiminae) species from eastern Anatolia, Turkey

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ABSTRACT

The species-rich genus *Astragalus* L. (Fabaceae) is an important plant group as forage, erosion control and refuge plants for animals especially arthropods as well as insects. This plant genus is distributed in temperate zone of Northern Hemisphere with over three thousand species and about four hundred species in Turkey where half of them endemic. The Sitonini Gistel (Coleoptera: Curculionidae: Entiminae) is a polyphagous group feeding on mainly Fabaceae plants, many of species is known as important pest on cultivated ones. This study is conducted aiming to determine Sitonini species associated with *Astragalus* plants in eastern Anatolia extending to eastern Mediterranean Turkey in 2018-2020. The field investigations were conducted in natural ecosystem at the elevations 700-1900 m asl. using litter reducer sifting plant remnants under *Astragalus*, beating spiny semi-shrubs and sweeping net. With this research, eight species were determined as follow: *Sitona callosus* Gyllenhal, 1834 (Ağrı province, Patnos - Meydan Mountain- 1882 m), *S. humeralis* Stephens, 1831, *S. callosus*, *S. concavirostris* Hochhuth, 1851, *S. fairmairei* Allard, 1869, *S. hispidulus* (Fabricius, 1777), *S. macularius* (Marsham, 1802) (Iğdır Province, Tuzluca – Donandı - 1072 m, Hamurkesen – 1821 m), *Charagmus intermedius* Kuster, 1847, *S. humeralis*, *S. callosus*, *S. concavirostris*, *S. hispidulus*, *S. macularius, S. puncticollis* Stephens, 1831 (Kahramanmaraş Province, Ahırdağı - 1877 m, Ilıca - 1594 m and Kümperli - 1650 m), *S. callosus* and *S. fairmairei* (Kars Province, Digor – Halıkışla - 1016 m, Kağızman – Ağdam - 1152 m and Devebükü - 1221 m). The investigation results revealed that *Astragalus* plants serve food source and refuge habitats for hiding, aestivation and hibernation.

Keywords: *Astragalus*, food and refuge plant, sitonini, Eastern Anatolia.

Oral Presentation
Friday
Invasive Species & Biodiversity of Parasites and Their Hosts-1

Culicoides tbilisicus Dzhafarov, 1964 (Diptera: Ceratopogonidae), A New Record for Turkish Biting Midges

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ABSTRACT

The *Culicoides* biting midges have a wide distribution in the World. They are important in terms of health and veterinary care because their females are fed by sucking blood. There are 62 species record belonging to the genus *Culicoides* in Turkey. This study was carried out to determine the *Culicoides* (Diptera: Ceratopogonidae) species that distributed in the Sarıkum Nature Reserve Area (Sinop-Turkey) which has suitable feeding and breeding habitats for biting midges. Samples were collected using the CDC miniature light trap and the black fluorescent light trap at between the months of May-October 2013 and May-November 2017. Light traps were placed around the lake before sunset and biting midges were caught during the night. The distribution of *Culicoides tbilisicus* Dzhafarov, 1964 species in the study area was determined. A total of 330 specimens of this species, two of which were males, were caught in May, June of 2013 and in May, June and July of 2017. Descriptions of the female and male of *C. tbilisicus* are given. As a result of this study, this is the first time *C. tbilisicus* has been reported from Sinop in Turkey.

Keywords: Biting midges, *Culicoides*, Sinop, Lake Sarıkum, Turkey.

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Oral Presentation
Friday
Invasive Species & Biodiversity of Parasites and Their Hosts-1

Investigation on Weevil (Curculionoidea) Diversity at Burnaz Coastal Dunes in Eastern Mediterranean Turkey

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ABSTRACT

Burnaz coastal dunes is considered as one of the "key biodiversity area" at Mediterranean Basin Biodiversity Hotspots, among specific protected areas with 1360 hectares. It is located northwest corner of Iskenderun Gulf at the provinces border Hatay and Adana at coast of eastern Mediterranean Turkey. This dune is a nesting locality of Soft-shelled Nile Turtle. One of the specific floristic research was revealed occurrence over 200 plant species in Burnaz Dunes, seven of them endemic. Although this dunes host to very rich biotopes, threatened by several land uses, invaded plastic waste and oil remnants, threatened by oil terminals, cycle power plant and electricity power at nearby it. This is the first weevil diversity investigation at Burnaz Dunes in Eastern Mediterranean Turkey. The weevil species, *Protapion nigritarse* (Kirby, 1808), *Ceratapion onopordi* (Kirby, 1808), *Charagmus variegatus* (Fåhraeus, 1840), *Larinus cynarae* (Fabricius, 1787), *L. onopordi* (Fabricius, 1787), *Rhinocyllus oblongus* Capiomont, 1878, *Hypolixus pica* (Fabricius, 1798), *Mogulones beckeri* (Schultze, 1900), *Ceutorhynchus chalybaeus* Germar, 1823, *Tychius meliloti* Stephens, 1831 and *Myllocerus robusticeps* Pic, 1903 are determined. The host plant *Silybum marianum* (L.) Gaertn harbors *R. oblongus* and *L. cynarae*; and *Echinops spinosissimus* Turra is a new host plant record for *L. onopordi*. The aim this presentation is to call attention about diversity for an insect group and awareness threats on this peculiar area need to be conservation.

Keywords: Weevil diversity, coastal dunes, threats, conservation, Burnaz.

Oral Presentation
Friday
Effects of Biodiversity to Human Health-2

An Ethnobotanical Properties of The Some Taxa of Şebinkarahisar District in The Giresun Province (Turkey)

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ABSTRACT

Biodiversity includes the differences in genes, species and ecosystems and is the most important natural richness of a country. Because of the great differences in geology, geomorphology, topography, climate and being one of the ancient life centers, Turkey undisputedly possesses a rich flora and cultural heritage in a temperate zone.

The main purpose of this study was to determine wild and domestic plants using foodstuff, remedy, and other ethnobotanical purposes. For this aim the study was conducted between between May 2019-August 2020 years. The ethnobotanical usages of 66 plant taxa from 34 families were recorded. Most of them belonged to the families Asteraceae (11 taxa), Rosaceae (6 taxa), and Lamiaceae (5 taxa). Although there were some overlapping uses (especially betwenn foodsuaff and remedy) 56 plant species were used for food, 25 species for medicinal purpose, 5 species as animal feed, 5 spesies as decorative purpose and a plant species as toy. Depending on data collected, the parts of the plants used, the aim in using them and the preparation methods were determined. Additionally, phytogeographical regions and endemism situations of the identified plants are defined. All plant specimens collected were identified botanically and deposited at the Herbarium of the Faculty of Arts and Sciences of the Ondokuz Mayıs University (OMUB).

Keywords: Ethnobotany, foodstuff, medicinal plant, Şebinkarahisar, Giresun.

Oral Presentation
Friday
Effects of Biodiversity to Human Health-2

Abilities and Behaviours of some Monocotyledonous and Dicotyledonous Plant Species Consumed as Food in Perceiving the Water Source

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ABSTRACT

Water is the basic ecological factor necessary for living things to survive. Plants transmit water to other organs through their roots. The most basic of the studies on roots is the water perception behaviour and ability of plants. In this study, the abilities and behaviours of a total of six monocotyledonous and dicotyledonous plant species in perceiving the water source were investigated. Dicotyls of these taxa: *Cucumis melo* L. cv. Kirkagac and cv. Ananas, *Citrullus lanatus* (Thunb.) Matsum.et Nakai cv. While Crimson, those with monocots are *Zea mays* L. cv. Sweetcorn and cv. Dekalb6630, *Triticum aestivum* L. cv. Esperia. The experimental setup was prepared using a Y-shaped PVC pipe, soil, aquarium type multi-head air pump, soft silicone pump hose, digital MP3 and headphones. The branches of the Y-shaped PVC pipes are marked A and B, with one arm for each operation directly exposed to the water/sound of running water/recorded water sound. The seeds were sown in seed beds (containing Petri dish and filter paper) formed with pure water at a photoperiod of 21ºC/12 hours light-12 hours dark. When the roots reached 0.5 cm, each was placed in the experimental setup as a seedling for an experimental setup. The experiments were carried out for 5 days. At the end of the experimental period, the seedlings were removed from the apparatus and the orientation of the roots recorded (A or B). Although there are differences between species in the experimental results, it has been confirmed by the data that the effects of bioacoustics on root behaviour are evident in general and that plants benefit from bioacoustics.

Keywords: Hydrotropism, bioacoustics, monocotyledonous, dicotyledonous.

Acknowledgement: We would like to thank TUBITAK for financially supporting the study within the scope of TUBITAK 2209-A project.

Oral Presentation
Friday
Effects of Biodiversity to Human Health-2

Specification and Functional Properties Evaluation of Some Tropical Fruits

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ABSTRACT

Fruits are important for the daily diet as they contribute to the daily intake of macro and micro-nutrients such as fruits carbohydrates, fibers, potassium, folate, vitamins, proteins, carotenoids and polyphenols. The fruits contain phytochemicals which act as antioxidants as well as bio-functional components. Tropical fruits are well known for their distinctive organoleptic properties and their chemical properties contributing to their uniqueness. Most of the tropical fruits are exotic which enable them to be good source of nutrients and antioxidant. They contain a good amount of phytochemical and other active functional molecules such as isoorientin, piceatannol and some amount of gamma-aminobutyric acid (GABA) in passion fruits, bromelain in pineapple, phytosterols in avocados and papain in papaya. The tropical fruits can be consumed fresh, fruit juices, jams, wines, purees, jellies and can be added to some others foods such as yoghurt, cakes and salads as active ingredients. The aim of the present research was to evaluate the nutritional properties, antioxidant, phytochemical characteristics and medical aspects of some tropical fruits especially those grown in sub-Saharan countries basically in Rwanda which are; passion fruits (*Passiflora edulis*), guava (*Psidium guajava*), pineapple (*Ananas comosus*), tamarillo or tree tomato (*Cyphomandra betacea*), avocado (*Persea americana*) and papaya (*Carica papaya*).

