6th Symposium on the Lacertids of the Mediterranean Basin

23-27 June, 2008
Mythimna Lesvos, Greece

Editors

Pafilis P., Kotsakiozi P. and E.D. Valakos

Organized by:

Societas Hellenica Herpetologica
Prefecture Authority of Lesvos

Under the aegis of:

Department of Environment (University of Aegean)
Department of Biology (University of Athens)

Organizers
Stratis D. Valakos
Panayiotis Pafilis

Organizing Committee
Valentin Pérez-Mellado
Triantaphyllos Akriotis
Petros Lymberakis
Panayiota Maragou
Stratis N. Valakos
Panayiota Kotsakiozi

Scientific Committee
Nick Arnold
Wolgang Böhme
Massimo Capula
Miguel Carretero
Claudia Corti
Raoul Van Damme
James Harris
Panayiotis Pafilis
Valentin Pérez-Mellado
Vicente Roca
Stratis Valakos
Luis Vicente

Monday, June 23rd

08:00 – 18:30 Arrival and registration

18:30 – 18:45 Opening Ceremony

18:45 – 19:15 *T. Akriotis:* Biodiversity of Lesvos (p. 12)

19:30 Welcome Party

Tuesday, June 24th

10:00 – 11:00 Plenary Lecture, Q/A. *Erik Svensson*: Functional ecology and evolutionary consequences of colour patterns in lizards and other animals (p. 56)

11:00 – 11:20 Coffee Break

Functional Ecology of Lacertids, Chairman: V. Roca

11:20 – 11:40 *K. Huyghe, A. Herrel, J. F. Husak and R. Van Damme:*
Male colour morphs in a polymorphic lizard species (*Podarcis melisellensis*) differ in testosterone, performance, and mite parasitism (p. 29)

11:40 – 12:00 *B. Vanhooydonck, G. Meulepas, A. Herrel and P. Aerts:*
Functional analysis of parachuting in the lacertid lizard, *Holaspis guentheri*. (p. 62)

12:00 – 12:20 *V. Pérez-Mellado, Z. Ortega, T. Alonso, C. Guerra, A. Villa and M. Garrido:*
Behavioral thermoregulation of two populations of the Balearic lizard, *Podarcis lilfordi* (Günther, 1874) (p. 42)

12:20 – 12:40 *M. A. Carretero:*
How rigid are preferred temperatures in lacertids? An evolutionary survey in *Podarcis* (p. 25)

12:40 – 13:00 *E. Nikolouzou, P. Pafilis, J. Foufopoulos, R. Tsitsiloni E.D. Valakos*
The impact of island features on the resistance to infection in isolated populations of Aegean wall lizard (*Podarcis erhardii*) (p. 39)

13:00 – 17:00 Free Time

17:00 – 18:00 Poster Session 1

18:00 – 18:20 Coffee Break

18:20 – 20:00 Round Table: Conservation of endangered and isolated populations and species,
organised by Panayiota Maragou, WWF Greece.

21:00 Symposium Banquet

Wednesday, June 24th

Excursion to Fossil Forest of Sigri and the coastal city of Eressos, birthplace of the ancient poet Sappho

Thursday, June 26th

10:00 – 11:00, Plenary Lecture, Q/A. *Shai Meiri:* Global aspects of lizard body size (p. 38)

11:00 – 11:20 Coffee Break

Systematics and Phylogeography, Chairman: D.J. Harris

11:20 – 11:40 *D. J. Harris:*
Taxonomic inflation and red lists: how have Mediterranean reptile conservation issues been affected? (p. 28)

11:40 – 12:00 *M. A. Carretero, E. Ayllón, N. Sillero, R. Godinho, D.J. Harris and P. L. Hernández-Sastre:*
Combining methodologies in lacertid conservation. The case of *Lacerta schreiberi* in Montes de Toledo (Spain) (p. 26)

12:00 – 12:20 *A. Perera and D. J. Harris:*
Comparative phylogeographic patterns of Western Mediterranean lacertids (p. 42)

12:20 – 12:40 *A. Lima, S. Larbes, C. Pinho, M. A. Carretero, J. C. Brito and D. J. Harris:*
Podarcis in Algeria: new molecular insights (p. 34)

12:20 – 13:00 *N. Alpagut-Keskin and T. Cetin-Dogan:*
The Karyology of *Anatololacerta anatolica* (p. 13)

13:00 – 13:20 *P. Lymberakis and N. Poulakakis:*
Palaeogeography and the History of Lacertidae in Greece (p.37)

13:20 – 17:00 Free Time

17:00 – 20:00 Excursion to Natural History Collection of Vrissa

Friday, June 27th

10:00 – 11:15 Plenary Lecture, Q/A. *Jonathan Losos*: Lizards in an Evolutionary Tree: Ecology and Adaptive Radiation of Island Anoles (p. 36)

11:15 – 11:30 Coffee Break

11:30 – 12:10 *S. Sfenthourakis and K. Triantis:*
Biogeography of Greece (p. 52)

Ecology and Ecomorhology, Chairman: V. Pérez-Mellado

12:10 – 12:30 *A. Kaliontzopoulou, M. A. Carretero & G. A. Llorente:*
Sources of head shape variability in *Podarcis* wall lizards: A first snapshot into habitat use (p.31)

12:30 – 12:50 *P. Pafilis, V. Pérez-Mellado, J. Foufopoulos and E. D. Valakos:* Shedding the tail in islands: Adaptations to insularity (p. 40)

12:50 – 13:10 *A. Runemark & E. I. Svensson:*
Premating isolation and parallel island gigantism in Skyros wall lizard *Podarcis gaigeae* (p. 48)

13:10 – 17:00 Free Time

17:00 – 18:00 Poster Session 2

18:00 – 18:20 Coffee Break

18:20 – 20:00 Round Table: Inventory, Taxonomy and Conservation status of Mediterranean Lacertidae, organized by Petros Lymberakis, NHMC

20:00 Closing ceremony

FIRST POSTER SESSION

Tuesday, June 24th

17:00 – 18:00

1. F. Ahmadzadeh: A Contribution on *Lacerta media* Populations in Agricultural Environments in North West of Iran. (p. 11)

2. *M. Capula, R.M Cipolla, C. Corti and A. Nappi:* Allochromatic individuals of *Podarcis siculus* from southern Italy: evidence for high variability in coloration pattern in island and mainland populations from Campania. (p. 23)

3. *P. Kapli, P. Kyriazi, P. Lymberakis and N. Poulakakis*: Molecular systematics and herpetofauna conservation: examples of Lacertidae from the east Mediterannean region (p. 31)

4. *A. Lima, A. Kaliontzopoulou and M.A. Carretero:* Assessing asymmetry patterns in *Podarcis bocagei* and *P. carbonelli.* (p. 32)

5. *A. Lima, C. Pinho, M. A. Carretero and D.J. Harris:* Mitochondrial DNA variability within *Podarcis* morphotype 2: more cryptic variation? (p. 35)

6. *N. Rastegar-Pouyani and A. Khosravani:* Systematics and distribution of the Iranian Plateau species of *Mesalina* (Sauria: Lacertidae). (p. 44)

7. *D. Salvi, M. Capula, P. Bombi and M. Bologna:* How many archaeolacertas inhabit Corso-Sardinian Plate? Allozyme variation and differentiation in *Archaeolacerta bedriagae.* (p. 49)

8. *B. Terrasa, V. Rodriguez, R.P. Brown, V. Pérez-Mellado, A. Picornell, J.A Castro and M.M. Ramon.:* The genetic variability of *Podarcis pityusensis* vs. *Podarcis lilfordi.* (p. 57)

9. *B. Terrasa, V. Rodriguez, V. Pérez-Mellado, A. Picornell, R.P Brown, J.A Castro and M.M Ramon:* Phylogeographic structure of *Podarcis lilfordi* in the Balearic archipelago. (p. 59)

10. *A. Žagar, G. Planinc and M. Krofel:* New records of Horvath's Rock Lizard (*Iberolacerta horvathi*) from Slovenia.

(p. 63)

11. *M. Arakelyan and I. Stepanyan:* The size of red cells of hybrids and parental species of lizards of genus *Darevskia* (p. 15)

12. *V. Roca V. and M.A. Galdón*: Evidences of *Hepatozoon* (Coccidiomorphida: Hepatozooidae) as blood parasite of Iberian lizards. (p. 50)

SECOND POSTER SESSION
Friday, June 27th
17:00 – 18:00

1. *M.J Amaral, M.A Carretero, A.R Agra, A.M.V.M Soares and R.M Mann:* A tiered approach to reptile ecotoxicology in Europe using lacertids as sentinel organisms. (p. 14)

2. *D. Barbosa, E. Font, E. Desfilis, R. Ribeiro and M. A. Carretero:*Reproductive isolation in Iberian *Podarcis*: What do field and lab studies tell us? (p. 16)

3. *M. Biaggini, R. Berti and C. Corti:* Numerous and big eggs ... an awarding mechanism for a successful colonizer? Preliminary data on female reproductive success of *Podarcis siculus campestris.* (p. 18)

4. *M. Biaggini, R. Berti and C. Corti:* Different habitats, different pressures? Preliminary data on *Podarcis siculus campestris* external parasite rate and predation pressure in different agricultural habitats**.** (p. 20)

5. *V. Cafuta, T. Trilar:* Infestation of lizards (Lacertidae) by ectoparasites in central and southwestern Slovenia. (p. 22)

6. *I. Grbac, I. Mihoci, K. Hellemans and R. Van Damme:* Thermoregulation in syntopy; fine – scale differences in island Podarcis populations. (p. 27)

7. *P. Pafilis, K. Sagonas, A. Runemark, E. Svensson, E.D. Valakos*: Reproductive advantages of gigantism and how intraspecific competition could be involved.

8. *V. Pérez-Mellado, A. Domínguez-Azabal, J. Lluch, P. Navarro, J.Á. Hernández-Estévez, T. García-Díez and M. Garrido*: Factors affecting prevalence and intensity of blood parasites on an insular lizard, *Podarcis lilfordi* (Squamata, Lacertidae). (p. 43)

9. *V. Roca, J. Foufopoulos, E.D. Valakos and P. Pafilis:* Gastrointestinal helminth communities of the Aegean Wall lizard

Abstracts

A Contribution on *Lacerta media* Populations in Agricultural Environments in North West of Iran

F. Ahmadzadeh

Department of Biodiversity and Ecosystem Management, Environmental Sciences Research Institute, Shahid Beheshti University, Evin, Tehran, Iran

Two species of *Lacerta* genus are found in Northwest of Iran: *Lacerta media* and *Lacerta strigata*. *Lacerta media* has wide distribution range and is an important lizard fauna element in agro-ecosystems and river closed humid areas. The aim of this study was to provide reasons for high population size of this species in agro ecosystems. So, this study was performed in the farming areas in Meshkinshar, Ardabil province of Iran from 2003 to 2006. Based on extensive field research, it has been mainly found that *Lacerta media* is the most abundant reptile species in mentioned habitats and it just inhabits areas that are much closed to water. Our results also showed, animal is hidden by dense grass vegetation cover especially male that has green color. They use old hallows of mice and other small vertebrates for hiding and egg lying. In spring they are seen on cultivated filed boundaries on stones on sunny days. As specific result, they are found in apple orchards more abundant than other cultivated fields. It seems that permanent food accessibility (insects) and fewer predators are most reasons. Finally, *Lacerta* media is interesting species to study from a conservational point of view because of its unusual frequency of occurrence as parallel with human activities.

Lesvos Biodiversity

T. Akriotis

Biodiversity Conservation Laboratory, Department of Environmental Science, University of the Aegean

The island of Lesvos is noted for its rich biodiversity, evident in its diverse fauna, flora, habitats and landscapes. Biodiversity richness is high compared to other islands in the Aegean Sea and various geographical, historical and geological factors can be invoked to partly account for this. However, various peculiarities of the island's biodiversity are hard to explain by traditional approaches. Much of the interest of Lesvos's biodiversity is closely connected with a long history of human activities on the island which shaped its present form. Due to their high conservation interest, several parts of the island have been proposed as part of the Natura 2000 network. Current human activities are changing the long-standing relationship of the local human population with their environment and the challenge for the future is to devise ways to maintain the dynamic equilibrium that prevailed up until now.

The Karyology of *Anatololacerta anatolica*

N. Alpagut-Keskin and T. Çetin-Doğan

Ege University, Faculty of Science, Department of Biology, Zoology Section, 35100 Bornova /Izmir, Turkey

Anatolacerta has included 3 species and one of them is *Anatololacerta anatolica* (Werner 1900). This species has two distinct subspecies respectively; *Anatololacerta anatolica anatolica* and *Anatololacerta anatolica aegaea* (Eiselt and Schmidtler 1987). The systematic of *Anatololacerta* based on morphology and which is included species has not been studied karyotypically. Therefore we aimed to report the karyotype of specimens and obtained differences from 4 different populations of *Anatololacerta anatolica* subspecies which is distributed in Western Anatolia. The result showed that two subspecies possess 2N = 38 uniarmed (subtelocentric) chromosomes that is 36 macrochromosomes and 2 microchromosomes.Also meiotic plates showed that 19 bilavents.

