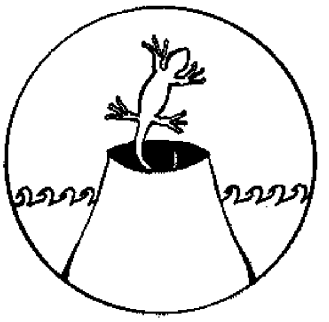
Fifth International Symposium on the Lacertids of the Mediterranean Basin



Lipari, Aeolian Islands, Sicily, Italy
7-11 May 2004

Abstracts

Edited by

Claudia Corti and Pietro Lo Cascio

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In September 1989, at the First World Congress of Herpetology in Canterbury, a group of herpetologists decided to organise a periodical scientific meeting focused on the Mediterranean lacertid lizards. This idea was concretised about three years later in Mytilini, by the "First International Symposium on the lacertids of the Mediterranean Basin". During the following editions the Symposium got more and more successful, becoming a meeting point for a number of specialists devoted to the study of the biology, ecology, zoogeography, genetics, taxonomy, systematics and phylogeny of this group of reptiles.

After Greece (1992), Portugal (1995), Croatia (1998) and Spain (2001), this Symposium will now take place in Italy for the first time. The choice of Lipari Island as the meeting venue is not casual: the Aeolian Archipelago is inhabited by an endemic, and one of the most threatened, Mediterranean lacertid lizard.

The study of the Mediterranean lacertid lizards represents a key point for understanding the mechanisms regulating the evolution of the Mediterranean's ecosystems and in particular those ones related to islands. Conservation of biodiversity is the main target that such a knowledge significantly contributes to fulfil.

We are very pleased for having organised this Symposium, and we are sincerely grateful to all the participants who contributed to achieve such an remarkable scientific standard through their contributions.

Lipari, April 2004

Claudia Corti and Pietro Lo Cascio

Fifth International Symposium on the Lacertids of the Mediterranean Basin

Programme

Friday, 7 May 2003

9.00-12.00 – Reception and registration of participants at Nesos (Corso Vittorio Emanuele, 2)

13.00 – Welcome cocktail at Nesos' garden

16.00 – Opening ceremony at the Archaeological Regional Aeolian Museum

1st Session
Chairman: V. Pérez-Mellado and E. Valakos

16.30 – Plenary lecture: E. N. Arnold – "Using other insular reptiles to help understand island lacertids"

17.30-18.00 – Coffee break

18.00 – E. S. Roitberg & E. M. Smirina – "Geographic variation in sexual size dimorphism in the Sand Lizard, *Lacerta agilis*"

18.30 – Setting up of posters (at the Archaeological Museum)

Saturday, 8 May 2004

2nd Session
Chairman: E.N. Arnold and M. A. Carretero

10.00 – Plenary lecture: D. J. Harris, C. Pinho & N. Ferrand – "Iberian *Podarcis*: delimiting species boundaries"

11.00-11.30 – Coffee break

11.30 – M. Ferreira, V. Proenca, B. Perraud, A. C. Luz & L. Vicente – "The use of space by *Podarcis carbonelli berlengensis*"

12.00 – A. C. Luz, C. Monasterio & L. Vicente – "Microhabitat selection in *Podarcis carbonelli berlengensis*"

12.30 – M. Ferreira, V. Proenca, P. Antunes, R. Barbault & L. Vicente – "A long-term study on the demography of *Podarcis carbonelli berlengensis* on the Island of Berlenga"

13.00-15.30 – Lunch

3rd Session.
Chairman: M. Capula and L. Vicente

15.30 – Plenary lecture: V. Pérez-Mellado & N. Riera – "Unique interactions of insular lizards and plants. The case of the Dead Horse Arum (*Dracunculus muscivorus*) and the Balearic Lizard (*Podarcis lilfordi*)"

16.30-17.00 – Coffee break

17.00 – D. J. Harris & V. Batista – "Across the Straits of Gibraltar: three lacertid lizards tell three different stories"

17.30 – Poster Session "1"

Sunday, 9 May 2004

Excursion by boat to Salina Island: visit to the Protected Area of "Monte Fossa delle Felci e dei Porri" and Scoglio Faraglione Islet.