Key word: Tropical fruits, phytochemical, antioxidant, nutrional value, functionel properties.

Oral Presentation
Friday
Effects of Biodiversity to Human Health-2

Types of Paeonia and Their Use in Phytotherapy

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ABSTRACT

Treatment with medicinal herbs dates back to the times before Christ and has been widely used all over the world for years. Today, its importance is increasing day by day and it is widely preferred by the public as it is more reliable. According to the World Health Organization, 20 thousand plant species are known in modern and traditional medicine. The number of plants used by the cosmetic and botanical industry is not included to the number. It takes many years to recognize a plant and use it in treatment and it is very difficult to protect it. Therefore, it is of great importance to recognize and develop the plants used in phytotherapy in the past. Our country has a great richness of flora. While it was said that there were 3000-5000 species that grow naturally in our country until 1960, according to the studies and researches of the last 40 years, it has been revealed that this number is over 9000 today. *Paeonia* L. (Paeoniaceae), known as "peony", is a perennial (geofit) plant with showy and attractive flowers and tubers under the ground. Paeoniaceae family is located in the rich flora of our country and has been used for their many medicinal effects. In this review article, peony species and their use in phytotherapy in Turkey and World were discussed with the studies on the subject.

Keywords: *Paeonia*, peony, phytotherapy, geophyte.

Oral Presentation
Friday
Population Ecology

Age and Body Size of the Mediterranean Chameleon, *Chamaeleo chamaeleon*, (Linnaeus, 1758) from Adana, Turkey

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ABSTRACT

The family Chamaeleonidae is one of the most remarkable lizard groups, considering the independently moving eyes, prehensile tail, ballistic tongue and gripping feet. Skeletochronology, which is a common method to determine the age, has been successfully contributed to understand several evolutionary and ecological processes for different lizard species. On the contrary, the age determination of chameleons has limited data. A total of 29 specimens (15 males and 14 females) from Akyatan, Adana Province (Turkey), were investigated using the skeletochronology method and the demographic structure was revealed. Age was determined by counting the lines of arrested growth (LAGs) from cross-sections. The mean snout-vent length (SVL) was higher in females (88.01 mm) than in males (82.86 mm). The mean age was 3.07 years in females and 2.93 years in males. There was no statistically significant difference between sexes in age (Mann-Whitney U test; $p=0.623$) and SVL (Mann-Whitney U test; $p=0.337$). Body size and age were not correlated in both males and females (Spearman correlation; $p=0.20$ for males; $p=0.27$ for females). Results obtained here indicate that *C. chamaeleon* is one of the short-living lizard species when compared with other lizards. This feature brings animals vulnerable against rapid environmental changes. The current study provides important data for both the sustainability of *C. chamaeleon* populations and subsequent studies.

Keywords: *Chamaeleo chamaeleon*, skeletochronology, age, body size, longevity.

Acknowledgement: This work was supported by Dokuz Eylül University Scientific Research Coordination Unit with Project Number 2017.KB.FEN.002.

Oral Presentation
Friday
Population Ecology

Life-history traits in a population of the Artvin lizard, *Darevskia derjugini*

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ABSTRACT

The Artvin Lizard, *Darevskia derjugini* (Nikolsky, 1898), is distributed in the Black Sea coastal region of Turkey (Provinces of Trabzon, Rize and Artvin), Georgia, Azerbaijan and Russia.The vertical distribution of the species is up to 1700 m a.s.l. It is classified as "near threatened" in the IUCN red List of Threatened species. In this study, we investigated age structure, age at sexual maturity and lifespan (as demographic life-history traits) as well as body size of a *Darevskia derjugini* population (n=30, 13 males, 17 females) from Murgul, Artvin, using skeletochronology. Our findings indicated that age upon attaining sexual maturity was three years for both sexes in this high-altitude population. The maximum longevity was seven years. There was no statistically significant difference between male and female individuals in terms of average age. Female individuals were significantly larger than male individuals. As reported for many lizards, we found a significant positive relationship between age and body size within each sex of Artvin lizard. The information given about some life history characteristics of a near-threatened species in this study may contribute to effective conservation management in the future.

Keywords: Artvin lizard, skeletochronology, body size, age, near threatened.

Acknowledgement: The unit BAP of Recep Tayyip Erdoğan University financially supported this study under grant number FBA-2017-714.

Oral Presentation
Friday
Population Ecology

Seasonality of Phytoplankton Size Classes and Pigment Indices along the Southeastern Black Sea

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ABSTRACT

Seasonality of phytoplankton size classes and pigment indices were investigated along the Southeastern Black Sea from November 2015 to August 2016. Significant seasonal variation in phytoplankton size classes were detected and their ratios ranged from 2% to 71%; from 3% to 77%; from 5% and 91% for picophytoplankton, nanophytoplankton and microphytoplankton, respectively. During the study period, microphytoplankton was the main group with a high content of photosynthetic carotenoids. Depending on season, pigment indices significantly changed along the study area. Canonical correspondence analysis revealed that general pattern of phytoplankton size classes along the study area are controlled seasonally by physico-chemical drivers. The differences observed in phytoplankton size classes also indicated phytoplankton adaptive strategy to changing environmental factors.

Keywords: Phytoplankton, size classes, Southeastern Black Sea.

Acknowledgement: This study was funded by TUBITAK (The Scientific and Technological Research Council of Turkey; Project No: 113Y189).

Oral Presentation
Friday
Invasive Species & Biodiversity of Parasites And Their Hosts-2

The *Bruchus* L. (Coleoptera: Chrysomeliadae) Species Feeding on *Vicia* Plants in Northeastern Anatolia

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ABSTRACT

The Bruchinae (Coleoptera: Chrysomelidae) subfamily includes 1700 species and known as seed beetles. Most of them are specialized to the host plant and this group develops in seeds of Fabaceae plants. The genus *Bruchus* Linneaus, 1767 is one of the species-rich group and important in agricultural aspect. A few species are known as famous pest in stored legume seeds. There is a good interaction between host plant and seed beetles. The adults feed on flower pollens, providing pollination and keeping plant distribution in balance by larvae feeding on seeds which are very essential. The *Vicia* L. (Fabaceae) is a genus with about 140 species distributing Europe, America, Asia and Africa, over 60 species occur in Turkey. In the northeast Anatolia, *Vicia* species are widely distributed in natural habitats, and also cultivated for both fodder and green fertilizer purposes. The aim of this study is to determine *Bruchus* species diversity associated with *Vicia* plants in northeast Anatolia Region. In this study, fifteen species *Bruchus* were identified in the northeast Anatolia region and twelve of them were obtained from *Vicia* spp. The species were detected on flowers or seeds of *Vicia cracca* which are as follows; *Bruchus affinis* J. A. Frölich 1799, *Bruchus brachialis* Fåhraeus 1839, *Bruchus hamatus* Miller 1881, *Bruchus libanensis* Zampetti 1993, *Bruchus loti* Paykull 1800, *Bruchus lugubris* Fåhraeus 1839, *Bruchus luteicornis* Illiger 1794, *Bruchus sibiricus* Germar 1824 and *Bruchus venustus* Fåhraeus 1839. *Bruchus pisorum* (Linnaeus 1758) and *Bruchus rufimanus* Boheman 1833 were found on *Vicia sativa* L. *Bruchus libanensis, B. rufimanus* and *Bruchus rufipes* Herbst 1783 were detected on *Vicia pannonica* L. According to the number of collected individual, *B. hamatus* (250 specimens) is the most common species, while *B. rufipes* (1 specimen) and *B. luteicornis* (1 specimen) were rare ones.

Keywords: *Bruchus* species, *Vicia*, the Northeast Anatolia Region, biodiversity.

Acknowledgement: This study was a part of the doctoral thesis and was supported by the Atatürk University Scientific Research Funding (BAP project 2015/167).

Oral Presentation
Friday
Invasive Species & Biodiversity of Parasites And Their Hosts-2

The Deterrent Effect of Some Natural Chemicals on the Feeding of *Thaumetopoea pityocampa* Den. & Schiff. (Lep: Thaumetopoeidae) Larvae

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ABSTRACT

Thaumetopoea pityocampa is the most important defoliating insect for several pine species and cedars. In this study, the inhibition effect of some natural chemical agents was investigated during the feeding of larvae. A no-choice test was set up with the larvae as control and test groups in an experimental design for 8 days. It was given the ponderosa needles that treated oleic and chlorogenic acid solutions to separate test groups. The solutions were prepared from chlorogenic and oleic acid with different concentrations such as 25%, 50%, 75% for each test group. At the end of feeding experiments, antifeedant index (AFI) was calculated for each solution with different concentrations. It was determined that there had been a strong relation between concentrations of solution and AFI values regarding oleic acid ($r= 0.998$, $P < 0.05$). However, there was no significant relationship between concentrations of solution and AFI values regarding chlorogenic acid ($r= 0.663$, $P > 0.5$). As a result oleic acid showed a strong feeding deterrent on the larvae of *T. pityocampa*.

Keywords: Pine processionary caterpillar, feeding inhibition, oleic acid, chlorogenic acid, antifeedant index.

Acknowledgement: This work was supported by the Gazi University under Grant 04/2016-10 number.