A tiered approach to reptile ecotoxicology in Europe using lacertids as sentinel organisms

M.J Amaral[1, 2], M.A Carretero[2], A.R Agra[1], A.M.V.M Soares[1] and R.M Mann[1]

[1] *Cesam & Department of Biology, University of Aveiro, 3810-193 Aveiro, Portugal*
[2] *CIBIO Centro de Investigação em Biodiversidade e Recursos Genéticos, Campus Agrário de Vairão, 4485-661 Vairão, Portugal*

Lizards are one of the least studied groups in ecotoxicology and despite a recent increase in number of studies, there is still a lack of knowledge regarding their response to environmental contamination. Lacertid lizards have been identified as potential model species for reptile ecotoxicology in Europe. They offer several advantages over other groups as they are usually highly abundant; have strong site fidelity; are easy to capture, mark and recapture in the field; and are easy to maintain in captivity. The main goal of our project is to assess if highly abundant lacertid lizards belonging to the genus *Podarcis* in Southern Europe, can be used as bioindicators of pesticide exposure and toxicity in areas of intensive agriculture. We have chosen *Podarcis bocagei* because is a widely abundant species and the only lacertid present on high pesticide usage corn fields dominating the landscape of north-western Portugal. As a first approach, we will document the abundance, demography and biological fitness of the species occurring in areas of either intensive or negligible pesticide usage. A second approach aims to study naïve lizards in more controlled experiments, both in mesocosm and laboratory experiments to validate field observations. We intend to employ a variety of techniques to assess pesticide exposure and toxicity including biochemical, behavioural, morphological and molecular biomarkers. On a larger scale we hope to study bioaccumulation processes in lizards, reflect on the biological significance of the reported tissue concentrations and develop criteria to predict risk to lizard populations. In the future, similar projects using lacertids as bioindicators could be developed in other parts of the Mediterranean Basin.

The size of red cells of hybrids and parental species of lizards of genus *Darevskia*

Arakelyan M.[1] and I. Stepanyan[2]

[1] *Yerevan State University, Alek Manukyan 1, Yerevan 0025, Armenia*
[2] *Institute of Zoology of National Academy of Science of Armenia, P. Sevak 7, Yerevan 0014, Armenia*

The cytometrical analyses of diploid bisexual species *Darevskia valentini*, and closely relative parthenogenetic species *D. unisexualis* and *D. armeniaca*, as well as their triploid hybrids (*D. valentini* × *D. unisexualis* and *D. valentini* × *D. armeniaca*) and tetraploid hybrid *D.valentini* × *D. unisexualis* arising from hybridization in mixed population in vicinity of Kuchak village (Aragatsotn region, Armenia) has shown significant differences ($P<0.001$) in surface and perimeter of erythrocytes between all of them according to ANOVAs post-hoc test. The size of red blood cells of triploid hybrids exceeds that of diploids by 25-30%, but tetraploid male exceeds diploid males by 22% and by 10 % smaller than those of triploid male hybrids. Among parental species the smallest parameters of erythrocytes have *D. valentini,* when *D. unisexualis* have the largest red blood cells. Accordingly, the erythrocytes of hybrids of *D.valentini* × *D. unisexualis* were larger than *D. valentini* × *D. armeniaca.*

Reproductive isolation in Iberian *Podarcis*: What do field and lab studies tell us?

D. Barbosa[1,2], E. Font[1], E. Desfilis[3], R. Ribeiro[2,4] and M. A. Carretero[2]

[1] *Unidad de Etología, Instituto Cavanilles de Biodiversidad y Biología Evolutiva, Universidad de Valencia, Spain*
[2] *CIBIO, Centro de Investigação em Biodiversidade e Recursos Genéticos, Portugal*
[3] *Departamento de Psicobiología, Facultad de Psicología, Universidad Complutense de Madrid, Spain*
[4] *Departament de Biologia Animal (Vertebrats), Facultat de Biologia, Universitat de Barcelona, Spain*

To gain insight into the role of behaviour in promoting reproductive isolation between *Podarcis bocagei* and *Podarcis* morphotype 1, sister species belonging to the *P. hispanica* species complex, we conducted field and laboratory observations. We studied lizards in rocky outcrops and man-made stone walls in Moledo do Minho (NW Portugal), where these two species occur in syntopy. During the reproductive season of 2006 we video-recorded interactions between free-ranging individuals in a stone wall ca 50 m long. These observations allowed us to document and describe, in natural conditions, the behaviours exhibited during male-female interactions. Interactions were assigned one of the following scores, reflecting increasing levels of courtship behaviour:

(1) No response: either lizards remain close or one of them moved away;

(2) Displays: one of the lizards exhibited visual displays (e.g. foot-shakes strut) or the male followed the female;

(3) The male bites the female tail;

(4) The male attempts (abdominal bite) or copulates with female.

A comparison of intra- and interspecific interactions revealed that the former received significantly higher scores, indicating that lizards exhibited more courtship towards conspecifics. During the spring of 2008 we used an experimental approach to assess, now under controlled laboratory conditions, whether intraspecific encounters would result in more courtship (i.e. higher courtship scores) than interspecific encounters. Briefly, we staged male-female encounters in glass terraria and video-recorded ensuing interactions for 30 min. Analyses revealed that interaction scores

were again significantly higher in intraspecific encounters, and also that males displayed significantly more in the presence of conspecific females. These results suggest that males are able to discriminate conspecific from heterospecific females and stress the importance of behavioural mechanisms in maintaining reproductive isolation in this complex group of lacertids. The study of reproductive interactions within this group adds an important new dimension to ongoing research about their phylogeography.

Numerous and big eggs ... an awarding mechanism for a successful colonizer?

M. Biaggini[1], R. Berti[1] and C. Corti[2]

[1] Dipartimento di Biologia Evoluzionistica "Leo Pardi", Via Romana 17, 50125 Florence, Italy
[2] Museo di Storia Naturale - Sezione di Zoologia "La Specola", Via Romana, 17 - 50125 Florence, Italy

A certain habitat may be favourable for a species if inside it suitable conditions for growth, reproduction and survival of that species persist. For oviparous reptiles in particular, the egg-stage can play an important role in determining distribution patterns; however its influence, above all in human altered landscape is scarcely explored.
This study, performed in Tuscany, central Italy, investigated the female reproductive success of the lacertid lizard *Podarcis siculus campestris* inside agricultural habitats. We surveyed vineyards and olive tree plantations showing different agricultural managements: intensive (use of chemicals and machineries) and traditional (no/little amounts of chemical compounds, maintenance of grass soil cover). In six sampling sites we collected a total of 50 females (a minimum of 7 individuals per site) from April to late July 2007, covering the whole annual reproductive period. Females were singly housed in terraria exposed to natural condition of light-dark, ventilation and air temperatures; individuals were daily weighted and terraria were checked at least twice a day for eggs. Soon after deposition eggs were measured and singly weighted on a digital balance to the nearest 0.001g; females were also weighted after oviposition and then released to the site of capture. Our first aim was to examine the mechanism of *P. siculus campestris* female reproductive investment in the surveyed populations; in a second step, we wanted to verify if such investment was influenced by factors such as land use, agricultural management, external parasite rate and predation pressure (as indicated by the occurrence of regenerated tails). We considered three main variables in the analyses: clutch size, clutch mass and average egg weight (all of them were adjusted for log-maternal SVL and the effects of oviposition period and of the time elapsed between capture and egg laying were controlled).

We found that relative fertility (residuals of the regression between clutch size and maternal SVL) was correlated with average egg weight, thus revealing the presence of no trade off between clutch size and average egg weight. Moreover, relative reproductive investment (residuals of the regression between clutch mass and SVL) was positively correlated with both relative fertility and average egg weight. This result "suggests" that females that invest more do it laying both more and heavier eggs. ANCOVA analyses revealed that clutch size and clutch mass were not influenced by land use, land management, deposition period, external parasite rate and regenerated tail occurrence. On the contrary, average egg weight was correlated to the external parasite rate.

The obtained results are in agreement with the well known adaptability of *P. siculus*. In the populations we surveyed the reproductive output was not influenced by very different habitats and levels of anthropic disturbance. Nor this lizard showed a trade-off between clutch size and egg weight, typical in the presence of food availability and habitat constraints.

Different habitats, different pressures?
Preliminary data on *Podarcis siculus campestris* external parasite rate and predation pressure in different agricultural habitats.

M. Biaggini[1], R. Berti[1] and C. Corti[2]

[1] Dipartimento di Biologia Evoluzionistica "Leo Pardi", Via Romana 17, 50125 Florence, Italy
[2] Museo di Storia Naturale - Sezione di Zoologia "La Specola", Via Romana, 17 - 50125 Florence, Italy

Cultivated areas in central Italy are very common habitats for the lacertid lizard *Podarcis siculus campestris*. Land uses, however, can show deeply different characteristics in their structure thus probably bringing important consequences for their inhabitants. In this study we analysed the rate of external parasites (ticks) and the occurrence of regenerated tail (as indicator of predation pressure) in populations of *Podarcis siculus campestris* living in two different land uses, highly characterizing the Tuscan agricultural landscape (central Italy): vineyards and olive tree plantations. For each land use, in particular, we surveyed two intensively cultivated areas (use of chemicals and machineries) and one "traditionally" managed area (no/little amounts of chemical compounds, maintenance of grass soil cover). A total of 120 lizards were collected from early Spring to Summer. All lizards were measured (SVL and head measures), the amount of ticks was counted and the presence of broken/regenerated or entire tail was recorded; individuals were then released in the same place of their capture.
The comparison of SVL among different habitat categories (distinguishing land uses and different managements) did not revealed striking differences: however, both males and females living in the traditionally managed olive tree plantation resulted to be smaller (even if significant differences were found only in some comparisons). As for external parasite rate we found very clear results both in relation to the land use and to the sex of individuals. Lizards with the highest number of ticks were found in the olive tree plantations (both intensively and traditionally managed) while the individuals from vineyards were almost not parasitized by ticks. Males in particular seemed to suffer a higher external parasite pressure. These results seem to agree with other studies in which a

preference of ticks for olive trees was highlighted and put in relation with both physical characteristics of the trees (e.g. crumbled bark) and their being visited by hosts (lizards). Regarding the sex ratio of parasitized individuals, other studies demonstrated that male lizards, are more exposed to parasites due to their higher activity rate. The regenerated tail occurrence pattern was much more homogeneous: a very weak difference was found just between sexes (more males than females showed broken/regenerated tail) while land use and management did not seem to influence the predation pressure, at least as revealed by the considered indicator.

Infestation of lizards (Lacertidae) by ectoparasites in central and southwestern Slovenia

V. Cafuta[1, 2] and T. Trilar[3]

[1] Mala vas 25, SI-1000 Ljubljana, Slovenia.
[2] Societas herpetologica slovenica – društvo za preučevanje dvoživk in plazilcev, Večna pot 111, SI–1000 Ljubljana, Slovenia.
[3] Pridoslovni muzej Slovenije, Prešernova 20, SI-1000 Ljubljana, Slovenia.

In seasons 2003 and 2004 we examined 312 individuals of lacertid lizards for ectoparasites in central and southwestern Slovenia.

Collected were 538 Ixodes *ricinus* ticks (Acarina, Ixodidae) (71.7% larvae and 28.3% nimfae) on 103 lizards (33.0%). The region of forelimbs (armpit) was the most preferred attachment site of ticks. Most infested were lizards living near woods, least infested those living in areas with no vegetation coverage. Males were more infested than females, but only in the spring time. Lizards living in the submediterranean area were significantly less infested than lizards in areas with continental climate. We noticed a certain dynamics in the number of larval and nymphal stages throughout the season. The Green Lizard (*Lacerta viridis* complex) was the most infested lizard species (77.4% infestation), and the Italian Wall Lizard (*Podarcis sicula*) was the least infested (11.1% infestation). There was only a weak correlation between lizard size and tick number.

We also noticed 1101 parasitic mites (subclass Acarina, excluding Ixodida) infesting 25.9% of lizards. Some mites were collected and later identified as *Ophionyssus lacertinus* and *Ericotrombidium* sp. (Trombiculidae). The Italian Wall Lizard (*Podarcis sicula*) was most infested lizard species with parasitic mites (76.7% infestation). The majority of parasitic mites was concentrated in the region of hind legs, under belly scales and on the tail. There was no statistically significant difference in infestation in various habitats or between males and females. Lizards living in the submediterranean area were significantly more infested than lizards in areas with continental climate (exactly the opposite as infestation with ticks). These are the first data on parasitic mites on lacertid lizards in Slovenia.

Allochromatic individuals of *Podarcis siculus* from southern Italy: evidence for high variability in coloration pattern in island and mainland populations from Campania

M. Capula[1], R. M. Cipolla[2], C. Corti[3] and A. Nappi[2]

[1]Museo Civico di Zoologia, Via Ulisse Aldrovandi 18, I-00197 Roma, Italy.
[2]Associazione Vivara Amici delle Piccole Isole, Piazza Riario Sforza 159, I-80139 Napoli, Italy
[3]Museo di Storia Naturale dell'Università di Firenze, Sezione di Zoologia "La Specola", Via Romana 17, I-50125 Firenze, Italia.

Podarcis siculus is a lacertid lizard characterised by considerable variability in coloration pattern. In this species underside is usually whitish or greyish, always without dark spots. However, in some small island populations from Italy individuals can be allochromatic, *i.e.* completely black (melanic), bluish, or with a blue belly (*e.g.* the famous "blue lizard" – *P. siculus coerulea* - from Faraglione di Fuori and Faraglione di Mezzo islets, near Capri Island, Campania, southern Italy). It must be noted that, in some cases at least, melanic individuals can be observed also in continental areas (*e.g.* Roscigno, Campania, southern Italy).

The evolutionary significance of the allochromatic patterns is still unclear, and some hypotheses were done to explain their origin.

In this study several small island populations of *P. siculus* from Campania (southern Italy) were surveyed to point out the occurrence of allochromatic individuals. The islands and islets on which the investigations were carried out are the following: Camerota, Capri, Castello Aragonese, Castelluccia, Faraglione di Fuori, Faraglione di Mezzo, Gallo Lungo, Ischia, Licosa, Monacone, Nisida, Procida, Punta Pennata, Rovigliano, Scoglio di S. Anna, Vetara, Vivara. In addition, several continental areas were also surveyed in order to find out allochromatic individuals.

We were able to find individuals with bluish underside on the following islands: Castelluccia, Camerota, Faraglione di Mezzo, Faraglione di Fuori, Licosa, and Monacone Vetara. On the Castello Aragonese Islet no allochromatic individual was found but one with a dark-grey underside. Individuals with bluish underside were also observed in some continental localities of the Salerno province (Capaccio, Marina di Camerota, Paestum, Palinuro, Punta Licosa,

Sapri). The allochromatic individuals were often found together with individuals characterized by whitish underside.