Monday, 10 May 2004

4th Session.
Chairman: D. J. Harris and E. Roitberg

10.00 – Plenary lecture: M. A. Carretero – "Reproductive cycles in Mediterranean lacertids: plasticity and constraints"

11.00-11.30 – Coffee break

11.30 – N. P. Zhdanova & V. M. Zakharov – "Developmental stability of Sand Lizard (*Lacerta agilis* L.) under optimal and non-optimal conditions in experiment and in natura"

12.00 – D. Hawlena, A. Bouskila & Z. Abramsky – "Blue tail and striped body: why growing-up lizards change their infant costume?"

12.30 – Photo (in front of the Archaeological Museum)

13.00-15.30 – Lunch

5th Session.
Chairman: M. Mylonas and J. Moravec

15.30 – Plenary lecture: M. Capula – "Population heterogeneity and_conservation concerns for *Podarcis raffonei*, a critically endangered Mediterranean lacertid lizard"

16.30 – Coffee break

17.00 – E. N. Arnold – "The morphological context of current research on Mediterranean lacertid lizards"

17.30 – Special lecture: L. Vicente – "Millennium Ecosystem Assessment. Information to conserve ecosystems and enhance human well-being"

18.00 – Round table

22.00 – Concert

Tuesday, 11 May 2004

6th Session.
Chairman: W. Mayer and P. Lymberakis

10.00 – G. Sideris & K. Jasper – "Inherent divergence revealed in genetic variation among mtDNA sequences from three populations of *Ophisops elegans* in Psarà, Greece"

10.30 – M. Arakelyan – "Comparison of parasitic infestation in parthenogenetic and bisexual species of rock lizards"

11.00 – Poster session "2"

12.30 – Closing ceremony

20.30 – Farewell Party

Poster Session "1"

1) M. Ferreira, V. Proenca, L. Vicente: A record of melanism in *Podarcis carbonelli berlengensis*

2) P. Lo Cascio, C. Corti: The micro-insular distribution of the genus *Podarcis* within the Aeolian Archipelago: a possible historical interpretation

3) A. C. Luz, C. Monasterio, L. Vicente: Compared morphology of two insular *Podarcis carbonelli berlengensis* populations

4) P. Lymberakis, E. Valakos, A. Kaliontzopoulou, N. Poulakakis, C. Kassara, M. Mylonas: Quantitative and meristic morphological characters reflect distinct aspects of the evolutionary history of *Podarcis erhardii* (Bedriaga 1876)

5) W. Mayer, J. Moravec, M. Pavličev: Differentiation within Syrian populations of the lizard *Mesalina brevirostris*

6) C. Pinho, C. Corti, M. A. Carretero, D. J. Harris: Genetic variability within *Podarcis tiliguerta*: preliminary evidence from 12s rRNA gene sequences

7) N. Poulakakis, P. Lymberakis, E. Valakos, P. Pafilis, E. Zouros, M. Mylonas: Aspects of the evolutionary history of *Podarcis taurica* (Pallas 1814), *P. gaigeae* (Werner 1930) and *P. milensis* (Bedriaga 1882) in Greece.