Oral Presentation
Friday
Invasive Species & Biodiversity of Parasites And Their Hosts-2

Aphids (Hemiptera: Aphididae) Diversity on Oaks (*Quercus* spp.) in the South Marmara Region and the Presence and Distribution of the Oak Aphids in Turkey

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ABSTRACT

Oaks [*Quercus* spp. (Fagaceae)] are an important forest tree species on worldwide, and oak is generally the dominant species in most of the Mediterranean forests. Also, this genus is one of the most important forest trees in Turkey in terms of species richness and distribution area with about a quarter of the country's forest area. Aphids in the family Aphididae from order Hemiptera are represented more than 5000 species belong to 510 accepted genera, and about half of them feed on different tree species in all or part of their life. Approximately 225 aphid species belongs to more than 40 genera associated with oak trees worldwide. With the study, the aphid species feed on oak trees aimed to determine in the South Marmara Region of Turkey including Çanakkale and Balıkesir Province. Aphid sampling was done between March and October from 2018 to 2020. As a result of the identification of the collected aphid samples, eight species from five genera belong to three subfamilies (Calaphidinae, Lachninae and Thelaxinae) of the family Aphididae were revealed. These oak aphids are *Hoplocallis picta* (Ferrari, 1872); *Myzocallis (Myzocallis) boerneri* Stroyan, 1957; *Myzocallis (Pasekia) komareki* (Pašek, 1953); *Tuberculatus (Tuberculoides) eggleri* Börner, 1950; *Tuberculatus (Tuberculoides) maximus* Hille Ris Lambers, 1974; *Tuberculatus (Tuberculoides) moerickei* Hille Ris Lambers, 1974; *Lachnus roboris* (Linnaeus, 1758) and *Thelaxes suberi* (Del Guercio, 1911). The obtained results show that oak trees in the South Marmara Region have a rich diversity of aphids. Also in this study, the presence and distribution of aphid species identified on oak trees in the studies conducted in Turkey were evaluated to reveal the diversity of the oak aphids in Turkey.

Keywords: Aphid, oak tree, diversity, South Marmara Region, Turkey.

Oral Presentation
Friday
Invasive Species & Biodiversity of Parasites And Their Hosts-2

Reassess of the *Valgothrombium alpinum* Willmann, 1940 (Actinedida: Microtrombidiidae)

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ABSTRACT

The genus *Valgothrombium* Willmann, 1940 includes thirty one species. Seventeen of them are known postlarval forms and eleven of them are larval forms while three of them only are known both postlarval and larval forms. *Valgothrombium alpinum* Willmann, 1940 only recorded from Austria and Poland in the world. The mite specimens were collected from Bayburt and Erzincan Provinces, Turkey. The samples were caught with extraction in Berlese funnels. Examined material was preserved in 70% ethyl alcohol and cleaned in 9 % KOH solution. The specimens were fixed on slides in Hoyer's medium. Measurements were taken and photographing made under a Leica DM 4000 microscope with phase contrast. The adults of *Valgothrombium* separable with differences of their dorsal setae, palps or crista metopica structures from each other. The examined species defined as adults of *V. alpinum*. Various characters of this species were photographed with a microscope. Morphological data provided based on adults of this species. Also, Turkish samples of this species were compared with European samples. In the present work, we aimed to contribute to the knowledge on species of *Valgothrombium*.

Keywords: Acari, Parasitengona, Microtrombidiidae, Turkey.

Acknowledgement: This work was mainly funded by Scientific Research Project (BAP) number FEN-A-140613-0026 (ScientificResearchDepartment of Erzincan University).

Oral Presentation
Friday
Invasive Species & Biodiversity of Parasites And Their Hosts-2

Bruchinae Species (Coleoptera: Chrysomeliadae) Feeding on Field Bindweeds in Northeastern Anatolia Region

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ABSTRACT

Convolvulus arvensis L. (Field bindweed) is one of the most important weeds in agricultural fields. It is a very deep rooting plant a vigorous root systeam that extend to a considerable distance and is very hard to eradicate from the soil. Today, both mechanical and chemical control is carried out against this wild weed. However, it is still not enough. Nevertheless, *Spermophagus* Schoenherr species belonging to the Bruchinae family can partially control these weeds in nature. Bruchids are specialist plant feeders devoloping on a limited number of host plant species. The host plant selection is accomplished by females on pods or fruits that are only available during a short period of the year. In this study, three *Spermophagus* species were found feeding on flowers and seeds of *C. arvensis* in Northeast Anatolia region. These species are *Spermophagus sericeus* (Geoffroy 1785), *Spermophagus kuesteri* Schilsky 1905 and *Spermophagus calystegiae* Lukjanovitch & Ter-Minassian 1957. Especially, *S. sericeus* is most common species in all research territory. These species are overwinter as adult stage. The adults appear in the last week of May in nature. They reach the maximum population between June and July. Adults feed on pollens of *C. arvensis* and lay their eggs one by one under the sepals of the maturing capsules. The hatched larvae enter into seed from capsule shell and complete the entire larval and pupal stage development in the seed. As they completely consume endosperm of seeds, the seeds lost ability of germination. Almost all seeds in every capsule are contaminated in dense population. The existence of these species very important in order to be in balance of wild bindweed in nature. The results revealed that these beetles have a high potential for reducing seed numbers and further research need to be used in biological control of *C. arvensis.*

Keywords: Bruchinae, *Spermophagus* species, *Convolvulus arvensis* L., biological control.

Acknowledgement: This study was a part of the doctoral thesis and was supported by the Atatürk University Scientific Research Funding (BAP project 2015/167).

Oral Presentation
Friday
Environmental Toxicology-2

The Effect of Different Malathion Concentrations on Algal Growth in Cultural Conditions

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ABSTRACT

Malathion is one of the most commonly used insecticides to destroy hazelnut pests in hazelnut gardens in Giresun region. This insecticide is thought to be dragged from the soil by rain, flood and snow water, polluting rivers, lakes and seawaters. The aim of the study is to determine the effect of different malathion concentrations on the growth of green algae isolated from streams under culture conditions. Growth of species to be grown in culture streated with 0.05 mg / L, 0.5 mg /l, 1 mg /l, 5 mg /l and 10 mg /l malathion was compared with those grown in non-malathion culture. In addition, pH and conductivity measurements of the cultures, after dosing were made during the study. With this research, it was tried to determine the change of algae growth in cultures depending on the increase in malathion concentration. As a result of the study, it has been observed that the determined doses affect algae growth negatively. Different malathion concentrations reduced the growth of the culture and the total cell number was reduced by 19% compared to the control group. Our study supports the belief that although the low concentration level of pesticides does not have a significant effect on the aquatic environment, their accumulation in the long term will cause the aquatic environment to be polluted and the aquatic organisms to be negatively affected.

Keywords: Green algae, diatom, microalgae, malathion, pestisit, algaegrowth, stream.

Acknowledgement: This study was carried out by Giresun University BAP Coordinator with the number FEN-BAP-A-230218-19. Supported as a doctoral thesis project.

Oral Presentation
Friday
Environmental Toxicology-2

Effects of Juglone on the Antioxidant Metabolism in the Larval Hemolymph of the Greater Wax Moth *Galleria mellonella* L. (Lepidoptera: Pyralidae)

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ABSTRACT

Reducing the usage of chemical pesticides used to control pests in agriculture and stored products is an important phenomenon. Also, eco-friendly biopesticides or plant-based chemicals have become highly important for use in pest management tools to reduce the negative effects caused by synthetic pest control chemicals. In this study oxidative stress changes induced by one important phytochemical compound, juglone, in *Galleria mellonella* larvae were investigated. For this purpose, sublethal concentrations (LC_{10}: 0.5 mg; LC_{30}: 1.5 mg; LC_{50}: 2.3 mg) of juglone were directly incorporated into the 2 g diet of the first instar larvae of *G. mellonella*. Hemolymph samples of the last instars exposed to juglone were used to test for antioxidant enzyme activities (glutathione-S transferase - GST, glutathione peroxidases - GPx, catalase - CAT, and superoxide dismutase - SOD) and the amount of malondialdehyde (MDA). It was determined that antioxidant enzyme activities (SOD, CAT, and GST) and the amount of MDA in the hemolymph of last instar *G. mellonella* larvae treated with dietary juglone doses changed dose-dependently with respect to untreated larvae. However, there was no significant change observed in GPx enzyme activity in both treated and untreated larvae. Consequently, effective doses of juglone are toxic to the larval stage of pest and model organism *G. mellonella*.

Keywords: Juglone, *Galleria mellonella*, hemolymph, antioxidant system.

Acknowledgement: This research was supported by Anadolu University Scientific Research Projects Commission, of Turkey (Grant Number 1608F610).

Oral Presentation
Friday
Biogeography and Global Climate Change Effects on Biodiversity Areas

Importance of Stones for Soil Invertebrate Diversity of Mediterranean Oak Forests in Fire Events

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ABSTRACT

In the last decades wildfires, despite its important role in many natural ecosystems and life cycle of many species, have progressively become more problematic for biodiversity all around the world. The present degradation and transformation of natural ecosystems through continuous human pressure together with the advance of climate change has made wildfires increasingly common and recurrent in many regions of the world. The number of studies focusing on fires has increased in recent years but a large gap in knowledge remains, especially regarding how animal biodiversity is affected in the immediate post-fire period in the burnt areas. A pairwise comparison between burnt and unburnt areas immediately after a fire was used to understand its effects in soil macroinvertebrate associated with stones in Mediterranean oak forests located at central Portugal. Alive and dead specimens of macroinvertebrate under stones of each area were collected and identified to family level. Most of the macroinvertebrate community remained in the affected area despite a decrease in abundance, richness, diversity, and equitability. Among the most affected *taxa* were Pulmonata, Isopoda, Diplopoda and Coleoptera with a mortality rate between 80% and 100% of its specimens. Higher mortality rates were attributed to a combination of traits that include slow locomotion, air moisture dependency and body size. Stone depth and stone area showed positive correlation with macroinvertebrate richness and abundance in both burnt and unburnt areas. Stones functioned as refuge in the fire event, aiding in the survival and after-fire macroinvertebrate biodiversity maintenance in the affected area. This study shows the importance of micro-habitats for the safeguard of biodiversity within fire affected areas and updates the knowledge on how soil macroinvertebrate recolonization of burnt areas occurs.