Based on present data and literature on *P. siculus*, allochromatic patterns seem to be relatively widespread in Campania, while are not known at all in populations from central and northern Italy. In Campania individuals with bluish or dark underside were observed both on small islands and on some continental areas. However, in continental areas the frequency of allochromatic individuals seems to be lower than on islands. It is noteworthy that the *P. siculus* populations from Campania, which are characterized by a high degree of phenotypic plasticity also in the pattern of the upper parts, have levels of genetic variability higher than those found in the morphologically low variable populations from central and northern Italy.

How rigid are preferred temperatures in lacertids? An evolutionary survey in *Podarcis*.

M. A. Carretero

CIBIO, Centro de Investigação em Biodiversidade e Recursos Genéticos, Campus Agrário de Vairão, 4485-661 Vairão, Portugal

Lacertids are considered conservative in terms of their thermal physiology. Namely, whereas their temperatures in the field vary according to the environment, their preferred body temperatures (Tp) when free of thermal constraints remain similar within species even if under different climate regimes. In contrast, phylogenetically distant lacertid lineages sharing the same habitats may display distinct Tps more related with their biogeographic origins. The evolutionary limits of this so-called thermal rigidity remain, nevertheless, undefined. Here, the variation of Tp is analysed across the Iberomaghrebian *Podarcis* clade (*P. bocagei*, *P. carbonelli*, *P. vaucheri* and *P. hispanica* sensu lato). For this monophyletic group of closely related forms, some still not formally described, the knowledge of their phylogenetic relationships, divergence times and palaeoecological scenarios is now considerably robust. A total of 229 adult lizards belonging to 11 lineages were exposed to a thermal gradient and temperatures were recorded at 9 time intervals within the period of activity. Once the effects of diel rhythms, size and pregnancy were excluded, variation in Tp was recorded between some of the forms. Lineages diverging during the Pleistocene displayed similar Tps whereas sister taxa separated since the Pliocene show significant differences even if current ranges overlap. The most basal lineages in the phylogeny selected for different temperatures even if sister taxa but approached others not directly related to them. Apparently, divergence times higher than 3 mya are able to promote Tp shifts in this species complex. Such results are discussed in relation with the evolutionary history of this group.

Combining methodologies in lacertid conservation. The case of Lacerta schreiberi in Montes de Toledo (Spain)

M. A. Carretero[1], E. Ayllón[3], N. Sillero[2], R. Godinho[1], D.J. Harris[1] and P. L. Hernández-Sastre[3]

[1]CIBIO, Centro de Investigação em Biodiversidade e Recursos Genéticos, Campus Agrário de Vairão, 4485-661 Vairão, Portugal
[2]CICGE, Centro de Investigação em Ciências Geo-Espaciais; Universidade do Porto, Departamento de Matemática Aplicada, Rua do Campo Alegre, 687, 4169-007 Porto, Portugal
[3]AHE, Apartado de Correos 191, 28910 Leganés, Spain

The Schreiber's Lizard, *Lacerta schreiberi*, is a large lacertid with Atlantic affinities endemic to Western Iberia. Whereas in the Northwest the area of occupation is continuous and populations are abundant, the Southern populations become rare and isolated, restricted to some Atlantic spots surrounded by Mediterranean, unsuitable environments. Because these Southern isolates harbour a considerable part of the genetic diversity of the species and are extremely vulnerable at mid-term, determining their conservation status is prioritary. Here, a multidisciplinary approach based on field censuses, GIS modelling and population genetics was used to asses the conservation status of the populations from Montes de Toledo (South-Central Spain). Local populations were censused by transect methods, tissue sampling of selected individuals were taken and locations were recorded with a GPS. In the lab, samples were genetically characterised using a battery of seven autosomal microsatellites and two SNPs in nuclear loci. Results indicated that in this region the species range is fragmented in subisolates strictly associated to mountain streams surrounded by well conserved riverine vegetation. The potential distribution model calculated by MAXENT indicates areas with high precipitation, low temperature and deciduous forests. The species presence was not recorded or not recently replicated in some of those areas. Population sizes are small (5.23 indiv./hour/observer). The three isolated demographic nuclei were genetically differentiated (with private alleles) but kept high genetic diversity suggesting that isolation is not contemporary but postglacial, old enough to have produced genetic drift. The category Endangened (EN) (A 2bc B 1, 2cde) for these populations is recommended. Subsequent guidelines for conservation management are provided.

The study is being carried out by the AHE (Spanish Herpetological Association) with funds provided by Junta de Castilla-La Mancha.

Thermoregulation in syntopy; fine – scale differences in island Podarcis populations

I. Grbac[1], I. Mihoci[1], K. Hellemans[2] and R. Van Damme[2]

[1]Croatian Natural History Museum, Demetrova 1, HR-10000 Zagreb, Croatia
[2] Department of Biology, University of Antwerp, Universiteitsplein 1, B-2610 Antwerpen, Belgium

We studied the thermoregulatory behaviour and microhabitat use of the lacertid lizards *Podarcis sicula* and *Podarcis melisellensis* on the island Vrgada (East Adriatic, Croatia) during early spring. The sympatry of the two *Podarcis* species on Vrgada is exceptional in that most other small islands in the Adriatic harbour only one of the two species, likely as the result of competitive exclusion. It is thought that the dominant robust colonizing *P. sicula* replaces the more slender native *P. melisellensis* on those islands were it gets a foothold.

We here test the hypothesis that on Vrgada, despite apparent syntopy on a macrohabitat scale, *P. sicula* occupies the better microhabitats and forces *P. melisellensis* into (thermally) less favourable ones. We measured field body temperatures of active lizards of both species, and compared them to operative temperatures and temperatures selected in laboratory conditions, to compare the accuracy and effectiveness of thermoregulation between the two species. We also estimated the thermal quality of the microhabitats occupied by the two species. In addition, we checked for possible differences in activity cycles and (thermoregulatory) behaviour.

Taxonomic inflation and red lists: how have Mediterranean reptile conservation issues been affected?

D. J. Harris

CIBIO, Centro de Investigação em Biodiversidade e Recursos Genéticos, Campus Agrário de Vairão, 4485-661 Vairão, Portugal, and Departamento de Zoologia e Antropologia, Faculdade de Ciências da Universidade do Porto, 4099-002 Porto, Portugal.

The IUCN red list of threatened species is the most complete resource defining the global status of plants and animals. Red list indices tend to show threat-status deterioration over time in fully assessed taxonomic groups, such as birds. However, the effect of taxonomic inflation, and especially biases towards the naming of taxa that would qualify as threatened in red lists, remains relatively unexamined. Here I assess the effect of taxonomic inflation and various species concepts on reptiles from the Mediterranean Basin. A proportionally high percentage of reptiles listed from this region in the higher threat categories are not good species under most definitions, and thus taxonomic inflation may also be inflating extinction risk trends.

Male colour morphs in a polymorphic lizard species (*Podarcis melisellensis*) differ in testosterone, performance, and mite parasitism

K. Huyghe[1], A.Herrel[2], J.F. Husak[3] and R.Van Damme[1]

[1]Laboratory for Functional Morphology, Department of Biology, University of Antwerp, Universiteitsplein 1, B-2610 Wilrijk, Belgium
[2]Department of Organismic and Evolutionary Biology, Harvard University, 26 Oxford Street, Cambridge, MA 02138, USA
[3]Department of Biological Sciences, Virginia Tech, Blacksburg, VA 24061, USA

Through their direct action on behaviour or through their influence on morphology and performance, circulating testosterone (T) levels are mediators of aggressive displays and interactions. T levels also affect the degree of parasite infection, through their effects on immunocompetence. We tested these ideas on a population of lizards, which exhibits a colour polymorphism. Males occur in 3 different colours (white, yellow, orange), providing an opportunity to test the idea of morphs being alternative solutions to the evolutionary challenges posed on the link between hormones, morphology, performance, and parasite load. Morphs differ in size, and bite force capacity, but they don't differ in locomotion performance or activity pattern. Here, we test the hypothesis that these differences are related to differences in testosterone levels and parasite loads between morphs, suggesting a balance between different fitness effects. Secondly we test the existence of a correlation between T and different performance variables. We found that higher T levels increase bite force capacity and that the orange morph indeed has a higher blood plasma T level than the yellow morph, and that it suffers more from parasite (mite) infection. It seems that selection pressures have indeed induced alternative solutions in this species, reflected in different morphs.

Sources of head shape variability in Podarcis wall lizards: A first snapshot into habitat use

A. Kaliontzopoulou[1, 2], M. A. Carretero[1]and G.A. Llorente[2]

[1] CIBIO/UP, Centro de Investigação em Biodiversidade e Recursos Genéticos, Campus Agrário de Vairão, 4485-661, Vairão, PORTUGAL.
[2] Herpetología, Dep. Biología Animal, Fac. Biología, Univ. de Barcelona, Av. Diagonal 645, 08015, Barcelona, Spain

The head of lacertid lizards is an extremely interesting structure, serving as a model for studying mosaic evolution. It serves various functions, all crucial for the lizards' survival and reproductive success, including habitat and refuge use, feeding, male antagonistic behaviour and mating. Among these factors, habitat and refuge use has been proposed as the main factor driving head shape evolution. *Podarcis* wall lizards provide an appealing model system because they occupy a wide variety of different habitats. Here we explore head shape variability in relation to habitat use, using data on all the presently recognised species of this genus. We assigned species to four categories based on their general habitat preferences according to the literature and expert knowledge. We used both linear biometry and geometric morphometrics in order to study the particular modifications related to habitat use in this genus. Head dimensions gave a general idea of such modifications. As expected, saxicolous species had flatter and wider heads, while ground-dwelling ones were higher and narrower. The use of geometric morphometrics permitted us the visualisation of specific head shape modifications: in comparison with saxicolous species, ground-dwellers have shorter snouts and a less developed parietal region. Laterally, their heads are also more compact, presenting an enlargement of the entire head posterior to the eye. Nevertheless, insular species were visibly distinct, revealing the existence of selective pressures other than habitat influencing head shape. The degree of sexual dimorphism also varied between habitat types. The preliminary results available give us a much more detailed image of the adaptive modifications of head shape in relation to habitat use and allow us to explore the mechanical restrictions imposed and formulate further hypotheses to be tested.

Molecular systematics and herpetofauna conservation: examples of Lacertidae from the east Mediterannean region

Kapli P. [1,2], Kyriazi P. [1,2], Lymberakis P. [1] and N. Poulakakis [1,2]

[1] Natural History Museum of Crete, University of Crete, Knosos Ave, P.O.Box 2208, 71409 Irakleio, Crete, Greece
[2] Departments of Biology, University of Crete, Vassilika Vouton, P.O.Box 2208, 71409 Irakleio, Crete, Greece

The assessment of biodiversity by means that ignore the evolutionary relationships of the living forms can be quite misleading, resulting in the over-evaluation of some morphs and the ignorance of other evolutionary significant units. Molecular phylogeny, which is a potentially powerful tool for the conservation of biodiversity, provides essential evidence for setting conservation priorities on several taxa. Phylogenetic analyses can identify cryptic, genetically distinct lineages as well as non-distinctive lineages earlier perceived as separate taxa. The herpetofauna of the east Mediterranean region, which could be considered as one of nature's most intensively active evolutionary laboratories, serves as an excellent example. Phylogenetic analyses on several lacertid taxa of this area have revealed cases of hidden diversity, paraphyly, new species and new endemics. In several cases the presence of cryptic species (*Podarcis levendis, P. cretensis*), species with very restricted distributions (*P. gaigeae*, *P. milensis*), paraphyletic (*M. guttulta*) or even polyphyletic species (*O. elegans*) were revealed. Such cases impose a considerable revision of the taxonomic views and conservation priorities. Based on these findings, many questions have been answered and certainly new ones have emerged, contributing not only to our knowledge on the east Mediterranean herpetofauna, but to broader issues of conservation biology, prioritizing conservation efforts and enhancing the need for a new multidisciplinary and innovative tool for screening and re-evaluating biodiversity.

Assessing asymmetry patterns in *Podarcis bocagei* and *P. carbonelli*

A. Lima[1,2], A. Kaliontzopoulou[1,3] and M.A. Carretero[1]

[1] CIBIO, Centro de Investigação em Biodiversidade e Recursos Genéticos, Campus Agrário de Vairão, 4485-661, Vairão, Portugal.
[2] Departamento de Zoologia-Antropologia, Faculdade de Ciências da Universidade do Porto, 4099-002 Porto, Portugal.
[3] Herpetología, Dep. Biología Animal, Fac. Biología, Univ. de Barcelona, Av. Diagonal 645, 08028, Barcelona, Spain.

Among the Iberian members of the genus *Podarcis*, two species are present in the North-Western region: *P. bocagei* and *P. carbonelli*. The high morphological and ecological similarity between them as well as their well-known distribution ranges, provides a special opportunity to evaluate asymmetry patterns typically displayed by wall-lizards.

Levels of asymmetry expression have been correlated with several kinds of abiotic, biotic and genetic stresses. The few asymmetry studies focusing on reptiles have found that even minor morphological asymmetries could have an impact on individuals' survival, altering their fitness for example through reduced escaping performance. Others found that asymmetry varied across the species distribution range, increasing in the peripheral populations, while others evaluated isolation effects between insular and continental populations through fluctuating asymmetry. Therefore, asymmetry may be a useful fitness index but in order to be valuable in comparative studies, the levels of variation usually displayed by natural populations must be determined first.

In our study we aim to define the asymmetry patterns present in these species through the analysis of meristic and linear biometric bilateral traits. We include characters from different structures, like the head and the limbs, to capture individual asymmetric variation. Measurement error was assessed in order to quantify the between sides variation truly due to asymmetry. After this initial stage, those traits that showed fluctuating asymmetry were analyzed separately because these can be used to evaluate the levels of developmental instability displayed by different populations. The occurrence of other types of asymmetry, particularly directional asymmetry, were also detected and

evaluated. The similarity between asymmetry patterns of both species was tested as well as the occurrence of sexual dimorphism in asymmetry variation. We exemplify the application of asymmetry indices to a specific situation of sympatry, as it may pose stressful conditions to populations occupying similar habitats. The results will be presented in the ecological and evolutionary framework of these species.