8) Z. Volaki, M. Skopeliti, O. Tsitsilonis, P. Pafilis, E. D. Valakos: A novel approach to the phylogenetic study of *Lacertidae*: correlation of immunological responses with morphological characteristics

Posters Session 2

9) C. Adamopoulou, S. Zotos, A. Legakis: Spatial organization of a population of *Podarcis milensis*

10) G. Aloise, M. Cagnin, E. Sperone, S. Tripepi: The relative abundance of lacertids of the genus *Podarcis* along an ecological-altitudinal transect (Calabria, Italy)

11) D. Barbosa, E. Desfilis, M. A. Carretero, E. Font: Chemically-mediated species recognition in *Podarcis* lizards

12) M. Biaggini, E. Paggetti, P. Bazzoffi, R. Brizzi, C. Corti: Conservation of the lacertid lizard diversity in agro-ecosystems

13) T. Bonacci, G. Aloise, M. Cagnin, P. Brandmayr, T. Zetto Brandmayr: The predatory behaviour of *Podarcis sicula* (Rafinesque-Schmaltz 1810) in captivity: preliminary data

14) M. A. Carretero, E. Marcos, P. De Prado: Intraspecific variation of preferred temperatures in the ne form of *Podarcis hispanica**

15) M. A. Carretero, A. Perera, D. J. Harris, V. Batista, C. Pinho: Oukaïmeden: spring aspect of the diet in an alpine lizard community

16) F. Graziani, R. Berti, R. Brizzi, L. Dapporto, C. Corti: *Podarcis* populations in agri-environment of Tuscany: the role of olive tree plantations

17) A. Kaliontzopoulou, G. Llorente, M. A. Carretero, C. Llorente: Morphology and reproduction of a population of *Podarcis hispanica* in Barcelona

18) P. Lo Cascio, L. Luiselli, C. Corti: Preliminary data on the ecology of *Podarcis filfolensis* of Lampione Islet (Pelagie Archipelago, Channel of Sicily)

19) P. Pafilis, J. Foufopoulos, P. Lymberakis, N. Poulakakis, C. Simou, E. D. Valakos: Relationships between predation pressure, tail loss performance and energetics of post-autotomy movement in continental and insular populations

20) A. Perera, M. A. Carretero, D. J. Harris, V. Pérez-Mellado: Site variation in the diet of the Mediterranean lizard *Lacerta perspicillata*

21) E. Sperone, A. Bonacci, S. Tripepi: Distribution and ecological preferences of lacertids in Calabria

Contents

SPATIAL ORGANIZATION OF A POPULATION OF *PODARCIS MILENSIS*

Chloe Adamopoulou, Savvas Zotos, Anastasios Legakis

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Key words: home range, mating system, territorial behavior, insular.

The spatial organization of a population of the endemic lacertid *Podarcis milensis* was studied from May to October, in a sandy, back-dune ecosystem on Milos island (Aegean Archipelago, Greece).

Male/female home range ratio was 1.67. Each male overlapped with up to 6 females, while each female with up to 5 female neighbours closely spaced. Female home ranges were overlapped extensively by male home ranges, up to 100% of their range. Both males and females maintained high fidelity to the same home ranges from season to season.

Our data indicate male territorial behavior in this population. Behavioural observations in the field support the above. Males defended territories from intruders even during October. Results are discussed within the context of the specific study system.

THE RELATIVE ABUNDANCE OF LACERTIDS OF THE GENUS *PODARCIS* ALONG AN ECOLOGICAL-ALTITUDINAL TRANSECT (CALABRIA, ITALY)

Gaetano Aloise, Mara Cagnin, Emilio Sperone, Sandro Tripepi

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Key words: *Podarcis*, ecological-altitudinal transect, relative abundance.

There are many environmental factors determining the distribution of lacertids and it is not always easy to understand the specific role of each of them. For this purpose, seventy-five sampling stations in Calabria, situated along an ecological altitudinal transect linking the Ionian and Thyrrhenian slopes, have been considered.

The main biotopes are represented in the transect, these were characterized by bioclimate and by the vegetation cover defined by type, by structure and by the percentage of tree cover.

Pitfall traps, checked monthly, have been used for a sampling throughout the year.

The use of this methodology allowed the evaluation of the relative abundance of the lizards belonging to the genus *Podarcis* in different environments and in relation with the different parameters considered.