Keywords: stones, micro-habitats, immediate after-fire effects, soil invertebrates, Mediterranean oak forests.

Acknowledgement: This study was supported by the European Regional Development Fund (ERDF) through the COMPETE2020 – Programa Operacional Competitividade e Internacionalização (POCI) and national funds through Fundação para a Ciência e a Tecnologia (FCT) under the scope of the project AQUAFIRE (PTDC/CTA-AMB/28936/2017). Thanks are also due for the financial support to Centro de Estudos do Ambiente e do Mar (CESAM) (UID/AMB/50017/2019), to FCT/MCTES through national funds. João Puga is recipient of an individual PhD grant (SFRH/BD/121406/2016) funded by national funds (OE), through FCT. We thank Ana Luísa Caetano and Tiago van der Worp for their assistance in fieldwork.

Oral Presentation
Friday
Biogeography and Global Climate Change Effects on Biodiversity Areas

Biogeography of Turkish *Salix* L. species

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ABSTRACT

Salix L. (willow) is the largest genus of Salicaceae occurring mainly in the Northern Hemisphere. Aim of the study is to examine the biogeography of 26 taxa of the genus *Salix* naturally found in Turkey based on nuclear gene region (*ITS*). An analysis was carried out by Reconstruct Ancestral State in Phylogenies (RASP) using geographic distributions on phylogenetic trees to reveal the biogeographic structuring of the studied *Salix* species. The results of RASP analysis showed that the current distribution of the *Salix* species was shaped by 37 dispersal events and 8 vicariance events. Consequently, subgenus *Salix* prefers habitats with continental climates such as Central Anatolia (*S. fragilis*) and Southeastern Turkey (*S. acmophylla*), whereas the subgenus *Vetrix* species (*S. elaeagnos, S. elbursensis, S. apoda, S. myrsinifolia, S. caucasica,* and *S. rizeensis*) are found in and adapted to wet and cool climates of the high latitude and altitude habitats of Northern and Eastern Turkey. The biogeographic history of Turkish *Salix* species using molecular data set was interpreted based on its dispersal events in which migrations of small groups still occur between the members of two subgenera (Subgenus *Salix* and *Vetrix*).

Keywords: *Salix* L., biogeography, phylogeny, nrDNA, Turkey.

Acknowledgement: This study has been funded by the Scientific and Technical Research Council of Turkey (TUBITAK) with project TOVAG 213O154 "Molecular Phylogeny of Turkish *Salix* L. species and genetic characterization of two economically valuable willow species (*Salix alba* and Salix *excelsa*) for tree breeding purposes" and supported by Middle East Technical University (METU) with project BAP-01-08-2012-013 "Türkiye Söğüt Türlerinin Moleküler Filogenetiği".

Oral Presentation
Friday
Diversity of Plant species, Systematics and Phylogeny-5

Preliminary Studies on Reproductive Success in *Fritillaria aurea* Schott (Liliaceae)

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ABSTRACT

This study includes preliminary studies on the reproductive success of *Fritillaria aurea* Schott (Liliaceae). There are about 160 species in the world, *Fritillaria* L. 44 taxa of its species have a natural distribution in Turkey and 22 species are endemic to our country. When the current literature is examined, it has been observed that although this genus, which has many varieties, has medicinal aromatic properties, includes taxa that should be used in ornamental planting and should be protected, studies on the understanding and protection of the reproductive biology of the genus are insufficient. In this context, reproductive control groups were established in the Erzincan Horticultural Research Institute application garden where breeding studies of the *Fritillaria* genus were carried out and findings of pollination and reproductive success of the *F. aurea* species were observed. Self-pollination, cross-pollination and free pollination success of the species were determined by controlled experimental setups on 30 healthy individuals. In addition, the identity of pollinators visiting the species, the number of pollen and the number of seeds were determined by various field and laboratory protocols. According to the findings, it was observed that the species did not self-pollinate (autogamy), the success of cross pollination (xenogamy) was 63% and the free pollination success was 68%. In the pollen and seed counts, the average number of pollen was 63,000 per anther and the average number of seeds per fruit was 236. In the observations made in the culture environment between 09.00 - 16.00 hours for 10 days, it was observed that the main pollinator of the species was *Apis mellifera* L. (honey bees) and no other pollinator insects were visited during this time period. These results show us that the species is suitable for cross pollination and self-sterile in the culture environment.

Keywords: *Fritillaria aurea*, pollination, reproductive biology.

Acknowledgement: This work was carried out in a project supported by TAGEM (General Directorate of Agricultural Research and Policies) with TAGEM/BBAD/17/A09/P09/05 project number.

Oral Presentation
Friday
Diversity of Plant species, Systematics and Phylogeny-5

Preliminary studies on the effects of different pollination types on reproductive success in *Scrophularia erzincanica* R.R.Mil (Scrophulariaceae) and *Scrophularia fatmae* Kandemir & İlhan

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ABSTRACT

Different pollination and reproduction trials were conducted to determine reproductive success of *Scrophularia erzincanica* and *S. fatmae*. These trials are free pollination, cross pollination (xenogamy), self pollination (autogamy), geitonogamy and apomixis experiments in the field. Both species are spesific to Erzincan and grow limited areas. One of the most important distribution areas of *S.erzincanica* is Sakaltutan Pass route (Erzincan-Sivas highway). In this area, monitoring station where the population is denser than others was chosen and approximately 30 individuals were monitored. During the field works, appropriate mechanisms have been established to monitor the success of different pollination types.

S. fatmae is an alpine species and grows at high altitude (ca.3000 m). Similar procedures have been carried out for *S.fatmae* as well as *S.erzincanica* At the beginning of the study, the number of ovule in both species was determined as 36. At the end of the applications, number of ovules turned into mature seeds were counted. According to the findings, seed productivity of *S. erzincanica* was higher in free pollination (12,7/36), autogamy (3,4/36) and xenogamy (10,8/36). In *S. fatmae*, seed reproduction success was higher in free pollination (23,9/36), autogamy (21,1/36) and xenogamy (16,3/36). Mature seeds were not observed in apomixis and geitonogamy experiments in both species. According to these results, the highest pollination in both species occurs in free pollination and the second choice is cross-pollination in *S. erzincanica* species and self-pollination in *S. fatmae* species. Genaral reproductive success rate is higher in *S. fatmae* than *S. erzincanica*. *S. fatmae* is an alpine species. It was concluded that this was due to a strategy of increasing reproductive success due to the decrease in pollinator types and density at high altitude. The number of flowers in *S. erzincanica* are at least twice of *S. fatmae*. It is thought that the large number of flowers in *S. erzincanica* may be to tolerate low reproductive success. The observations indicate that parasitic insects effect the reproductive success in *S. erzincanica*.

Keywords: Pollination, reproductive success, *Scrophularia erzincanica*, *Scrophularia fatmae*.

Acknowledgement: This work was carried out in a project supported by TUBİTAK with 218Z002 project number

Oral Presentation
Friday
Diversity of Plant species, Systematics and Phylogeny-5

The Diversity Of Vascular Plants And Conservation In Rize

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ABSTRACT

In this study, threats and recommendations regarding biodiversity conservation were presented for the Rize province along with the vascular plant diversity inventory, diversity of the target species, the taxa needed priority for conservation, ecosystem diversity, plant associations and the indicator taxa, habitat types and diversity index values according to the European Nature Information System (EUNIS) with monitoring plans at the species, habitat, ecosystem and regional level. Field studies were carried out for 60 days in 2014 with station works. The collected plant samples were given a collector number and they were dried according to herbarium methods. Locality, GPS, altitude and habitat information of the plants were noted, especially the population status of endemic and rare species were noted. The plant samples collected were stored in RTEÜ Herbarium. Endemic and rare plants of the IUCN risk categories determining the "Turkey Plant Red Data Book" has benefited from the data. Based on the results, 1665 vascular plant taxa belonging to 440 genera in 110 families were determined in Rize. In this study, inventory determination has been completed for Rize and priority taxa and areas to be monitored have been determined. In summary, the special taxa and habitats in Rize province that will be subject to monitoring are under danger due to factors such as urbanization, mining activities and pollution, especially road and agricultural land opening activities.

Key words: Rize, plant diversity, flora, taxon, conservation.

Acknowledgment: We would like to thank the General Directorate of Nature Conservation and National Parks, Rize Province Branch Directorate of the Ministry of Forestry and Water Affairs and the Anatolian Nature and Cultural Protection Cooperation for their contribution.

Poster Presentation

Hunting Dogs as a potential source of *Toxoplasma gondii* infection in humans

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ABSTRACT

Parasites are an incredibly diverse group of species, some of which are responsible for zoonotic diseases that can be transmitted to humans. Toxoplasmosis, is one of these parasitoses with economic, veterinary and medical importance. It is caused by *Toxoplasma gondii* and it affects most warm-blooded animals, including birds, mammals and humans. The frequency of infection in hunting dogs has not been much studied in Algeria, Furthermore, hunting dogs tend to have a high natural resistance to many pathogens. This study aims to detect *T. gondii* specific antibodies in hunting dogs and evaluate their importance to infect the environment. 91 sera of dogs were analyzed by serological tests and 37% hunting dogs were positive to *T. gondii*. This study shows for the first time a seroprevalence of *T. gondii* in hunting dogs in Algeria, and suggests that they might represent a potential source of infection for humans. Nonetheless, the prevalence of parasitic infections like Toxoplasmosis can depend on several parameters such as climatic conditions and changes or the diversity and resistance of hosts.