Podarcis in Algeria: new molecular insights

A. Lima[1,2], S. Larbes[1,3], C. Pinho[1], M.A. Carretero[1], J.C. Brito[1] and D.J. Harris[1,2]

[1] CIBIO, Centro de Investigação em Biodiversidade e Recursos Genéticos, Campus Agrário de Vairão, 4485-661, Vairão, Portugal.
[2] Departamento de Zoologia-Antropologia, Faculdade de Ciências da Universidade do Porto, 4099-002 Porto, Portugal.
[3] Département de Biologie, Faculté des Sciences Biologiques et Agronomiques, Université M. Mammeri. Tizi-Ouzou, Algérie.

Recent molecular studies indicate that *Podarcis* occurring in the extreme South of the Iberian Peninsula and North Africa from Morocco to Algeria and Tunisia constitute a monophyletic clade composed of several forms with unsolved status. In such studies mtDNA markers revealed high levels of differentiation between the forms ranging from the Moroccan Atlas and Rif and those found in Tunisia and Jebel Sirwah (South Morocco). However, the Algerian forms, which are geographically intermediate, have not been investigated so far.

Without a systematic sampling, assessing the structure and partition of the genetic variability of African *Podarcis* is not possible. Recent application of Geographic Information Systems (GIS) has provided models with a high degree of resolution for the entire North African region. These models have enabled the prediction of probable new locations of occurrence in unsampled regions, namely in Algeria. In fact, field work addressed to these places confirmed the previously unsuspected presence of these lizards and allowed the collection of samples.

In this study we determine the levels of genetic variability between Algerian populations placing them within the framework of *Podarcis* phylogeny. A more extensive sampling scheme was used that includes samples collected from the new localities identified by GIS models, in a total of 13 localities from Algeria. To accomplish our objective we used mtDNA molecular markers, namely partial 12S rRNA and NADH dehydrogenase subunit 4 gene sequences, combining published and new data. With this approach a better resolved phylogeny for *Podarcis* in North Africa is established.

Mitochondrial DNA variability within *Podarcis* morphotype 2: more cryptic variation?

A. Lima[1,2], C. Pinho[1], M.A. Carretero[1] and D. J. Harris[1,2]

[1] CIBIO, Centro de Investigação em Biodiversidade e Recursos Genéticos, Campus Agrário de Vairão, 4485-661, Vairão, Portugal.
[2] Departamento de Zoologia-Antropologia, Faculdade de Ciências da Universidade do Porto, 4099-002 Porto, Portugal.

Iberian *Podarcis* have been the target of intensive phylogenetic research during recent years because of the previously unexpected diversity found within. At present, the former *Podarcis hispanica* is recognized as a species complex parafiletic to *P. bocagei*, *P. carbonelli* and *P. vaucheri* with the majority of lineages being strongly supported by evidence coming from mtDNA, nuclear DNA and protein electrophoretic data. In some cases, morphological studies focusing on specific lineages have also agreed with their phenotypic distinctiveness which consequently conducted to their raise to the specific rank, such as *P. carbonelli* and *P. vaucheri*. However, some of the recent identified forms (i.e. "morphotype 1") still contain considerable genetic diversity, while the apparent relationships of other monophyletic groups change according to the kind of data analyzed.

From the recently published data, one highly divergent lineage seems to deserve a deeper look: *Podarcis* "morphotype 2". This lineage is the most widespread in the Iberian Peninsula, reported from across the Central and Southwestern regions. While its distribution in Portugal is well defined, its eastern distribution is less well known. Reflecting this situation, recent studies lack representative samples from its entire distribution range. However, when mtDNA markers were preliminary analyzed, considerable variation was reported but without obvious geographic partitioning. With this study we aim to evaluate the genetic diversity within this form. We conducted a more complete sampling scheme trying to cover the entire distribution range of this specific lineage. We combine new and previously published sequence data in order to perform a more complete phylogeographic analysis of the whole lineage. Furthermore, the geographic distribution of this form is now more precisely delimited.

Lizards in an Evolutionary Tree: Ecology and Adaptive Radiation of Island Anoles

J. B. Losos

Museum of Comparative Zoology and Department of Organismic and Evolutionary Biology, Harvard University, Cambridge, MA, USA

Caribbean anoles are renowned for their extent of adaptive diversification. What has made anoles such an important study group is not only their great diversity, both in terms of numbers of species and breadth of habitats used, but also the facility with which they have been studied from many different perspectives. I will discuss how phylogenetic analyses have - and continue- to yield interesting insights about the evolution of this group, and how ecological research has demonstrated that interspecific interactions have played an important role in regulating anole communities and driving evolutionary adaptation. This synthesis of ecological and evolutionary perspectives has yielded a rich understanding of the processes driving adaptive radiation.

Palaeogeography and the History of Lacertidae in Greece

Lymberakis P. [1] **and N. Poulakakis** [1, 2]

[1] *Natural History Museum of Crete, University of Crete, Knosos Ave, P.O.Box 2208, 71409 Irakleio, Crete, Greece*
[2] *Department of Biology, University of Crete, Vassilika Vouton, P.O.Box 2208, 71409 Irakleio, Crete, Greece*

The number of phylogeographic studies on Mediterranean lacertids (Lacertidae) has increased significantly during the last decade. Several cases of hidden diversity, paraphyly and polyphyly have been revealed, allowing the more accurate explanation of the contemporary distributions of these species and the proposition of biogeographic scenarios. The growth of our knowledge functioned as a means for testing, refining and consequently revising such scenarios to a clearer view of the family's history.

However, we are still far from being in position to compose a coherent reconstruction of the evolutionary history of Lacertidae. At the same time though, we consider that such an "exercise", especially at a local scale, could be extremely useful. The rational for this is that under the light of current advances in phylogeny, contemporary species distributions raise specific questions which in turn may offer feedback hinting specific directions that phylogenetic research should focus on.

Here, we attempt an approach of the history of lacertids in Greece based on recent phylogenetic and phylogeographic data. Greece appears to follow the major evolutionary events proposed for Europe. However, a series of local differentiations may be observed, as Greece has functioned as a glacial refuge for many species and its fauna has strong influences by the contact with the Asian fauna through Turkey. Several events of invasions, possible extinctions, reinvasions, isolations and consequent speciation formed the lacertid fauna inhabiting the area.

Global aspects of lizard body size

S. Meiri

NERC Centre for Population Biology, Imperial College London, Silwood Park, Ascot, Berkshire, SL57PY, UK

Body size is instrumental in influencing animal physiology, morphology, ecology and evolution, as well as extinction risk. At large scales body sizes usually show a unimodal, right skewed distribution. In lizards large size is often thought to be associated with herbivory and with island dwelling, but no large scale comparative studies have formally addressed these issues.

In order to better understand the evolution of body size and its ecological consequences I studied the body size distribution of the world's lizard species. Using maximum snout-vent length (SVL) as an index of body size I was able to estimate sizes of 4875 species, comprising >99% of the currently recognized species. I then examined several hypotheses regarding the influence of body size on lizard evolution and ecology, assessing if body size influences species richness, habitat use, diet, activity times, island dwelling, and extinction risk.

The lizard body size frequency distribution is highly modal and right skewed and similar distributions characterize most lizard families and lizard assemblages across biogeographic realms. There is a strong negative correlation between mean body size within families and species richness. However, small size does not promote high diversification rates at the generic level but only at higher taxonomic levels corresponding to more disparate body plans. Herbivorous lizards are larger than omnivorous ones, which are in turn larger than carnivorous lizards. Insular lizards tend towards both extremes of the size spectrum, especially on islands devoid of mammalian carnivores. These phenomena may be linked, with the absence of mammalian predators allowing insular lizards to attain larger body sizes by means of release from predation and evolution into the top predator niche. Semi-aquatic and nocturnal lizards are characterized by large body sizes. These phenomena may best be explained by invoking thermal constraints: probably cooling rates in semi-aquatic taxa, and rapid heating rates in diurnal lizards. While extinction risk increases with body size, this might be a result of bias in the size of species whose threat status has been studied.

The impact of island features on the resistance to infection in isolated populations of Aegean wall lizard (*Podarcis erhardii*)

Nikoulouzou, E[1]., Pafilis, P[2, 3]., Foufopoulos, J[2], Tsitsiloni, R[1]. and E. D. Valakos[1]

[1] Section of Human and Animal Physiology, Department of Biology, University of Athens, Panepistimiopolis, 157-84 Athens, Greece
[2] School of Natural Resources and Environment, Dana Building, 430 East University, University of Michigan, Ann Arbor, MI 48109-1115, USA
[3] Modern Greek Program, Department of Classical Studies, 2160 Angell Hall, 435 S. State, University of Michigan, Ann Arbor, MI 48109-1115, USA

The consequences of fragmentation may have severe effects on the survival of isolated populations. The importance of this phenomenon is of a major importance in conservation biology and has initiated new disciplines such as conservation physiology and immunoecology. Insularity provides an excellent system for the study of fragmentation. Island`s features, such as area and age, have been reported to exert a direct impact on organisms: genetic diversity is positively correlated with island area but negatively correlated with island age and exactly the same pattern stands for the efficiency of immune system, since the last is depended directly on genetic variation. We worked in a system three islands of Central Aegean that differ in age and area: Naxos, a large (430 km^2) and old island (16.350 y.a.), Kopries, a small, young islet (0.3 km^2, 4.200 y.a.) and Daskalio, a tiny (0.01 km^2) and very young (1.500 y.a.) islet. Genetic variation in these populations is described by the following relenence: Naxos > Daskalio > Kopries. Using this study model, we tried to assess the impact of fragentation on the immune system of Aegean wall lizard (*Podarcis erhardii*). We expected that reduced genetic variation in small and old islands would impair immune response increasing thus the susceptibility to infections by parasites. We used exclusively adult males in order to eliminate the impact of female particularities (oviposition, gravidity).

Infection was made artificially using the hemoparasite *Hepatozoon* sp., which is a natural parasite of *P. erhardii*. We have to mention that this parasite comes from another taxon (*P. cretensis*), that considers as sister species to *P. erhardii*. We quantified paraiste

burden through light microscopy in blood smears every 4 days for two weeks.

Parasite load was considerably lower in the case of Naxos, suggesting that lizards from this population are able to resist parasite infection. The reverse results were obtained from Kopries where infection was realized easily and quickly whereas the population from Daskalio shows an intermediate response.

We believe that our findings could be attributed to the restricted genetic variation of Kopries, due to the small size and the age of the island. Hence island`s features seem to shape immune efficiency as result of decreased genetic diversity.

This project are co-founded by PENED 03

Shedding the tail in islands: Adaptations to insularity

Pafilis P.[1,2], Foufopoulos P.[1]., Lymberakis P.[3] , Pérez-Mellado P.[4] and E. D. Valakos[5]

[1] School of Natural Resources and Environment, Dana Building, 430 East University, University of Michigan, Ann Arbor, MI 48109-1115, USA
[2] Modern Greek Program, Department of Classical Studies, 2160 Angell Hall, 435 S. State, University of Michigan, Ann Arbor, MI 48109-1115, USA
[3] Molecular Systematics Lab, Natural History Museum of Crete, Knossos Av., P.O. Box 2208, 71409, Iraklion, Crete, Greece
[4]Department of Animal Biology, University of Salamanca, 37071, Salamanca, Spain
[5] Section of Human and Animal Physiology, Department of Biology, University of Athens, Panepistimiopolis, 157-84 Athens, Greece

Caudal autotomy, the self-induced shedding of the tail, is a very common defensive strategy in lizards, among various taxa. Especially in lacertids, it is considered as the main antipredatory mechanism and applied widely. Autotomy has been always related to predation regime and, though considerable scepticism, used as an index of predation pressure. Tail shedding frequency depends on the balance between benefits and disadvantages and whenever costs exceed advantages, the performance of the ability decreases. Shed tail thrashes vigorously in order to distract predator and increase hadling time, facilitating the lizard`s escape. Post-autotomy movement is fueled by glycogen which converts anaerobically into lactic acid. The duration of tail movement is a crucial factor for the survival of the lizard and depends on final lactate concentration.

Though levels of predation pressure are implicated in tail shedding performance, the impact of predator`s identity and the composition of predator`s community through time (which may be altered due to extinctions or introductions) on autotomy features have been slightly studied. In this study, working with Mediterranean insular species, we tried to detect possible deviations from the typical mainland pattern. We analysed various traits of autotomy such as tail shedding performance, lactate production, glycogen consumption and duration of tail movement. Finally we attempted to clarify if the effect of certain predators on autotomy is more significant than other`s.

According to our results, the essential factor determining autotomy rates was predation regime and not just the origin of the

species (mainland or island). Moreover the presence of vipers appears to shape tail shedding performance. The limited period of exposure to efficient predators could be the underlying reason for the shortest duration of tail movement in western species whereas all eastern species had the same (higher) values. Main physiological pathways supporting anaerobic metabolism seem to be conservative in all examined species.