Keywords: *Toxoplasma gondii*- hunting dogs- prevalence - resistance

Poster Presentation

Investigation of the public health risks of the invasive species *Aedes albopictus* and *Aedes aegypti* in Turkey

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ABSTRACT

As in many parts of the world, our country is under the threat of invasive species. This threat includes not only invasion of native species habitats and niches, but also different types of threats. One of these threats is the vector potential of invasive species, and they pose serious risks in terms of both plant and animal health. Mosquitoes are the most important groups in terms of public and animal health. *Aedes albopictus* and *Aedes aegypti* are the most important species in this group. In this study, in 2019 between August, September and October the presence of viruses that threaten public health in the Black Sea region, Artvin, Rize, Trabzon and Giresun provinces and in the Marmara regions, Kocaeli, Istanbul, Sakarya were investigated from 105 points. The collected samples were transported to the laboratory under suitable conditions and stored at -80 until the laboratory studies. 24 pools were created in the studies. West Nile virus (WNV) was detected Çayeli, Fındıklı, Arhavi, Kırklareli and Istanbul pools, Flavovirus was detected Findikli, Hopa and Istanbul pools and Cell Fusing Agent virus was detected Hopa pool. This situation has revealed that these two species pose a serious risk in terms of public health in a very short time since they entered our country.

Keywords: Invasive species, *Aedes albopictus*, *Aedes aegypti*, virus, surveillance.

Acknowledgement: This research was supported by TUBITAK (Grant Number: KBAG 117Z116)

Poster Presentation

Determination of the Effects of Lead Treatment on Development Period, Fecundity, Sex Ratio and Longevity of *Bracon hebetor* (Hymenoptera: Braconidae)

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ABSTRACT

The impact of the lead (Pb) treatment on development period, fecundity, sex ratio and longevity of larval ectoparasitoid *Bracon hebetor* (Hymenoptera: Braconidae) was examined through a diet incorporation assay. Late instar larvae of *Achroia grisella* (Lepidoptera: Pyralidae) were used as host species. Three different concentrations (50, 100 and 200mg/kg) of lead were added to the synthetic diet of host and parasitoids reared on these hosts were used for the experiments. Treatment with lead prolonged the development period of females at 200 mg/kg concentration, but no significant effect determined for males. The results also indicated that fecundity of parasitoid declined at 100 mg/kg and female sex ratio decreased at all lead-treated groups compared to control. Lead treatment had no effect on the longevity of females, but a significant increase in longevity was recorded at 100 mg/kg for males.

Keywords: *Bracon hebetor*, development period, fecundity, sex ratio, longevity.

Poster Presentation

The Interaction of Lead with Protein, Lipid and Carbohydrate Concentrations in *Bracon hebetor* Say (Hymenoptera: Braconidae) Adults

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ABSTRACT

The influence of lead (Pb) on protein, lipid and carbohydrate level of parasitoid *Bracon hebetor* Say (Hymenoptera: Braconidae) was investigated. Late instar larvae of *Achroia grisella* (Lepidoptera: Pyralidae) were used as host. Host larvae were fed on a synthetic diet containing one of the three lead concentrations (50, 100 and 200 mg/kg). For control group, lead did not added to the diet of host species. Lipid, carbohydrate and protein levels of parasitoids reared on these hosts were compared. All experiments were conducted at 25 ± 2°C temperature, 60 ± 5% relative humidity and 16L:8D photoperiod conditions at the Animal Physiology Research Laboratory, Ondokuz Mayıs University. Treatment with lead increased the protein levels of female at 100 and 200 mg/kg concentrations. For males protein level increased at all tested lead concentrations. Lipid levels of both sexes considerably decreased at 200 mg/kg lead concentrations. Carbohydrate level of lead treated females also reduced significantly at all lead concentrations. For males, carbohydrate level showed fluctuations among lead-treated groups with a significant increase at 50 mg/kg and a considerable decrease at 200 mg/kg with respect to the control.

Keywords: *Bracon hebetor*, lead, protein, lipid, carbohydrate.

Poster Presentation

Survey of the Possible Fungal Pathogens of *Orosanga japonica* (Hemiptera: Ricanidae) in Eastern Black Sea Area

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ABSTRACT

Orosanga japonica (syn. *Ricania japonica*, Hemiptera: Ricaniidae) is one of the most important pests in the Black Sea Region of Turkey. The pest causes damage by feeding on various vegetables and fruits (cucumbers, beans, cabbage, kiwi), and other plants especially tea at nymph and adult periods. The pest is known to be effective on plants by absorbing the juice of the plants due to its mouth structure. Although various methods and microbial factors from different source have been tried to control on the pest until recently, the detection of fungal pathogens on the pest is limited.

Entomopathogenic fungi are one of the most important microbial agents in pest control. Because the pest has the piercing and sucking mouth parts, and the climatic features of the region take advantageous to use entomopathogenic fungi in the pest management.

In this study, we isolated seven fungal isolates from *O. japonica* adults with fungal infection collected from vine leaves in Pazar district of Rize for the first time in Turkey. According to morphological (infection contour, colony morphology, spore contour) and molecular characterization studies based on the internal transcribed spacer (ITS) sequences, all of isolates were identified as strain of *Beauveria bassiana* (Oj1-Oj7).

Using of the fungal isolates in microbial control of the pest are extremely important for the quality and healthy production of our country. It is planning that insecticidal effects of all fungal strains against *O japonica* will be determined both laboratory and field conditions.

Keywords: *Orosanga japonica*, entomopathogenic fungi, *Beauveria bassiana.*

Poster Presentation

Biocontrol efficacy of *Trichoderma atroviride* ID20G against biotic stress of *Rhizoctonia solani* B227 in bean development

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ABSTRACT

Trichoderma is a genus of fungi in the family Hypocreaceae, that is present in all soils, where they are the most prevalent culturable fungi. The effectiveness and some properties of *Trichoderma atroviride* ID20G strain isolated from tea growing areas against the biotic stress caused by *Rhizoctonia solani* B227 (AG4) isolate in bean development were investigated.

Some enzyme activities of *T. atroviride* ID20G strain were investigated by chromogenic method. The tolerance of some biologically important heavy metals (Cu, Pb, Zn and Cd) to different concentrations was determined by the radial growth inhibition method. The effectiveness of *T. atroviride* ID20G and *Rhizoctonia solani* B227 (AG4) isolates on bean seed pathogenicity test and seed germination success was investigated by water agar method. The efficiency of *T. atroviride* ID20G and *R. solani* B227 on bean growth / development parameters was investigated by pot experiment.

Trichoderma atroviride ID20G was found to be tolerant to heavy metals at high concentrations (100-400 mM). Plant growth promoting enzyme activities were observed. It was determined that *T. atroviride* ID20G had no negative effect on the germination of bean seeds compared to the control. In pot experiment, when control and *R. solani* B227 groups were compared to each other; It was determined that there was a significant difference ($p < 0.05$, Tukey) as a result of statistical analysis performed with stem and main root length, number of fringes and lesion scale values in the root. However, the ID20G and B227 + ID20G groups were found to reduce pathogenic activity when compared with the R. solani B227 group. It was observed that *R. solani* B227 caused pathogenicity in beans (Zulbiye) and the pathogenicity was generally decreased in the presence of *T. atroviride* ID20G. It was concluded that *T. atroviride* ID20G can be used as a plant protection agent in bean cultivation.

Keyword; Plant pathogen, bean, *Rhizoctonia solani*, *Trichoderma atroviride.*

Poster Presentation

Monitoring Of The Development Of A Bacterial Community For The Strain "*Pseudomonas fluorescens*" And Characterization By Several Microscopies

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ABSTRACT

The boom in the chemical industry in recent years has led to massive contamination of the environment through the discharge of toxic effluents. Bioremediation processes allow in situ decontamination of the environment using microorganisms. Therefore, optimal process development requires being able to anticipate the behavior of the bacterial population of interest in situ, in response to different environmental factors and their fluctuations. For this, it is essential to become familiar with the physiology of bacterial biofilm and to understand the regulation of the processes of interest.

It is in this context that our research problem is situated in order to highlight the role of biofilms (*Pseudomonas fluorescens* strain) in the bioremediation of water contaminated by xenobiotic in vitro and in situ and to understand the different mechanisms undertaken by these microorganisms to ensure their role.

The objective of this work is to study the different stages in the development of the bacterial biofilm for the *P. fluorescens* strain, starting with the adhesion of the bacteria until the detachment of the biofilm over a maximum incubation period of 96 hours. The characterization of the biofilm was carried out using several microscopies: light microscopy, atomic force microscopy (AFM), scanning electron microscopy (SEM) and confocal microscopy. Our preliminary results show that the development of the biofilm is governed by different phases of growth, the most important being the maturation which takes place after 24 hours. The bacterial community then acquires a three-dimensional structure constituting a polymeric network forming an extracellular matrix, then followed by the step of detaching the bacteria which disrupt the structure of the biofilm. A number of cells return to the planktonic state after 96 hours in culture. Moreover, the influence of the physicochemical treatment of the substrate on the adhesion of the biofilm was also studied.

Keywords: bioremediation, biofilms, *Pseudomonas fluorescens*, atomic force microscopy (AFM), scanning electron microscopy (SEM), confocal microscopy.

Poster Presentation

Atomic Force Microscopy Study of Telluric Bacteria "*Pseudomonas fluorescens*" Used in The Bioremediation of Soils Contaminated with Xenobiotics

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ABSTRACT

Phytoremediation is a relatively new approach to removing contaminants from the environment. And it can be defined as the use of tolerant plants to eliminate, destroy or sequester dangerous substances (xenobiotic). To improve the detoxifying action of these plants under conditions of environmental stress, bacteria are added near their roots. Among the microorganisms that can adapt to different environments and ecosystems are bacteria of the genus *Pseudomonas* including *P. aeruginosa*, *P. putida* and *P. fluorescens*.

The species that we have chosen for this work is *Pseudomonas fluorescens*, very well known for its capacity to colonize the roots of plants and to increase the efficiency of the root absorption of the metallic trace elements present in natural environments. On the other hand, the morphological characteristics as well as the membrane structuring of *P. fluorescens* have only been very partially studied.