Reproductive advantages of gigantism and how intraspecific competition could be involved

Pafilis P.[1, 2], Sagonas K.[3], Runemark A.[4], Svensson E[4]. and E. D. Valakos[3]

[1]School of Natural Resources and Environment, Dana Building, 430 East University, University of Michigan, Ann Arbor, MI 48109-1115, USA
[2]Modern Greek Program, Department of Classical Studies, 2160 Angell Hall, 435 S. State, University of Michigan, Ann Arbor, MI 48109-1115, USA
[3]Section of Human and Animal Physiology, Department of Biology, University of Athens, Panepistimiopolis, 157-84 Athens, Greece
[4]Department of Animal Ecology, Ecology Building, Lund University, SE-22362 Lund, Sweden

Gigantism is a well known phenomenon in various taxa and has been described from many insular populations. Intraspecific competition emerges as one of the most acceptable among the various explanations that has been proposed. Though intra-species competition is considered rather uncommon among lacertids, there is strong evidence from dense insular populations supporting the opposite theory. In this paper we report another case of gigantism in a system comprised excusively of islands. Skyros wall lizard (*Podarcis gaigeae*) is endemic to Skyros Archipelago (western Aegean Sea). In 2 cases gigantic populations were discovered in the tiny islets Diavates and Lakonissi, close to the west coast of the main island. Both islets host dense populations (800 and 500 ind /ha respectively). In this study we assess the reproductive characteristcs of these two populations and we compare them to a population from Skyros. Tail autotomy is related traditionaly to predation regime. However predation pressure in our study system varied from relaxed (Skyros) to minimum (Diavates and Lakonissi). Hence we believe that the high proportions of regenerated tails observed in the islet populations (45-65% in comparison to 30% in the case of Skyros) could be interpreted as sign of a strong intraspecific competition. This approach is further reinforced by the high canibalism in Diavates. In our study we combined field and laboratory observations with measurements from museum speciments.

In all cases females produced two or three clutches and oviposition lasted from early March until middle summer. Clutch size was bigger in the case of the gigantic populations of Diavates

(2.69 eggs) and Lakonissi (2.17) in comparison to Skyros population (1.94). Egg volume, and subsequently clutch volume, followed that grade according to which the bigger eggs were born in Diavates and the smaller in Skyros. SVL of juveniles replicated once more that same pattern: females from Diavates gave birth to young giants (33 cm) while hatchlings` size in Lakonissi was smaller (30.2 cm) but still higher than in Skyros (27.8 cm). Statistical analysis revealed that clutch size corrected for maternal SVL is correlated to egg volume only in the case of Diavates giants.

According to our results bigger lizards produce more and larger hatchlings. Under this light gigantism could be a solution to eliminate the body morphology constrains on the reproductive output in lizards, offering the opportunity to increase both clutch size and egg volume and consequently offspring size. It is well established that large juveniles are better survivors, a pivotal advantage when grow up under difficult conditions, as in the case of the islets under study.

Comparative phylogeographic patterns of Western Mediterranean lacertids

A. Perera[1] and D. J. Harris[1, 2]

[1] CIBIO, Centro de Investigação em Biodiversidade e Recursos Genéticos, Campus Agrário de Vairão. 4485-661 Vairão, Portugal.
[2] Departamento de Zoologia e Antropologia, Faculdade de Ciências da Universidade do Porto, 4099-002 Porto, Portugal.

Comparative phylogeography in Europe has historically focused on the role of southern regions, especially the Iberian Peninsula, Italy and the Balkans, as "refugia" for biodiversity during the last glacial periods. Recent assessments of the Iberian Peninsula have highlighted two new important aspects - the existence of "refugia within refugia" and the porous nature of geological barriers such as the Strait of Gibraltar- that can help to explain the distribution patterns of some species. We analyze the phylogeographic patterns of the ocellated lizards (*Lacerta/Timon)* from the Iberian Peninsula and North Africa, using both new and published data, and we compare it to recently observed patterns in other lacertids such as *Acanthodactylus* or *Podarcis*. The patterns obtained will be compared to other reptiles from the region. High levels of cryptic diversity exist in almost all species. Some tentative biogeographic patterns for North Africa will be postulated, although more data from other species will be needed to support these hypotheses.

Factors affecting prevalence and intensity of blood parasites on an insular lizard, *Podarcis lilfordi* (Squamata, Lacertidae)

V. Pérez-Mellado[1], A. Domínguez-Azabal[1], J. Lluch[2], P. Navarro[2], J.Á. Hernández-Estévez[1], T. García-Díez[1] and M. Garrido[1]

[1] *Department of Animal Biology, University of Salamanca*
[2] *Department of Zoology, University of Valencia*

Blood parasites can have negative effects on lizard hosts, such as testicular reduction, low levels of haemoglobine, an increase of immature erythrocytes, low levels of oxygen consumption and a significant reduction of sprint speed. Thus, blood parasites are able to produce a measurable decrease in individual fitness. Factors as host density, abundance of invertebrate vectors and the sex or body condition of hosts can affect parasitic prevalence and intensity of infestation.

In this piece of work we explore the extent of prevalence and intensity of haemogregarines intraerythrocytic parasites in several populations of the Balearic lizard, *Podarcis lilfordi*. 491 lizards from 37 different populations were studied. In average, less than 1% of erythrocytes were infected by haemogregarines, showing significant differences on the intensity of infection amongst populations under study. More than 90% of individual lizards were infected. These also showed significant differences amongst populations. In Menorca and Cabrera coastal islets, we found a significantly higher proportion of infected males than females. In Mallorca islets, bigger adult males were more prone to load blood parasites, while this effect was not detected in females.

In the three groups of studied populations, Menorca, Mallorca and Cabrera, we found a significantly higher body condition of adult males than females. But body condition had no detectable effect in the intensity and prevalence of blood parasites. The prevalence, unlike the intensity, was significantly associated with lizard density.

We compare our results with those of studies made with lacertid lizards from continental and insular populations.

Behavioral thermoregulation of two populations of the Balearic lizard, *Podarcis lilfordi* (Günther, 1874)

V. Pérez-Mellado, Z. Ortega, T. Alonso, C. Guerra, A. Villa and M. Garrido

Department of Animal Biology, University of Salamanca, Spain

Coastal islets of Balearic Islands share several ecological conditions, such as the scarcity of food resources and the lack of a strong predation pressure. During spring and summer 2006, we studied the thermal ecology of two populations of the Balearic lizard, *Podarcis lilfordi,* from two different coastal islets of Menorca (Balearic Islands, Spain): Aire and Colom.

In both islets and seasons, we found that *P. lilfordi* regulates its body temperature rather accurately, showing effectiveness values ranging between 0,8 and 1. During spring at Aire islet, the vast majority of operative temperatures (T_e) were out of the optimum range (T_{sel}). But, nevertheless, the Balearic lizard performed an effective thermoregulation. Lizards remained active in both islets for as long as they were able to, and were only inactive in the late afternoon of summer days. We found significant differences in T_e from different habitats, showing a high heterogeneity of the thermal conditions in both islets under study. This habitat heterogeneity allows an effective shuttling heliothermic behavior of lizards.

Differences found between islets are notable. There is a dramatic increase of thermoregulation accuracy between seasons in Aire, markedly less pronounced in Colom. Based on our study, we foreview that wind would produce a cooling effect, that would be stronger in Aire than Colom. Hence, in Aire islet, there was a more effective thermoregulation in summer than spring. Further research needs doing in order to check the potential role of melanism and other factors in such thermoregulation differences amongst populations of the same species.

Systematics and distribution of the Iranian Plateau species of *Mesalina* (Sauria: Lacertidae)

N. Rastegar-Pouyani and A. Khosravani

Department of Biology, Faculty of Science, Razi University, 67149 Kermanshah, Iran

The genus *Mesalina* Gray 1838 is a holophyletic genus within the Lacertidae, mostly occurring in the Saharo-Sindian region as well as North Africa. This genus encompasses 13-14 species, 2-3 of which occurring in Iran. The Iranian species of *Mesalina* are as follows: *Mesalina watsonana*, *M. brevirostris* and, most likely, *M. gutulatta*. Of these, *M. watsonana* is widely distributed, occurring in most parts of the Iranian Plateau.

Based on extensive study and research, systematics and distribution of the Iranian Plateau species of *Mesalina* are discussed and their distribution maps are given.

Gastrointestinal helminth communities of the Aegean Wall lizard (*Podarcis erhardii ruthveni*, Lacertidae) from the Sporades Islands (Northwestern Aegean Sea, Greece).

V. Roca[1], J. Foufopoulos[2], E. Valakos[3] and P. Pafilis[2, 4]

[1]Departament de Zoologia, Facultat de Ciències Biològiques, Universitat de València. Dr. Moliner, 50. 46100 Burjassot, Spain.
[2]School of Natural Resources and Environment, Dana Hall, 440 Church St., University of Michigan, Ann Arbor, MI 48109-1041, USA.
[3]Section of Human and Animal Physiology, Department of Biology, University of Athens, Panepistimioupolis 157-84, Athens, Greece
[4]Modern Greek Program, Department of Classical Studies, 2160 Angell Hall, 435 S. State, University of Michigan, Ann Arbor, MI 48109-1115, USA

The Aegean wall lizard Podarcis erhardii, is widely distributed across the islands of the Aegean Sea and has emerged as an important model for studying the evolution of life histories under a diversity of ecological and isolation conditions. While we have a relatively good understanding of the ecology and life history of the species, the parasite communities of the taxon remain almost completely unknown. Quantifying the composition of these communities in P. erhardii is not only important for autoecological reasons, but also because inter-island comparisons of the parasite communities of this host can shed light on the factors that structure parasite diversity in general.

Here we investigate the gastrointestinal parasite communities of P.erhardii ruthveni populations occurring on 17 islands of the Sporades group in the NW Aegean Sea. We dissected the GI tracts of 118 lizards and all helminths encountered were identified and recorded. In all, 8 species of helminthes were found, 1 Trematode (Paradistomum mutabile), 1 Cestode (Oochoristica sp.) and 6 Nematodes (Parapharyngodon micipsae, Parapharyngodon bulbosus, Parapharyngodon echinatus, Spauligodon sp., Abbreviata sp., and Skrjabinelazia sp.). The prevalence, mean intensity, and mean abundance of infection were respectively 61%; 5.74 (± 11.43; range 1-90); and 3.5 (± 9.3; range 0-90). The Brillouin's index of diversity was 0.048 (± 0.13; range 0-0.6). These values were lower than those obtained for P. erhardii from Cyclad Islands, and suggest that the investigated populations (i) harbour only impoverished helminth communities relative to other mainland and insular lacertid populations; (ii) persist on the non-herbivorous diet. These features can probably be best attributed to the insular conditions related to the trophic availability and the long periods of isolation of these island lizard populations.

Evidences of Hepatozoon (Coccidiomorphida: Hepatozooidae) as blood parasite of Iberian lizards

V. Roca and M.A. Galdón

Departament de Zoologia, Facultat de Ciències Biològiques, Universitat de València. Dr. Moliner, 50. 46100 Burjassot (Spain)

The presence of Haemogregarines (sensu lato) in the blood of many species of reptiles is not at all unusual. In Iberian and Canarian lacertid lizards, Haemogregarines have been recorded infecting erythrocytes. Most of the records were the mature gametocytes, and this fact always has disabled the accurate identification of these infecting forms because their morphology do not give enough information to identify them even at generic level. We have analyzed blood smears from 75 specimens of *Podacis bocagei* (Seoane, 1884) and 33 specimens of *Podarcis carbonelli* (Pérez-Mellado, 1981) from several localities of North-East Portugal. We found Haemogregarines (sensu lato) for 74.7% of *P. bocagei* and 69.7% of *P. carbonelli*. In order to progress in the identification of these Haemogregarines, we studied some characteristics other than the morphology of the mature gametocytes. Thus, we observed immature gametocytes (considered merozoytes by some authors) oval in form, and with a big central nucleus. Furthermore, we analyzed histologically the liver of 4 of the searched hosts (2 *P. bocagei*, 2 *P. carbonelli*). We detected the presence of latent cysts with sporozoytes. Both characteristics, the presence of merozoytes in the blood and the presence of cysts in the liver, have been recorded by several authors as typical of the genus *Hepatozoon*. Although more histological analysis are necessary to assert that the hole of the sample is infected by Hepatozoon, we suspect that not only *P. bocagei* and *P. carbonelli* from Portugal, but many species of Iberian (and probably Balearic and Canary) lacertid lizards (on which we are now developing some investigations) could be infected by species of this genus.

Premating isolation and parallel island gigantism in Skyros wall lizard *Podarcis gaigeae*

A. Runemark and E.I. Svensson

Department of Ecology, Lund University, Sweden

We will present data on pre-mating isolation between island populations and mainland populations of Skyros wall lizard, *Podarcis gaigeae*, using interest in chemical cues from the other sex as a proxy for mate preferences. Skyros wall lizard exhibit substantial morphological divergence in island populations within only a few hundred meters from the mainland source populations. Island gigantism has evolved at least twice, indicating that parallel ecological selection pressures are causing phenotypic divergence. This makes Skyros wall lizard an interesting model system for studying population divergence and speciation mechanisms. We have also detetected pronounced between-population differences in feeding structure from geometric morphometrics study of the skull. Differences in feeding structure are likely to be correlated with local diets, since a higher, shorter head-shape in lizards correspond to an increase in bite-force. Molecular genetic data from 10 microsatellite loci revealed that the island populations are much more diverged from each other and from the mainland populations, than the mainland populations are from each other. Reduction in gene flow could presumably have facilitated local adaptation in morphology and behavior on the islets.

How many archaeolacertas inhabit Corso-Sardinian Plate? Allozyme variation and differentiation in *Archaeolacerta bedriagae*

D. Salvi[1], M. Capula[2], P. Bombi[1] and M. Bologna[1]

[1] Department of Biology, University "Roma Tre", Viale G. Marconi 446, 00146 Rome, Italy
[2] *Museo Civico di Zoologia, Via U. Aldrovandi 18-I, 00197 Rome, Italy*

Archaeolacerta bedriagae (Camerano, 1885) is a rock lizard endemic to Corsica and Sardinia. Based on weak morphological traits four subspecies have been described to date. The nominal subspecies (*A. b. bedriagae*) occurs on Corsica. The three following subspecies inhabit different geographic areas of Sardinia: *A. b. sardoa* (Gennargentu Massif), *A. b. paessleri* (Limbara Mountains), *A. b. ferrerae* (coastal Gallura). Allozyme variation in *A. bedriagae* was previously investigated by Guillame and Lanza (1982). These authors compared three populations only (one from Corsica and two from Sardinia) and obtained very high values of Nei's genetic distance, ranging from 0.172 to 0.309. However, the values of genetic distance indicated by those authors were completely wrong because of miscalculation. On a subsequent paper Guillame (1987) proposed a different genetic scenario, indicating corrected values of Nei's genetic distance among the three *A. bedriagae* populations, ranging from 0.133 to 0.186. These values, although being much lower than those estimated by Guillame and Lanza, are in fact very high, falling into the range obtained from comparisons between well recognized biological species of the genera *Lacerta* and *Podarcis*. In spite of this, Guillaume (1987) proposed to synonymised two subspecies (*A. b. paessleri* and *A. b. ferrerae*), and Lanza (1983) questioned the systematic validity of the Sardinian subspecies. On the other hand, based on the genetic data reported by Guillame and Lanza, Arribas (1999) hypothesized the occurrence of unrecognized species of the genus *Archaeolacerta* within the Corso-Sardinian area. In addition, in a paper devoted to the systematics of the tribe Lacertini, Arnold et al. (2007) found considerable mitochondrial DNA variation among three Corsican

individuals of *A. bedriagae*, and hypothesized the occurrence of more than one species.