This is the context in which this study is situated. (i) We, first of all, were interested in optimizing the conditions for cultivation and development of *P. fluorescens*. (ii) Then, we characterized its morphology by atomic force microscopy (AFM) and (iii) followed the temporal evolution of this bacterial population (aging study).

Through this study, we have succeeded in determining the optimal conditions for the culture of the species *Pseudomonas fluorescens* (culture medium, temperature and incubation period). On the other hand, morphological characterization showed that *P. fluorescens* is slightly different from other bacteria : elongated shape, invagination and characteristic membrane structure. And finally, the aging study revealed, after 30 days, the appearance of damage (morphological and membrane) indicating the decline in vitality of these bacteria.

Keywords: phytoremediation, bacterial morphology, *Pseudomonas fluorescens*, toxicity, atomic force microscopy (AFM)

Poster Presentation

Dairy effluents disinfection from contaminating bacteria by local clay of *Kenadsa-Bechar* (Southwest of Algeria).

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ABSTRACT

This present work is part of liquid discharges treatment thematic by studying the disinfection of dairy effluents from contaminating bacteria by local clay from *Kenadsa* (Bechar-Algeria).

The study estimated the clay adsorbing power by adsorption technique for bacteria contaminating the dairy effluent by determining the bacterial load before and after treatment. The MPN technique on liquid medium was used for bacterial load assessment. In addition, the calculation of the breakthrough time (filter breakdown) was also measured.

The results of the bacteriological analysis of dairy effluents before treatment showed an average bacterial load of 3,88 Log_{10} and 4,23 Log_{10} cfu/100mL for fecal coliforms and fecal streptococci respectively, exceeding the thresholds set by national and international regulations.

The clay treatment results have shown that the material used has a relatively high adsorption property for the tested system at 3 cm in height of the fixed bed, expressed by a reduction rate of bacterial load equivalent of 55 to 84, 62% and a breakthrough time, also called breakdown of the filter) inversely proportional to the initial bacterial load of discharges.

These preliminary results are very promising at the laboratory scale as a treatment method which respects the environment and opens up prospects for the future where the modification of operating conditions such as the height of the fixed bed, the flow speed or the clay structure like the particle size distribution of the adsorbents, known as one of adsorbent classes endowed with an antimicrobial property, can improve the process of disinfection by adsorption.

Keywords: Clay, dairy effluents, adsorption, breakthrough time, *Kenadsa* (Bechar).

Poster Presentation

Evaluation of the chemical risk of liquid effluents from a dairy unit in South West of Algeria

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ABSTRACT

Milk production, as well as various dairy products generate pollution in the form of food waste. The management of this waste concerns professionals which the objective of this study is to evaluate the raw liquid effluents chemical risk of a dairy industry located in Bechar (Algeria) by analysing of some physicochemical parameters.

The physicochemical analyzes of ten samples are interpreted on the basis of the regulatory requirements recommended by the Algerian standard.

The physicochemical analyzes of ten samples are interpreted according to the regulatory requirements recommended by the Algerian standard relating to the chemical discharge thresholds. The results obtained showed a sign of pollution revealed by high levels of the organic matter, expressed by significant means related to the following parameters; Chemical Oxygen Demand (COD: 810,33 mg/L), Biochemical Oxygen Demand(BOD_5: 797,91mg/L) Suspended Matter (SM: 47,3 mg/L) and Turbidity (174.014 NTU) exceeding those required by the standards, Except other parameters, namely pH, conductivity and sulphate, les nitrate, nitrite ions that show an acceptable values. Although these waters present a high organic load (report BDO_5/COD = 0,985), they constituted by dissolute organic matters (SM/BDO_5 = 0,076). The examination of report COD/BDO5 = 1,015 underlines well the biodegradable character of mixed wastewater of this dairy industry.

The high pollution levels are because the lack of wastewater treatment. One that can have a harmful impact on the environment, biological diversity and therefore on humans as well.

Keywords: Liquid effluent, Bechar, discharge standards, dairy industry, pollution, environment.

Poster Presentation

CRISPR/Cas system and phage/plasmid biodiversity of *Vagococcus* spp. through protospacer analyses

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ABSTRACT

CRISPR-Cas (Clustered regularly interspaced short palindromic repeats- CRISPR associated genes) is an immune system process of bacteria or archaea to gain immunity against phage or plasmid invasions. In this process, short DNA sequences of phages/plasmids are inserted into the repeat sequences in the CRISPR array and this is called as protospacer. In this study, CRISPR/Cas systems and phage/plasmid biodiversity of 13 *Vagococcus* spp. strains were investigated through the spacer analyses of the CRISPR/Cas system. The studied strains had a wide variety of CRISPR /Cas systems. Three strains had type I-B, six strains had type II-A, two strains had I-C, three strains had II-C while only one strain (*V. fluvialis* strain UFMG-H6B) had type I-E. Spacer analyses showed that there are phage or plasmid invaders within five strains. Phage invaders of strains were mostly from phylogenetically close genera such as *Enterococcus, Lactococcus,* or *Streptococcus.*

Keywords: *Vagococcus* spp., phage, plasmid, CRISPR-Cas, spacer.

Poster Presentation

Biocontrol efficacy of *Trichoderma lixii* ID11D against biotic stress of *Rhizoctonia solani* B227 in bean development

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ABSTRACT

Trichoderma is a genus of soil fungi found worldwide. They are fast-growing, highly adaptable fungi that form symbiotic relationships with plant roots. The effectiveness and some properties of *Trichoderma lixii* ID11D strain isolated from tea growing areas against the biotic stress caused by *Rhizoctonia solani* B227 (AG4) isolate in bean development were investigated.

Some enzyme activities of *T. lixii* ID11D strain were investigated by chromogenic method. The tolerance of some biologically important heavy metals (Cu, Pb, Zn and Cd) to different concentrations was determined by the radial growth inhibition method. The effectiveness of *T. lixii* ID11D and *Rhizoctonia solani* B227 (AG4) isolates on bean seed pathogenicity test and seed germination success was investigated by water agar method. The efficiency of *T. lixii* ID11D and *R. solani* B227 on bean growth / development parameters was investigated by pot experiment.

T. lixii ID11D has been determined to have strong enzyme activities, wide temperature range for reproduction and a high tolerance to toxic metals, salinity, drought and fungicides. It was observed that *T. lixii* ID11D strain had no negative effect on the germination success of seeds compared to the control. In the pot experiment, when the control and *R. solani* B227 groups were compared to each other, it was determined that, there was a significant difference as a result of statistical analysis ($p< 0.05$, Tukey) performed with stem and main root length, number of fringes and lesion scale values in the root. It was determined that *R solani* B227 (AG4) isolate caused pathogenicity in beans (Zulbiye) and *T. lixii* ID11D strain decreased pathogenicity in all parameters. It was concluded that *T. lixii* ID11D strain can be used as a good biocontrol and plant support agent against Rhizoctonia solani in bean cultivation.

Keyword: Biocontrol, beans, *Rhizoctonia solani*, *Trichoderma lixii*.

Poster Presentation

Three New Potential Cargo Microorganisms With Isolated From Honeybees in Turkey

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ABSTRACT

In this study, it was aimed to identify the swarming bacteria (E2-1A, E21-1A and E176-1B) isolated from three bee samples taken from different geographical regions by traditional and molecular methods. It is nown that these swarming bacteria are capable of information processing, containing an exceptionally high number of communication-related genes. This means a very high "Bacterial Social Intelligence Coefficient (IQ) Score". That is why bacterial social intelligence can be estimated by their ability to communicate, sense their environment and adapt accordingly. In addition these microorganisms known as Cargo Microorganisms.

The honeybee samples were first surface sterilized, disintegrated in saline water, kept at 80 °C for 10 minutes and cultured in MYPGP agar. The samples were ccharacterized by macroscopic and microscopic features. Than DNA isolations of the isolates were made, 16S rRNA was identified molecularly according to gene sequence analysis and phylogenetic tree. In molecular diagnosis, E2-1A and E21-1A strains (100% and 96.5%, respectively) were found to be similar to *Paenibacillus cookii* strain L5 and E176-1B strain 100% *Paenibacillus lautus* strain FJAT-45556.

Motility is crucial as it enables bacteria to seek out and colonize suitable environments. Motile bacteria face rapid environmental changes and thus has to respond to those changes much faster. Moreover, also facilitates the spread of other non-motile microbes and fungi that bind to motily colonies in their habitats. Many *Paenibacillus* species stimulate plant growth; for example, by aiding in nutrient intake through nitrogen fixation and by producing cytokines, peptide antibiotics and volatile substances that elicit a defense response. It is thought that the isolated and characterized strains in our study are visually quite striking strains and their use in bioremediation by determining their properties promoting plant growth will be beneficial.

Keyword: Swarming bacteria, *Paenibacillus lautus*, *P. cookie*, honeybee,

Poster Presentation

Plant Use and Diversity in Urban Homegardens in Latin America – A Review

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ABSTRACT

Urban homegardens are the predominant form of urban agriculture. Even when smaller than the rural ones as a consequence of the competition for space with infrastructure development, urban homegardens have the potential to provide food security and social wellbeing for city dwellers, meeting - among others - productive, recreational and aesthetic households needs. The multifunctionality of homegardens is critical for low-income families and is favoured by a high plant species diversity, a common feature of urban homegardens across different cities that helps increasing dietary variety, constitutes an alternative/additional income, and improves households livelihood. Households may adapt agrobiodiversity composition for the gardens to meet their needs. Agrobiodiversity found in urban homegardens is likely to be much higher than in other urban land use types and is mainly represented by exotic species. This review provides evidence from the literature about the link between agrobiodiversity and livelihoods with urban homegardens in Latin America.

Keywords: Agrobiodiversity, food security, household, livelihood.

Acknowledgement: This review was financially supported by the Faculty of Tropical AgriSciences (project number 20205011) of the Czech University of Life Sciences.

Poster Presentation

Contribution to The Divergence Time of *Bufo bufo* and *B. verrucosissimus* Using New Anatolian Dataset

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ABSTRACT

Molecular clocks have contemporarily influenced current remarks on the timing of important events in evolutional histories. Accurate estimations of divergence times are a key factor for inferring diversification rates and identifying the causes of variation in rates of molecular evolution. In this study, we contributed to the diversification time of *B. bufo* and *B. verrucosissimus* by way of using new comprehensive dataset delimited on Anatolia landmass. For this, genetic sequences were obtained from GenBank belonging to *B. bufo* and *B. verrucosissimus* from Anatolia to construct the chronogram. Haplotypes were determined using a concatenated (16S + Cytb) mtDNA data. The optimal models for each gene were selected according to BIC. A total of 1332 bp concatenated dataset was subjected to Bayesian analysis using BEAST v1.8.2 under the birth-death process with the uncorrelated-lognormal clock model, the substitution rate sampled from normal distribution with a mean of 0.0069 and a standard deviation of 0.0017 per a million year. We also specified two fossil calibration points. As a result of the analysis, we found approximately identical divergence times for taxa in *Bufo bufo* species group in regard of previous studies. Initial diversification point of ingroup node was found 11.45 Mya in concordance with the separation of *B. bufo* - *B. gargarizans* species groups. Splitting time of *B. bufo* and *B. verrucosissimus* collapsed into Pleistocene in which climatic oscillations, subsequent glacial-interglacial periods, and orogenesis formations were strong forces. As a key point, splitting time of Anatolian *B. bufo* clade was found around 0.64 Mya. Previously, divergence time of *B. bufo* in Italy was reported around 1.7 Mya. Taking this information into consideration, we assume that the difference might be occurred due to recolonization events during Pleistocene and own phylogeographic history of Anatolia.

Keywords: Bayesian analysis, phylogeny, speciation, mtDNA.

Poster Presentation

Digging Past: Bayesian Skyline Plot Analysis of *Bufo bufo* and *B. verrucosissimus* populations from Anatolia and Caucasia

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ABSTRACT

The demographic history of populations leaves a footprint in the genomes of their modern representatives and help us understanding correlation between demographic and paleoclimatic events. The consecutive glacial-interglacial cycles in Pleistocene intensively effected the population size and distributions of living organisms in the Northern Hemisphere. In this study, we aimed to investigate past population dynamics of *Bufo bufo* and *B. verrucosissimus* distributing in Anatolia and Caucasia. For this, we used a comprehensive Anatolian and Caucasian dataset obtained from GenBank. Past population dynamics of species were estimated using 16S rRNA and cytb markers and concatenated data under Bayesian skyline plot using BEAST v1.8.2. The best evolutional models for each gene were selected according to Bayesian information criteria. Analyses were run using uncorrelated lognormal relaxed clock, the Bayesian skyline as a coalescent model, mutation rate sampled from normal distribution with a mean of 0.0069 and a standard deviation of 0.0017 per a million year. According to our results, both species have relatively stable population expansion for 16S gene during last 10.000 years, but effective population size (N_e) of *B. bufo* is larger than *B. verrucosissimus*. For cytb, N_e of *B. verrucosissimus* has decreased between 50.000 – 15.000 years ago whereas it was more stable for *B. bufo*. Strikingly, our results suggested that N_e of *B. bufo* rapidly increased followed end of Last Glacial Maximum around the Pleistocene-Holocene transition period. This is similar to our previous findings that numerous haplotypes were found for *B. bufo* species along Anatolia indicating dimensional expansion. Lastly, we found identical results for concatenated mtDNA data in terms of effective population size against time as observed in cytb marker. Given that the distribution range of *B. verrucosissimus* is delimited in Caucasia and Mediterranean Region in Anatolia where refugia located during glacial periods, temporary bottleneck and smaller N_e are reasonable.

Keywords: Effective population size, demography, bottleneck, phylogeography, climatic oscillations.

Poster Presentation

Ecophysiological responses of *Zea mays* L. against thermal power plant fly ash applications

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ABSTRACT

Thermal power plant fly ash is one of the most important concerns of this form of energy generation, as it is the most important waste generated by burning coal in a thermal power plant. This kind of fly ash contains elements like Fe, Al, Si, Ca, Na and K which can be beneficial or harmful depending on the concentration. In order to evaluate the effect of thermal power plant fly ash on the ecological system, it is necessary to analyze the ecophysiological responses of plants. *Zea mays* L. (corn) is a worldwide consumed plant species which has been cultivated for 10000 years and it is an important model organism for genetics and biology. In this study, it was aimed that to observe ecophysiological responses of Corn against thermal power plant fly ash applications. For the experimental period, control (0 ppm), 500, 1000, 2500, 5000 and 7500 ppm of fly ash applications were set. Pots with 1 kg capacity used as seedbeds. Different fly ash concentrations were weighed and mixed with 500 g soil. Then fly ash added soils set in the pots. Corn (cv. Sweetcorn) seeds were soaked in soil filled pots and watered with 100 ml distilled water. The experiments took 14 days, and at the end of the experimental period % germination, hypocotyl and radicle lengths, seedling vigor index (SVI) were calculated. It was observed that 500 to 5000 ppm fly ash applications were stimulated the seed germination, stem and root development and also SVI, but 7500 ppm fly ash applications were inhibited the all ecophysiological parameters. We can say that lower than 5000 ppm fly ash can be useful for agricultural practices, however above 5000 ppm level it is harmful for plant development.

Keywords: Ecophysiology, fly ash, *Zea mays*

Poster Presentation

Comparison of *Tragopogon abbreviatus* and its close relative taxa based on anatomical data

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ABSTRACT

The purpose of the study is to determine the general root, stem and leaf anatomical features of *T. abbreviatus* (Boiss.) Coşkunç. & M.Gultepe and to compare with two subspecies of *Tragopogon porrifolius* L. based on anatomical features. The plant materials were collected from nature habitats during to taxonomic revision of Turkish *Tragopogon* and fixed in FAA (5 parts stock formalin, 5 parts glacial acetic acid, 90 parts 70% ethanol) for 24 h and stored in 70% ethanol. Anatomical observations were performed on cross section taken from roots, stems and leaves and also superficially section from leaf. The examined taxa are characterized with large vascular bundles surrounded by parenchymatic cortex including secretory cells and 2–5 layered collenchyma just below the epidermis. Latex canals are common among the cortex parenchmatous cells. The mesophyll of the *T. porrifolius* subsp. *longirostris* (Sch.Bip) Greuter is bifacial but it is equifacial in the other examined taxa.

The examined taxa were compared based on anatomical characteristic for the first time. Our observations showed that the root, stem and leaf anatomy are similar anatomically. But, mesophyll characteristics may provide some useful taxonomic contributions in the delimiting the closely related taxa.

Keywords: Anatomy, systematic, tragopogon, Turkey.

Acknowledgement: This study was supported by Scientific and Technological Research Council of Turkey (TUBITAK, Project number: 110T954)

Poster Presentation

New Taxonomic Findings for the Wild *Vaccinium* L. (Ericaceae) Taxa Distributed in Turkey

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ABSTRACT

With the present study, emended descriptions of *V. arctostaphlyos* L., *V. myrtillus* L., *V. uliginosum* L. and *V. vitis-idaea* L. belonging to the genus *Vaccinium* L. naturally distributed Turkey were prepared based on lots of herbarium and newly collected specimens. Properties of leaf base, veining type, calyx margin and surface features, fruit color and seed length were recorded for the first time for Turkish *Vaccinium*. The leaf base of *V. arctostaphylos* is fiber-fluted, it is ruminate in *V. myrtillus*, *V. uliginosum* and *V. vitis–idaea*. The number of aeroles (vein islets) formed by secondary vein is 8-9 in *V. arctostaphylos*. On the other hand, it is 5-7 in *V. myrtillus* and 3-4 in *V. uliginosum* and *V. vitis-idaea*. Calyx shape of *V. arctostaphylos* and *V. vitis-idaea* is triangular whereas it is wavy in *V. myrtillus* and *V. uliginosum*. Additionally it is recorded that all members of Turkish *Vaccinium* easily could distinguish by using mature fruit color which is dark black in *V. arctostaphylos*, red in *V. vitis-idaea,* dark purple in *V. myrtillus* and *V. uliginosum*. Among the examined taxa, seed of *V. uliginosum* showed the highest length value (1-1.8 mm). Also it is 1,2-1,6 mm in *V. arctostaphylos,* 1.2-1.4 mm in *V. myrtillus* and 1.3-1.5 mm in *V. vitis-idaea.* Furthermore a revised functional diagnostic key and updated distribution map was prepared here for wild *Vaccinium* distributed in Turkey.

Keywords: Diagnostic key, emended descriptions, *Vaccinium*

Poster Presentation

Achene Anatomy of *Lactuca* (Asteraceae) Taxa Endemic to Turkey

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ABSTRACT

Achene features are widely used in the family of Asteraceae to delimitate species boundaries. In this study we aimed to present and evaluate achene anatomical features of *Lactuca* taxa endemic to Turkey. The genus *Lactuca* is classified in the tribe Cichorieae (Asteraceae) and represented with 23 taxa in Turkey, 4 (*L. boissieri, L. fenzlii*, *L. glareosa* and *L. variabilis*) of which endemic to Turkey. Achenes were firstly either boiled in water or stored in Nitric acid (10%) solution and then embedded in paraffin wax. The transversely sections at 8−15 µ were double stained using safranin-fast green and mounted in entellan. All achenes are winged, however the thickness of wings variable. The mesocarp is composed of parenchymatous and fiber cells at wings and ribs, and only parenchymatous cells between ribs in all studied taxa. On the other hand *L. glareosa* has denser fiber cells in mesocarps than the others. Moreover, although hydrosite cells are presence in the wings of *L. boissieri, L. fenzlii*, and *L. variabilis*, *L. glareosa* has not these sorts of cells. Although all Turkish endemic *Lactuca* taxa are closely related based on molecular data, the extra ordinary achene anatomical features recorded in *L. glareosa* are most likely due to hard ecological condition of the species. Consequently achene anatomical data are useful to delimitate closely related taxa in the genus *Lactuca*.