In this paper allozyme variation of *A. bedriagae* was studied, and the results were compared with those obtained in previous studies. A total of 55 individuals from 5 Corsican (Roccapina) and Sardinian (Punta Falcone, Limbara Mountains, Gennargentu Massif, Mount Settefratelli) localities were used. All recognized subspecies were included in the analysis, plus one sample from southern Sardinia (Mount Settefratelli) for which the recognition of the subspecific status was suggested. For interspecific comparison, 11 individuals of *Iberolacerta cyreni* (Müller & Hellmich 1937) from Central Spain (Sierra de Guadarrama) were also analyzed. Approximately 2 cm of the tail tip of each lizard was taken off, in order to avoid killing animals, and stored below -70°C until electrophoretic analysis. Standard horizontal starch gel electrophoresis was performed on muscle tissue homogenates using buffer systems and procedures described by Capula. Gene products for the following 20 presumptive gene loci were analaysed,: *αGpd, Ldh-1, Ldh-2, Mdh-1, Mdh-2, Me-1, Me-2, Idh-1, Idh-2, 6Pgd, Sod-1, Ak, Pgm-1, Pgm-2, Ck, Mpi, Gpi, Est-1, Gp-1, Gp-2*. Genotype and allele frequencies were determined by direct count from allozyme phenotypes. The genetic relationships among the populations studied were evaluated using Nei's standard genetic distance (*D*). The phenetic relationships among populations were estimated by means of the UPGMA method.

Eleven out of 20 loci were found to be monomorphic, i.e. fixed for the same allele, in all populations (α*Gpd*, *Ldh-2*, *Mdh-1*, *Mdh-2*, *Idh-2, Sod-1*, *Ak*, *Pgm-1*, *Pgm-2*, *Gp-1*, *Gp-2*). Three out of nine polymorphic loci were weakly polymorphic (*Ldh-1*, *Me-2*, *Mpi*). Lizards from Corsica were characterized by two unique alleles, i.e. Mpi^{102} and $6Pgd^{95}$. Four unique alleles were found in the Sardinian populations: $Est\text{-}1^{102}$ in all populations, $Me\text{-}2^{95}$ in the population from the Limbara Mountains, $6Pgd^{105}$ and $Ldh\text{-}1^{95}$ in the populations from the Mount Settefratelli. Low levels of genetic differentiation were found in *A. bedriagae*, Nei's *D* ranging from 0.013 to 0.042, with an average genetic distance of 0.026 (SD = 0.010). A similar value of Nei's *D* was found between Corsican and Sardinian populations (*D* = 0.025; SD = 0.008). The sample from the Mount Settefratelli (southern Sardinia) was considerably differentiated from the other ones (average *D* = 0.032; SD = 0.011).

Low Nei's genetic distance values were found comparing the four recognized subspecies (average D = 0.023; SD = 0.007). Our results are not in accordance neither with those reported by Guillame and Lanza, nor with those by Guillame (1987), clearly indicating low levels of genetic differentiation among populations. Genetic differentiation among the recognized subspecies resulted to be much lower than the one estimated by Guillame and Lanza (1982). Our results are in agreement with the mitochondrial DNA analyses, the nuclear markers analyses and the morphometric analyses. This would indicate that the supposed occurrence of a unrecognized *Archaeolacerta* species within the Corso-Sardinian Plate is not supported by genetic data.

Biogeography of Greece

S. Sfenthourakis[1] and K.A. Triantis[2]

[1] Section of Animal Biology, Department of Biology, University of Patras, Patras, Greece
[2] Biodiversity Research Group, Oxford, University Centre for the Environment, Oxford, UK

The rich biodiversity of Greece combined with its special geographical features, offer great opportunities for biogeographic research. The complex palaeogeography and palaeoecology of the region, the richness in recent ecosystem types, the rugged topography of the mainland combined with the huge number and variety of islands, contribute further to this. During the last decades, an increasing number of researchers, both Greek and from other countries, publish studies that span a large range of biogeographical approaches. These cover various aspects of historical and ecological biogeography, as well as attempts towards synthetic explanations of modern distributional patterns. Historical approaches, facilitated by phylogenetic analyses based on molecular markers, aim to identify to relative merits of vicariance events, dispersal and *in situ speciation* in shaping current patterns of distribution, and to provide also a temporal framework of major cladogenetic events. This body of knowledge is increasing rapidly leading to new insights into the effects of crucial historical events, such as the breaking down of the south Aegean arc or the opening of the mid-Aegean trench, especially for endemic forms. At the same time, important contributions to ecological biogeography, within the general paradigm of island biogeography, have been made after analyses of insular communities on Greek islands. These include the Choros model, new approaches to the study of the Small Island Effect, the application of structural equation models in biogeographical analyses, concepts regarding non-adaptive radiation and several other innovations and elaborations of new ideas. In fact, the richness and variety of Greek islands regarding size, habitat diversity and isolation, provide a valuable tool for testing hypotheses of island biogeography and macroecology, such as species turnover, the role of habitat diversity, species co-occurrence etc.

Herein, we present a concise account of major contributions to the field and new insights gained from them regarding the shaping of spatial biodiversity patterns in this geographical area.

We conclude that Greece is one of the most important natural laboratories for biogeographic research that can become the leading paradigm in continental island biogeography, complementing oceanic archipelagos, such as Hawaii and the Canaries, towards a comprehensive understanding of spatial biodiversity patterns.

Thermoregulation by the lizard *Podarcis cretensis* (Squamata; Lacertidae) in Western Crete: Variation between three populations along an altitudinal gradient

Spaneli V.[1, 2], Valakos E.D.[3], Pafilis P.[4, 5], Lymberakis P.[1]

[1]*Natural History Museum of Crete, Knossou Av., PO Box 2208, 71409 Irakleio, Greece*
[2] *University of Crete, Department of Biology, Heraklion, Greece*
[3]*University of Athens, Section of Biology, Department of Human and Animal Physiology, 15784 Panepistimioupolis, Athens, Greece*
[4]*School of Natural Resources and Environment, Dana Building, 430 East University, University of Michigan, Ann Arbor, MI 48109-1115, USA*
[5]*Modern Greek Program, Department of Classical Studies, 2160 Angell Hall, 435 S. State, University of Michigan, Ann Arbor, MI 48109-1115, USA*

Thermal conditions change dramatically with altitude. Ectothermic animals suffer largely form these alterations to their thermal environments and undergo various adaptations. Thus some lizards show lower body temperatures at high elevations while others adopt behavioural adjustments to compensate for the cooler environment and the climate's seasonal extremes in these regions.

Podarcis cretensis is a recently redescribed species of the genus, endemic to the island of Crete, where it may be found from sea level to 2000m, and satellite islands. The aim of this study was to compare the thermoregulatory strategy of three populations of *P. cretensis* along an altitudinal gradient (0, 500 and 1000 m).

Study sites, all in western Crete, were covered with phrygana and visited during summer 2007. Body temperatures were estimated by taking cloacal temparature from lizards that were captured in the field. In order to assess operative temperatures we used copper models simulating the thermophysical capacities of this species. The set-point range (T_{set}) was determined in a laboratory thermogradient. Using the values of the aforementioned parameters we estimated the comparative thermoregulatory indexes (d_b, d_e, E, variance of T_b).

Our results suggest that in all populations lizards are active thermoregulators. The efficiency (E) of thermoregulation ranged from 0.81 to 0.93, with lowland population having the lowest value. Moreover, both accuracy and precision of thermoregulation increased with the altitude.

Thermoregulation by the lizard *Podarcis cretensis* (Squamata; Lacertidae) in Western Crete: Seasonal variation between three populations occupying different habitat types

Spaneli V.[1, 2], Valakos E.D.[3], Pafilis P.[4, 5], Lymberakis P.[1]

[1]*Natural History Museum of Crete, Knossou Av., PO Box 2208, 71409 Irakleio, Greece*
[2] *University of Crete, Department of Biology, Heraklion, Greece*
[3]*University of Athens, Section of Biology, Department of Human and Animal Physiology, 15784 Panepistimioupolis, Athens, Greece*
[4]*School of Natural Resources and Environment, Dana Building, 430 East University, University of Michigan, Ann Arbor, MI 48109-1115, USA*
[5]*Modern Greek Program, Department of Classical Studies, 2160 Angell Hall, 435 S. State, University of Michigan, Ann Arbor, MI 48109-1115, USA*

Ectotherms thermoregulate mainly by behavioural means. Though they are capable of behaviourally regulating their body temperatures, their natural environments eventually limit the extent of thermoregulatory accuracy. Thermoregulation is also influenced by the presence of competitors and predators as well as by the availability and location of food and retreat sites. In some cases a single species may exhibit different thermoregulatory behaviours in different habitats. Moreover, it is well known that both the thermal environment and the thermoregulatory behaviour of lizards show seasonal variation.

Podarcis cretensis is a recently redescribed species of the genus, endemic to the island of Crete and satellite islands where in may be found from sea level to 2000m.

The aim of this study was to compare the thermoregulatory strategy of 3 populations of *Podarcis cretensis* occupying different habitat types, during two seasons: spring and summer 2007. All study sites are in Western Crete, sea level. Ballos is a sandy site in the north coasts of Crete with very low ground coverage by small bushes (phrygana). Elaphonisi is in the south, the ground is a combination of sand and soil and has a high percentage covered by rocks and small bushes. Finally, Lissos gorge is in the south and it is soily with steep edges and high ground coverage by rocks, tall bushes (maquis) and trees.

We collected data on the main thermoregulatory parameters (T_b, T_e) at the study sites and determined the set-point range (T_{set})

in a laboratory thermogradient. Thermoregulatory indexes (d_b, d_e, E, variance of T_b) were estimated.

The efficiency (E) of thermoregulation ranged from 0.47 to 0.83, during spring and from 0.59 to 0.86 during summer, with the population occupying the open (low coverage) phryganic habitat having the lowest value in both seasons (partially thermoconformer during spring). The same population seems to be the less accurate thermoregulator in both seasons, showing that the risk of predation along with the lack of thermal variation within a habitat may be limiting factors to a lizard's thermoregulation. The effectiveness, the accuracy and the precision of thermoregulation increased during summer in all populations.

Functional ecology and evolutionary consequences of colour patterns in lizards and other animals

E. Svensson

Department of Ecology, Lund University, Sweden.

Animal colour patterns have fascinated laymen and naturalists for a long time and the evolution of colouration continue to be an active research field in ecology and evolutionary biology. Although the mechanistic and molecular genetic basis of colour patterns varies between taxonomic groups (e. g. between invertebrates and vertebrates), some generalizations can now be made about their function, ecology and evolution. For instance, colour patterns do often, although not always, have a rather simple genetic basis and are governed by one or a few loci of major effect (e. g. MCR1 which affects melanism in vertebrates). The genes influencing animal colouration do also often have *pleitropic* effects, that is, they influence other important phenotypic traits than colouration. For instance, colouration is often genetically and phenotypically correlated with traits as diverse as immune function and disease resistance, developmental rates, thermoregulatory capacity and sexual behaviour. These genetic and phenotypic correlations between colour and other traits are sometimes a result of correlational selection, that is, selection for optimal character combinations, that will favour phenotypic and genetic integration between adaptive traits. Finally, colour patterns often vary in a discrete fashion within populations, resulting in two or several distinct colour morphs that can co-exist locally. Such colour morphs could provide the raw material for subsequent speciation, either in sympatry or in allopatry. Colour could also become involved as sexual isolation characters, maintaing species integrity and serving as species recognition cues. I will discuss these manifold consequences of colour patterns in animals, and illustrate my talk with data from both my own research laboratory as well as from other laboratories. Examples from lizards and various invertebrate systems (damselflies, isopods) will be used in this discussion.

The genetic variability of *Podarcis pityusensis* vs. *Podarcis lilfordi*

B. Terrasa[1], V. Rodríguez[1], R. P. Brown[2], V. Pérez-Mellado[3], A. Picornell[1], J.A. Castro[1] and M. M. Ramon[1]

[1]Laboratori de Genètica. Universitat de les Illes Balears, Palma de Mallorca, Spain.
[2]School of Biological Sciences, John Moore University, Liverpool, UK.
[3]Departamento de Zoologia, Universidad de Salamanca, Salamanca, Spain

Two endemic species of *Podarcis* inhabit the Balearic archipelago, *Podarcis lilfordi* in Gymnesic islands (Mallorca, Menorca, Cabrera and associated islets) and *Podarcis pityusensis* in Pityusic islands (Ibiza, Formentera and surrounding islets). The morphological variation within both these species is considerable, and has lead to 28 and 23 subspecies in *P. lilfordi* and *P. pityusensis*, respectively, being generally accepted. Many are restricted to extremely small islets.

A preliminary genetic study indicated high genetic diversity among *P. lilfordi* while diversity was lower within *P. pityusensis*, indicating less population substructure. The structuring within *P. lilfordi* has since been described in detail, but the pattern within *P. pityusensis* is still poorly-known. We have now sampled 15 insular populations of *Podarcis pityusensis* from Ibiza and Formentera and one introduced population, Murada, in Palma de Mallorca. A total 61 individuals were analyzed (*n*=2-5 for each locality). We sequenced five fragments of the mitochondrial DNA: 12S rRNA, cytochrome *b* (two regions obtained separately), control region and an 800 bp (ND) fragment that included part of the ND1 gene, three tRNA genes, $tRNA_{Ile}$, $tRNA_{Gln,}$ and $tRNA_{Met}$ and part of the ND2 gene. The total length of mitochondrial sequence analyzed for each animal was 2382 bp.

We obtained the following measures of genetic diversity: Haplotype (gene) diversity and its sampling variance, Nucleotide diversity, Pi (p), the average number of nucleotide differences per site between two sequences and its sampling variance, Theta (per site) that for mitochondrial DNA is 2Nm, where N is the effective population size of females. We have also calculated, for each fragment, a haplotype network using the probability under parsimony criterion.

The results indicate much lower levels of mtDNA structuring diversity among *P. pityusensis* populations compared with *P. lilfordi*. The networks obtained for each gene in *P. pityusensis* show no evidence of missing internal nodes, in contrast with *P. lilfordi*, which is suggestive of very recent separation of populations.

The differing levels of diversity between the two species could be explained by the differences in area of Ibiza and Formentera. They are smaller, more ecologically uniform, and will have been subject to fewer historical periods of island separation due to lowering of sea-levels than in Mallorca, Menorca and Cabrera.

Phylogeographic structure of *Podarcis lilfordi* in the Balearic archipelago

B. Terrasa[1], V. Rodriguez[1], V. Pérez-Mellado[2], A. Picornell[1], R.P. Brown [3] , J.A. Castro[1] and M. M. Ramon[1]

[1] Laboratori de Genètica. Universitat de les Illes Balears, Palma de Mallorca. Spain
[2]Departamento de Zoologia. Universidad de Salamanca. Salamanca. Spain
[3]School of Biological Sciences. John Moore University, Liverpool, England

Two endemic species of *Podarcis* inhabit the Balearic archipelago in the Mediterranean: *Podarcis lilfordi* in the Gymnesic island group (Mallorca, Menorca, Cabrera and associated islets) and *Podarcis pityusensis* in the Pityusic group (Ibiza, Formentera and surrounding islets). They originated from range fragmentation of their common ancestor during the reflooding of the Mediterranean after the opening of the Strait of Gibraltar some 5.33 Ma years ago. Subsequent major changes in sea level have occurred, particularly during glacial periods of the Pleistocene, but these have not been sufficient to unite the two main island groups again. The last major ice ages, the Riss (200.000 years ago) and the Würm (25.000 years ago) were the most intense. Here we address interspecific evolution within the former species. *Podarcis lilfordi* is found on islands and islets off the coast of Mallorca and Menorca (including the Cabrera archipelago). It became extinct on these main islands during the past few thousand years. However 43 different insular populations of the endangered *P. lilfordi* still survive: 11 from islets around Mallorca, 16 from Menorcan islets and 16 from the Cabrera archipelago.

A total of 118 individuals were analyzed, two or three from each locality. We sequenced five fragments of mitochondrial DNA: 12S rRNA, cytochrome *b* (two regions obtained separately), control region and an 800 bp (ND) fragment that included part of the ND1 gene, three tRNA genes, $tRNA_{Ile}$, $tRNA_{Gln,}$ and $tRNA_{Met}$ and part of the ND2 gene. The total length of mitochondrial sequence analyzed for each animal was 2382 bp.

We analyzed the spatial component of the genetic diversity using Nested Clade Phylogeographic Analysis (NCPA) and examined dispersal patterns using coalescent-based analyses of historical migration to investigate the processes that may have lead to the

current phylogeographic patterns. Four unconnected parsimony networks were obtained: (I) all Menorcan populations, (II) Dragonera, Malgrats and Toro islands (Western Mallorca), (III and IV) the remaining populations from Cabrera and Mallorca.

Within network I, contiguous range expansion was inferred for both main clades. Populations from western Mallorca (II) have undergone historical allopatric fragmentation events following isolation around the start of the Pleistocene. Populations from Cabrera appear to have become isolated from north and south Mallorca more recently. Clades within networks III and IV showed some allopatric fragmentation and restricted gene flow (isolation by distance) among islands from Cabrera, as well as long distance dispersal between the Cabrera archipelago and southern Mallorca. The genetic effects of bottlenecks cannot be discarded in most of the smaller populations, some of these with a reduced population size.

Historical gene flow was estimated using MIGRATE. We have only obtained clear evidence of asymmetrical gene flow between networks III and IV. In Network I, we observed a South-North gene flow between the two clades (3-1 and 3-2) with haplotypes from Menorca. Between the two clades (4-1 and 4-2) belong to network IV gene flow was virtually symmetrical.

Predation pressure, density-induced stress and tail regeneration:

a casual-nexus situation or a bunch of independent factors?

Tsasi G.[1], Simou Ch.[1], Pafilis, P.[2, 3] and E. D. Valakos[1]

[1] *Section of Human and Animal Physiology, Department of Biology, University of Athens, Panepistimiopolis, 157-84 Athens, Greece*
[2] *School of Natural Resources and Environment, Dana Building, 430 East University, University of Michigan, Ann Arbor, MI 48109-1115, USA*
[3] *Modern Greek Program, Department of Classical Studies, 2160 Angell Hall, 435 S. State, University of Michigan, Ann Arbor, MI 48109-1115, USA*

Autotomy consists in the voluntary shedding of an expendable body part under conditions of defense. The broad phylogenetic expression of this trait represents the evolutionary success of this strategy. Caudal autotomy in lizards is followed rapidly by regeneration, revealing the importance of a fully functional tail. Predation pressure has been traditionally correlated with the tail autotomy performance. However there is a lack of evidence regarding the impact of predation regime on tail regeneration. Another important factor that has been neglected is the population density. Though it is well established that intraspecific competition in dense (usually insular) populations increase tail shedding performance, the impact of density on caudal regeneration remains understudied.

In this paper we worked with three populations of the Aegean wall lizard (*Podarcis erhardii*) experiencing different predation pressure: while Naxos island (the biggest in Cyclades group) hosts numerous predators, including snakes (and one species of viper), Kopries and Daskalio islets are snake-free biotopes. In order to evaluate the effect of density-induced stress on caudal regeneration, lizards were treated under two conditions of grouping, in one-individual and in six-idnividual terraria, and always in respect to their origin forming hence 6 different groups. Tail sheding occurred prior to this treatment following a standardised method. The length of the regenerated tail was recorder weekly. We used exclusively adult males in order to eliminate the impact of female particularities (oviposition, gravidity).

Regeneration rate was higher in the case of one-individual terraria for both islets. We believe that this finding could be attributed to the stress conditions exerted in the “crowded” terraria. Nonetheless no significant difference was found in the rates between one- and six-individual terraria in Naxos Island. We believe that the underlying reason must be the heavy predation regime under which fast tail regeneration is of a crucial importance, even under unfavourably overcrowded conditions.

Functional analysis of parachuting in the lacertid lizard, *Holaspis guentheri*.

B. Vanhooydonck, G. Meulepas, A. Herrel and P. Aerts

Laboratory for Functional Morphology, Department of Biology, University of Antwerp, Universiteitsplein 1, B-2610 Wilrijk, Belgium

Although the capacity to glide has evolved independently several times within lizards, only one lacertid lizard, *Holaspis guentheri*, has been observed using this type of locomotion to move from tree to tree. Here, we first test whether *H. guentheri* can be regarded a true glider/parachuter. We do so by quantifying gliding performance (i.e. velocity, glide distance and duration) and compare it to the performance of a typical gliding gecko, *Ptychozoon kuhli*, and a non-gliding lacertid, *Podarcis muralis*. Second, we investigate how *H. guentheri* glides by quantifying several biomechanical factors (i.e. angle of attack, lift and drag coefficient).

Although *H. guentheri* is as able to parachute as *P. kuhli*, it uses a different strategy to do so. Whereas the lacertid lizard generates more drag, the gecko generates more lift. In addition, the drag-based parachuting in *H. guentheri* results in a reduction of the velocity at landing; by using a lift-based strategy *P. kuhli* is able to cover greater distances.

New records of Horvath's Rock Lizard (*Iberolacerta horvathi*) from Slovenia

A. Žagar [1, 2], G. Plsnic [2, 3] and M. Krofel [2, 4]

[1]*Ul. Bračičeve brigade 10, SI-2310 Slovenska Bistrica, Slovenia*
[2] *Societas herpetological slovenica, Večna pot 111, SI-1000 Ljubljana*
[3]*Župančičeva 30, SI- 6330 Piran, Slovenia*
[4]*Dept. of Biology, University of Ljubljana, Večna pot 111, SI-1001 Ljubljana*

Horvath's Rock Lizard is a relict endemic species of Dinaric-East Alpine mountain range. It occurs in western Croatia, western Slovenia, north-eastern Italy, western Austria and southern Germany. It is one of the least known species of lacertids in Slovenia. Previously it had been assumed that its distribution is limited to high mountainous regions of Julian Alps, Trnovski gozd and Mt. Snežnik above 650 m a.s.l. Only in the recent years specimens have been found also outside this range in the Dinaric Mountains.

New finds were made in three regions of Slovenia, all located in Dinaric range in southern Slovenia. All individual lacertids were captured or approached to a close distance and determined by the position of supranasal, frontonasal and rostral scales, according to determination keys. In July 2006 a survey on the distribution of reptiles was made in Notranjsko podolje region, where we registered 23 individuals of Horvath's Rock Lizard at 6 localities. We found them on rocky ground in karstic terrain, on walls of ruins and in a dry riverbed. The altitude of the localities ranged from 458 to 640 m. During a reptile survey in Kočevje region from April to August 2007, new finds of *I. horvathi* were discovered at 17 localities, where we found 18 individuals. They were located on rocky cliffs in karstic terrain and rocky road banks in a mixed Dinaric forest (*Omphalodo-Fagetum*). The altitude of the localities ranged from 462 to 1066 m. Since 2006 there have been several observations of Horvath's Rock lizards also at one locality in Iški Vintgar at 370 m on rocky walls in a gorge.

At more than one location we captured both Horvath's Rock Lizard and Common Wall Lizard (*Podarcis muralis*) on the same wall or rocky ground. This confirms the fact that both species can occur syntopic at the same localities. Due to similarities in coloration and habitat preferences of *I. horvathi* and *P. muralis*, it is usually necessary to catch an individual to determine the species.

As it was thought in the past that in Slovenia Horvath's Rock Lizard is limited to high regions of the Alps and Dinaric Mts., this species was often not considered an option, when determining lizards in the lower regions of Dinaric range. Therefore some of the finds recorded in the past as *P. muralis* might actually be *I. horvathi*. We recommend that additional care should be taken, when determining the small lacertids and to inspect the position of snout scales whenever possible.

New data presented here suggest that Horvath's Rock Lizard is much more widespread throughout the Dinaric range in Slovenia than previously believed. Additional surveys are needed to get a better picture on the distribution of this endemic species and to determine its population status in Slovenia.

Preliminary data on the spatial ecology of *Acanthodactylus schreiberi* in a sand dune in Cyprus

S. Zotos, C. Adamopoulou and A. Legakis

Zoological Museum, Dept. of Biology, University of Athens, Panepistimioupolis, GR-15784, Athens, Greece

The spatial organization of a population of the lacertid *Acanthodactylus schreiberi* was studied from March to November in a sand dune ecosystem on Akrotiri Peninsula, Cyprus.

The mean home range for males during summer was 173.7 m^2 while for females 103.52 m^2. Male/female home range ratio was 1.68. During fall mean home range for males was significantly larger: 183.96 m^2 versus 89.32 m^2 for females. Male/female home range ratio for this season was 2.06. In summer each male overlapped with up to 6 females, while in fall with up to 3 females. During both seasons female home ranges overlapped extensively with male home ranges, up to 100% of their range. No significant correlation was found between male body size (SVL) and home range size, or between male home range size and the number of overlapping females.

Our data so far seem to indicate a system where the lizard spatial organization is governed principally by habitat qualities, such as refuge and food availability as well as thermoregulation spots.

Index of Authors

List of Condributors

Adamopoulou, Chloe
Zoological Museum, Dept. of Biology, University of Athens, Panepistimioupolis, GR-15784, Athens, Greece
cadam@biol.uoa.gr

Aerts, Peter
Department of Biology, University of Antwerp, Universiteitsplein 1, B-2610 Antwerpen

Agra, A.R.
Cesam & Department of Biology
University of Aveiro, 3810-193 Aveiro, Portugal

Ahmadzadeh, Faraham
Department of Biodiversity and Ecosystem Management, Environmental Sciences Research Institute, Shahid Beheshti University, Evin, Tehran, Iran,
F_Ahmadzade@sbu.ac.ir

Akriotis, Triantaphylos
Biodiversity Conservation Laboratory, Department of Environmental Science, University of the Aegean
takr@aegean.gr

Alonso, Teresa
Department of Animal Biology, University of Salamanca, Spain

Alpagut-Keskin, Nurşen
Ege University, Faculty of Science, Department of Biology, Zoology Section 35100, Bornova/Izmir, Turkey

Amaral, M.J.
Cesam & Department of Biology,
University of Aveiro, 3810-193 Aveiro, Portugal
CIBIO Centro de Investigação em Biodiversidade e Recursos Genéticos, Campus Agrário de Vairão, 4485-661 Vairão, Portugal
mjamaral@ua.pt

Arakelyan, Marine
Yerevan State University,
Alek Manukyan 1, Yerevan 0025, Armenia
arakelyanmarine@yahoo.com

Ayllón, E.,
AHE, Apartado de Correos 191, 28910 Leganés Spain

Barbosa, Diana Raquel
Unidad de Etología, Instituto Cavanilles de Biodiversidad y Biología Evolutiva, Universidad de Valencia, Spain
CIBIO, Centro de Investigação em Biodiversidade e Recursos Genéticos, Portugal
Diana.Carvalho@uv.es

Berti, R.
Dipartimento di Biologia Evoluzionistica "Leo Pardi"
Via Romana 17, 50125 Florence, Italy

Biaggini, Marta
Dipartimento di Biologia Evoluzionistica "Leo Pardi",
Via Romana 17, 50125 Florence, Italy
marta.biaggini@virgilio.it

Bologna, Marco
Department of Biology, University "Roma Tre",
Viale G. Marconi 446, 00146 Rome, Italy
bologna@uniroma3.it

Bombi, Pierluigi
Department of Biology, University "Roma Tre"
Viale G. Marconi 446, 00146 Rome, Italy
bombi@uniroma3.it

Brito, José Carlos
CIBIO, Centro de Investigação em Biodiversidade e Recursos Genéticos, Campus Agrário de Vairão, 4485-661, Vairão, Portugal.