Keywords: Asteraceae, Lactucinae, pericarp, cypsela.

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Poster Presentation

Morphological and Molecular Characterization of Different Garlic Genotypes Grown in Kayseri Conditions

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ABSTRACT

For this study, garlic genotypes were collected from 38 different locations and morphological and molecular characterization were performed in the laboratories of Erciyes University Faculty of Agriculture. In morphology, parameters such as head wet weight, head dry weight, head diameter, head height, number of head, broken head status and shell color were examined. Analysis of variance was made with SAS program with morphological data. KahramanmaraǤ4 type was found to be statistically different in terms of wet weight, dry weight and head diameter. In terms of molecular characterization, a total of 17 inter-simple sequence repeats (ISSR) primers were tested and 10 primers which were found to give clear recordable bands were selected and used in the analyzes. Dice similarity matrix was made with NTSYS Version 2.1 based on molecular data and this was used in drawing UPGMA dendrogram. The matrix formed according to the mean difference method was used in neighbor-joining analysis. In the analysis, TekDiǤ31 garlic type belonging to Tunceli region was found to be statistically different from other garlic types. Among the other genotypes except single clove garlic, The similarity coefficients were between 0.85 and 1.00. In general, some garlic clones (Maras3 and Kayseri30, Urfa33 and Topakli35, Kastamonu22 and Kastamonu28, Urfa10 Kastamonu14 Kastamonu15 Kastamonu20 Kastamonu25 Kastamonu29 and Bademci23) were found to be completely similar, while little differences were found between the others. As a result, although the clonal propagation of the garlic plant has revealed a wide morphological and partially molecular variation. From these findings, it was concluded that the variation between garlic genotypes may be due to mutations.

Keywords: Garlic, molecular characterization, morphological characterization, clonal reproduction.

Poster Presentation

Determination of Genetic Diversity of *Syntormon pallipes* Populations in Muğla Province Using ISSR Markers

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ABSTRACT

Today, biodiversity is of great value both for countries and universally. One of the factors that make up biodiversity is genetic diversity. Therefore, it is very important to determine the genetic diversity of the species. *Syntormon pallipes* is a cosmopolitan species in the Dolichopodidae family. In this study, 4 polymorphic ISSR markers were studied to assess the genetic variability within and among 5 *Syntormon pallipes* populations. Analysed of data was carried out by POPGENE ver. 1.32 and GenAlex ver. 6.05 software programs. A total of 144 loci were resulted by the analysis of 5 primers. The average number of alleles observed and the number of effective alleles for all populations were in the range of 1.61 ± 0.48, 1.81 ± 0.38 and 1.33 ± 0.36, 1.48 ± 0.36, respectively. The proportion of polymorphic loci for all populations ranged from 61,11 % to 81,94 % and Nei's gene diversity value ranged from 0,20 ± 0.19 to 0.27 ± 0.18. The level of gene flow was 2,40 per generation. Nei's genetic distance coefficient changed between 0,055 and 0,107 among all possible population pairs. According to Analysis of Molecular Variance (AMOVA), main contribution to genetic variance (% 90) was due to variation in populations.

Keywords: Muğla, dolichopodidae, *Syntormon pallipes*, ISSR, genetic diversity.

Acknowledgement: This research was supported by Mugla Sıtkı Koçman University, Scientific Research Projects Coordination Unit (Research Project Number: 09/04).

Poster Presentation

Review on Phytochemical and Antioxidant Properties of Passion Fruits (*Passiflora sp.*)

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ABSTRACT

The aim of the present research is to review bioactive phytochemicals, medical aspects and antioxidant properties of passion fruits (*Passiflora sp*). Passion fruit is known as tropical fruit which can have purple or yellow rigid rind and much seeds inside within the pulp. It is also well known for its good flavor and its unique aroma. It is one of the tropical fruits with many health benefit which include providing micronutrients such as pro-vitamin A, potassium, magnesium, calcium and iron; macronutrients such as fruits carbohydrates and edible fibers. It shown some medical aspects coming from its bioactive phytochemicals such as improving the level of insulin due to its content in piceatannol; to reduce anxiety due to its content in potassium and passion fruits can improve mental health due to its content in Gamma-aminobutyric acid (GABA) and beta-carboline harmala alkaloids with anti-depressant properties. It is a rich source of antioxidant which include polyphenols, vitamin C (Ascorbic acid) and carotenoids. It also shown to have low glycemic index (GI) where as it can be used by people having diabetes. The passion fruit's peels powder shown also that it can be used as food additives due to their high content in pectin. Passion fruit shown to have bioactive phytochemical, it can also be used in medicine and is as well a good source of antioxidants.

Key words: Passion fruits, phytochemical, antioxidant.

Poster Presentation

Current and potential distribution of *Aedes albopictus* and *Aedes aegypti* in Turkey

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ABSTRACT

Aedes albopictus and *Aedes aegypti* (Diptera: Culicidae) are capable of transmission more than 20 viruses, including dengue fever, chikungunya and Zika. These mosquitoes are important related to the arboviral origin pandemics and epidemics around the world. Determining the distribution and possible distribution potential to the new areas are contribute to the prediction of possible risk situations. Species distribution models (SDMs) are determine the most probable distribution areas of the species and very successful methods for disease transmission risk. The aim of this study was to determine the distribution of *Aedes albopictus* and *Aedes aegypti* current and potential distribution areas in Turkey. Black Sea, Marmara, Aegean, Mediterranean and Central Anatolia regions were investigated in order to determine the current distribution areas of these species. In total, 467 points were included for *Aedes albopictus* and 35 points for *Aedes aegypti*. 19 BioClim data used in the study (1 km resolution). Potential computational errors have been minimized by removing highly correlated data between these dataset. it was run in 100 replications. Reliability of the model was measured according to AUC values. In the prediction model, it was determined that the coasts of the Eastern Black Sea Region are suitable for *Aedes aegpti* and the Çukurova region in Mediterranean, coasts of Black Sea, Marmara, Aegean Regions are suitable for *Aedes albopictus* distribution. Thus these areas will be risky for arboviral disease transmission in the near future.

Keywords: *Aedes albopictus*, *Aedes aegypti*, distribution, species distribution models.

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Poster Presentation

Age Structure of *Bufo verrucosissimus* (Pallas, 1814) Males from Artvin, Turkey

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ABSTRACT

The Caucasian Toad (*B. verrucosissimus)* is a representative of *Bufo bufo* species group in Caucasia and a part of Anatolia. Although life-history traits of the species were subjected to the studies had been carried out in the border of Caucasia, there is still limited information from Turkey presented in literature. In this study, we aimed to provide a data on the age structure of *B. verrucosissimus* species in Turkey. For this, a total of 15 male specimens collected from Borçka Karagöl Lake, Artvin during breeding season in 2019. We measured snout-urostyl length and clipped the longest toe of each specimen. Skeletochronology analysis was executed following standard age structure procedure. 18 µm thick of cross-sections obtained from the diaphyseal part of phalanx were exposed to Ehrlich's haematoxylin, then LAGs were counted. For statistical analyses, normality assumption of data was checked using Shapiro-Wilks Test ($P > 0.05$). Afterwards, we performed Pearson's correlation test and constructed a regression model to compare body measurements and age. Analyses were run in R programming language. As a result of this study, the average age was 5.13 ± 1.35 years. The specimens aged 2-7 years, with body size of 66.58 - 79.86 mm (mean: 74.17 ± 3.60). In total, 33 % of specimens is 6 years. According to the previous studies, the maximum age in males was reported 10 years whereas minimum maturation is 2 years, the mean age 4.4 years, and body size 77.56 ± 4.31 mm in Caucasia. Besides, a statistically significant correlation ($P < 0.05$) was found between body size and age. In general, age and body size are positively and significantly related in anuran species alike our findings. In conclusion, our study contributed to the life history traits of *B. verrucosissimus* from Turkey with prior knowledges.

Keywords: Skeletochronology, Caucasian toad, life history, body size.

Poster Presentation

Aflatoxin B_1 Degradation by Commercial Enzymes

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ABSTRACT

Food safety is one of the most important areas nowadays. Most of mycotoxins are produced by different molds. Aflatoxin B_1 is one of the most important food contaminants. The main problems it causes are various types of cancer and death. Commercial enzymes are used in many areas. They can be used for aflatoxin B_1 removal in the field of food safety with their degradation properties. In this study, it was aimed to perform aflatoxin B_1 degradation by utilizing the degrading properties of commercial enzymes to organic compounds. It was used four commercial enzymes (HRP- Horseradish peroxidase, pectinase, protease, and proteinase). Experiment mixture was incubated 1 hour, 28 ºC in darkness. After incubation aflatoxin B_1 remain was extracted with ethyl-acetate 3 times. Aflatoxin B_1 extract was measured by HPLC- High Performance Liquid Chromatography. Aflatoxin B_1 degradation rates of horseradish peroxidase, pectinase, protease and proteinase enzymes were respectively 15.16%, 39.82%, 11.76% and 4.07%. Proteinase is not successful about aflatoxin B_1 degradation, but other enzymes have ability of degradation. Most successful commercial enzyme is pectinase. As a future vision, we can develop this pectinase enzyme to use for food safety. This enzyme is obtained from different organisms such as *Aspergillus niger*. Nature has diversity of solution of problems.

Keywords: Commercial enzymes, Aflatoxin B_1, Degradation, Mycotoxin.

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