Brown, R.C.
School of Biological Sciences, John Moore University. Liverpool. England

Cafuta, Vesna
Mala vas 25, SI-1000 Ljubljana, Slovenia.
Societas herpetologica slovenica – društvo za preučevanje dvoživk in plazilcev, Večna pot 111, SI–1000 Ljubljana, Slovenia.
vesna.cafuta@gmail.com

Capula, Massimo
Museo Civico di Zoologia,
Via Ulisse Aldrovandi 18, I-00197 Roma, Italy
m.capula@comune.roma.it

Carretero, Miguel A.
CIBIO/UP, Centro de Investigação em Biodiversidade e Recursos Genéticos
Campus Agrário de Vairão, 4485-661, Vairão, PORTUGAL
carretero@mail.icav.up.pt

Castro, J.A.
Laboratori de Genètica. Universitat de les Illes Balears. Palma de Mallorca. Spain

Çetin- Doğan, Tülin
Ege University, Faculty of Science, Department of Biology, Zoology Section 35100 Bornova /Izmir, Turkey

Cipolla, Riccardo Maria
Associazione Vivara Amici delle Piccole Isole
Piazza Riario Sforza 159, I-80139 Napoli, Italy
armnappi@tin.it

Corti, Claudia
Museo di Storia Naturale - Sezione di Zoologia "La Specola",
Via Romana, 17 - 50125 Florence, Italy Department of Zoology University of Valencia
claudia.corti@unifi.it

Desfilis, E.
Departamento de Psicobiología, Facultad de Psicología, Universidad Complutense de Madrid, Spain

Domínguez-Azabal, Antonio
Department of Animal BiologyUniversity of Salamanca

Font, E.
Unidad de Etología, Instituto Cavanilles de Biodiversidad y Biología Evolutiva, Universidad de Valencia, Spain

Foufopoulos, Johannes
School of Natural Resources and Environment, Dana Hall, 440 Church St., University of Michigan, Ann Arbor, MI 48109-1041, USA.
jfoufop@umich.gr

Galdón, M.A.
Departament de Zoologia, Facultat de Ciències Biològiques, Universitat de València. Dr. Moliner, 50. 46100 Burjassot, Spain

García-Díez, Teresa
Department of Animal BiologyUniversity of Salamanca

Garrido, Mario
Department of Animal Biology University of Salamanca, Spain

Godinho, R.
CIBIO,Centro de Investigação em Biodiversidade e Recursos Genéticos, Campus Agrário de Vairão, 4485-661 Vairão, Portugal

Grbac, Irena
Croatian Natural History Museum,
Demetrova 1, HR-10000 Zagreb, Croatia
Irena.Grbac@hpm.hr

Guerra, Carmen
Department of Animal Biology, University of Salamanca, Spain

Harris James D.
Departamento de Zoologia e Antropologia,
Faculdade de Ciências da Universidade do Porto, 4099-002 Porto, Portugal.
CIBIO, Centro de Investigação em Biodiversidade e Recursos Genéticos, Campus Agrário de Vairão, 4485-661 Vairão, Portugal,

Hellemans, Katelijne
Department of Biology, University of Antwerp
Universiteitsplein 1, B-2610 Antwerpen

Hernández-Estévez, José Ángel,
Department of Animal Biology University of Salamanca

Hernandez- Sastre, P. L.
AHE, Apartado de Correos 191, 28910 Leganés Spain

Herrel, Anthony
Department of Biology, University of Antwerp,
Universiteitsplein 1, B-2610 Antwerpen
anthony.herrel@ua.ac.be

Husak, Jerry F.
Department of Biology, University of Antwerp,
Universiteitsplein 1, B-2610 Antwerpen
Husak@vt.edu

Huyghe, Katleen
Department of Biology, University of Antwerp,
Universiteitsplein 1, B-2610 Antwerpen

Kaliontzopoulou, Antigoni
CIBIO/UP, Centro de Investigação em Biodiversidade e Recursos Genéticos
Campus Agrário de Vairão, 4485-661, Vairão, PORTUGAL
Herpetología, Dep. Biología Animal, Fac. Biología, Univ. de Barcelona,
Av. Diagonal 645, 08015, Barcelona, SPAIN
antigoni@mail.icav.up.pt

Kapli, Paschalia
Natural History Museum of Crete, University of Crete, Knosos Ave,
P.O.Box 2208, 71409 Irakleio, Crete, Greece
Department of Biology, University of Crete, Vassilika Vouton, P.O.Box 2208, 71409 Irakleio, Crete, Greece

Khosravani, Azar
Department of Biology, Faculty of Science, Razi University, 67149 Kermanshah, Iran

Kotsakiozi, Panayiota
Section of Human and Animal Physiology, Department of Biology,
University of Athens, Panepistimioupolis 157-84, Athens, Greece
pkotsakiozi@hotmail.com

Krofel, Miha
Dept. of biology, University of Ljubljana,
Večna pot 111, SI-1001 Ljubljana
Societas herpetological slovenica,
Večna pot 111, SI-1000 , Ljubljana
miha.krofel@gmail.com

Kyriazi, P.
Natural History Museum of Crete, University of Crete, Knosos Ave, P.O.Box 2208, 71409 Irakleio, Crete, Greece
Department of Biology, University of Crete, Vassilika Vouton, P.O.Box 2208, 71409 Irakleio, Crete, Greece

Larbes, Said
Département de Biologie, Faculté des Sciences Biologiques et Agronomiques,
Université M. Mammeri. Tizi-Ouzou, Algérie
CIBIO, Centro de Investigação em Biodiversidade e Recursos Genéticos
Campus Agrário de Vairão, 4485-661, Vairão, Portugal.

Legakis, Anastasios
Zoological Museum, Dept. of Biology, University of Athens,
Panepistimioupolis, GR-15784, Athens, Greece
alegakis@biol.uoa.gr

Lima, Alexandra
CIBIO Centro de Investigação em Biodiversidade e Recursos Genéticos,
Campus Agrário de Vairão, 4485-661 Vairão, Portugal,
Departamento de Zoologia-Antropologia, *Faculdade de Ciências da Universidade do Porto, 4099-002 Porto, Portugal.*
allima@gmail.com

Llorente, Gustavo A.
Herpetología, Dep. Biología Animal, Fac. Biología, Univ. de Barcelona,
Av. Diagonal 645, 08015, Barcelona, SPAIN

Lluch, Javier
Department of Zoology, University of Valencia

Losos Jonathan
Museum of Comparative Zoology and Department of Organismic and Evolutionary Biology, Harvard University, Cambridge, MA, USA

Lymberakis, Petros
Natural History Museum of Crete, University of Crete, Knosos Ave, P.O. Box 2208, 71409 Irakleio, Crete, Greece
lyberis@nhmc.uoc.gr
Mann, R.M.
Cesam & Department of Biology,
University of Aveiro, 3810-193 Aveiro, Portugal

Meiri, Shai
NERC Centre for Population Biology, Imperial College London, Silwood Park, Ascot, Berkshire, SL57PY, UK
s.meiri@imperial.ac.uk

Meulepas, Greet
Department of Biology, University of Antwerp,
Universiteitsplein 1, B-2610 Antwerpen

Mihoci, Iva
Croatian Natural History Museum
Demetrova 1, HR-10000 Zagreb, Croatia

Nappi, Armando,
Associazione Vivara Amici delle Piccole Isole,
Piazza Riario Sforza 159, I-80139 Napoli, Italy

Navarro, Pilar
Department of Zoology University of Valencia
valentin@usal.es

Nikolouzou, Eleftheria
Section of Human and Animal Physiology, Department of Biology, University of Athens, Panepistimioupolis 157-84, Athens, Greece

Ortega, Zaida
Department of Animal Biology, University of Salamanca, Spain

Pafilis, Panayiotis
School of Natural Resources and Environment, Dana Hall, 440 Church St., University of Michigan, Ann Arbor, MI 48109-1041, USA.
Modern Greek Program, Department of Classical Studies, 2160 Angell Hall, 435 S. State,University of Michigan, Ann Arbor, MI 48109-1115, USA
pafman@umich.edu

Perera, Ana
CIBIO, Centro de Investigação em Biodiversidade e Recursos Genéticos Campus Agrário de Vairão, 4485-661 Vairão, Portugal
perera@mail.icav.up.pt

Pérez-Mellado, Valentín
Department of Animal Biology, University of Salamanca, Spain
valentin@usal.es

Picornell, A.
Laboratori de Genètica. Universitat de les Illes Balears. Palma de Mallorca. Spain

Pinho, Catarina
CIBIO, Centro de Investigação em Biodiversidade e Recursos Genéticos, Campus Agrário de Vairão, 4485-661, Vairão, Portugal.

Planinc, Griša
Župančičeva 30,SI- 6330 Piran, Slovenia
Societas herpetological slovenica
Večna pot 111, SI-1000 Ljubljana
grisa.planinc@guest.arnes.si

Poulakakis, Nikos
Natural History Museum of Crete, University of Crete, Knosos Ave, P.O.Box 2208, 71409 Irakleio, Crete, Greece
Department of Biology, University of Crete, Vassilika Vouton, P.O.Box 2208, 71409 Irakleio, Crete, Greece

Ramon, M.M.
Laboratori de Genètica. Universitat de les Illes Balears. Palma de Mallorca, Spain
cori.ramon@uib.es.

Rastegar-Pouyani, Nasrullah
Department of Biology, Faculty of Science, Razi University, 67149 Kermanshah, Iran
nasrullah.r@gmail.com

Ribeiro, R.
CIBIO, Centro de Investigação em Biodiversidade e Recursos Genéticos, Portugal .

Departament de Biologia Animal (Vertebrats), Facultat de Biologia, Universitat de Barcelona, Spain

Roca, Vicente
Departament de Zoologia, Facultat de Ciències Biològiques, Universitat de València. Dr. Moliner, 50. 46100 Burjassot, Spain
Vicente.Roca@uv.es

Rodriguez, V.
Laboratori de Genètica. Universitat de les Illes Balears. Palma de Mallorca, Spain

Runemark, Anna
University of Lund, Sweden
Anna.Runemark@zooekol.lu.se

Sagonas, Kostas
Section of Human and Animal Physiology, Department of Biology, University of Athens, Panepistimioupolis 157-84, Athens, Greece

Salvi , Daniele
Department of Biology, University "Roma Tre",
Viale G. Marconi 446, 00146 Rome, Italy
salvi@uniroma3.it

Sfendourakis, Spyros
Section of Animal Biology, Department of Biology, University of Patras, Patra, Greece
sfendo@upatras.gr

Sillero, N.Cicge,
Centro de Investigação em Ciências Geo-Espaciais; Universidade do Porto, Departamento de Matemática Aplicada,
Rua do Campo Alegre, 687, 4169-007 Porto, Portugal

Simou, Chrisa
Section of Human and Animal Physiology, Department of Biology, University of Athens, Panepistimioupolis 157-84, Athens, Greece

Skela, Ariadni
Biodiversity Conservation Laboratory, Department of Environmental Science, University of the Aegean

Soares, A.M.Y.V.
Cesam & Department of Biology,
University of Aveiro, 3810-193 Aveiro, Portugal

Spaneli, Vassia
Natural History Museum of Crete, Knossou Av., PO Box 2208, 71409 Irakleio, Greece
University of Crete, Department of Biology, Heraklion, Greece
vassiaspan@yahoo.gr

Stepanyan , Ilona
Institute of Zoology of National Academy of Science of Armenia,
P. Sevak 7, Yerevan 0014, Armenia
ilona_e_68@mail.ru

Svensson, Erik I.
University of Lund, Sweden

Terrasa, B.
Laboratori de Genètica, Universitat de les Illes Balears, Palma de Mallorca, Spain

Trilar, Tomi
Pridoslovni muzej Slovenije, Prešernova 20, SI-1000 Ljubljana, Slovenia

Triantis, Kostas
Biodiversity Research Group, Oxford, University Centre for the Environment, Oxford, UK
cenv0030@herald.ox.ac.uk

Tsasi, Gerasimia
Section of Human and Animal Physiology, Department of Biology, University of Athens, Panepistimioupolis 157-84, Athens, Greece

Tsitsiloni, Rania
Section of Human and Animal Physiology, Department of Biology, University of Athens, Panepistimioupolis 157-84, Athens, Greece

Valakos, Stratis

Section of Human and Animal Physiology, Department of Biology,
University of Athens, Panepistimioupolis 157-84, Athens, Greece
evalakos@biol.uoa.gr

Van Damme, Raoul
Department of Biology, University of Antwerp,
Universiteitsplein 1, B-2610 Antwerpen

Vanhooydonck, Bieke
Department of Biology, University of Antwerp,
Universiteitsplein 1, B-2610 Antwerpen
bieke.vanhooydonck@ua.ac.be

Villa, Alejandro
Department of Animal Biology, University of Salamanca, Spain

Žagar, Anamarija
Ul. Bračičeve brigade 10, SI-2310 Slovenska Bistrica, Slovenia
Societas herpetological slovenica
Večna pot 111, SI-1000 Ljubljana

Zotos, Savvas
Zoological Museum, Dept. of Biology, University of Athens,
Panepistimioupolis, GR-15784, Athens, Greece
savvaszotos@care2.com