The results show a close relationship between lizard relative abundance and some factors, such as bioclimate, vegetation, altitude, season, soil solar irradiation and percentage of tree cover.

It is worth to note that the abundance considerably decreases in proportion to a growing percentage of the tree cover.

Moreover, evident winter activity was observed for the populations living at low altitudes, especially for those living near the large seasonal streams ("fiumare").

COMPARISON OF PARASITIC INFESTATION IN PARTHENOGENETIC AND BISEXUAL SPECIES OF ROCK LIZARDS

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Key words: parthenogenesis, genus *Darevskia*, parasitic infestation.

The reason for the predominance of sexual over asexual modes of reproduction remains one of the major outstanding problems in evolutionary biology.

A total of 153 adult females belonging to three parthenogenetic species of genus *Darevskia* (*D. armeniaca, D. unisexualis, D. dahli*) and 143 individuals belonging to three bisexual species (*D. valentine, D. nairensis, D. portschinskii*) from 4 sympatric populations was collected in Armenia for comparison of parasitic infestation. Among studied samples the infection by mites compose 21% and 49%, infection by helminth 6 % and 37% and infection by blood parasites 51% and 91% respectively for parthenogenetic and bisexual lizards, respectively. Our results contradict "Red Queen hypothesis" (Van Valen 1976). One of the consequences of the Red Queen principle suggests that sexual reproduction is maintained in populations because of the need to continually create genotypes that confer resistance against rapidly evolving pathogens and parasites. However, comparative susceptibility of parthenogenetic and sexual ancestral species of rock lizards to parasitic infection in areas of their sympatry show that bisexual species of rock lizards have higher level of mites, helminth and protozoan parasites, than parthenogenetic lizards. Moreover, in some sympatric zones, the parthenogenetic species tend to surpass in number the sexual ones.

The comparative study of parasitic infestation in parthenogenetic and bisexual species of rock lizards need in future research.

THE MORPHOLOGICAL CONTEXT OF CURRENT RESEARCH ON MEDITERRANEAN LACERTID LIZARDS

Nick Arnold

Natural History Museum, Cromwell Road, London SW7 5BD, United Kingdom.

Key words: Lacertidae, Mediterranean habitats, morphotypes.

The earliest studies of lacertid lizards were mainly morphological. Understandably, they were followed by a shift towards research on phylogeny, ecology and behaviour in their broadest senses. Nonetheless, it is often helpful to consider such process-based phenomena in a morphological context. For example, a knowledge of functional morphology suggests new problems to study and new approaches to existing ones. To provide a context for such insights, the anatomy of lacertids will be reviewed, contrasting the two broad morphotypes in the family. These are: 1. A very widespread, primitive morphotype associated with relatively mesic habitats and a degree of climbing; and 2. A derived morphotype associated with ground-dwelling in xeric situations that is confined to advanced Eremiainae and represented in the Mediterranean area by *Acanthodactylus*, *Ophisops* and *Mesalina*. Organ systems that will be considered include the nasal tract, eye and orbit, skull, pharynx, thoracic and abdominal regions, digestive tract, genitalia, tail, scaling, and scale micro-ornamentation. Although the primitive morphotype has been in Europe throughout the Neogene and earlier, it appears to be an efficient adaptive solution to the predominant niche space found there. One reason for the persistence of this morphotype is that 'minor' anatomical features critical to exploiting different niches are very labile on evolutionary time scales and so are fine-tuned by natural selection, even though most anatomy does not change much. These features include limb, digit and head proportions, development of cranial osteoderms and scale shape. Relative constancy in other morphological features implies that other changes in niche and apparent repeated replacement of clades over time may be based on non-morphological attributes.

USING OTHER INSULAR REPTILES TO HELP UNDERSTAND ISLAND LACERTIDS

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Natural History Museum, Cromwell Road, London SW7 5BD, United Kingdom.

Key words: Lacertidae, Mediterranean islands, evolution.

Many lacertids occur on islands including *Gallotia* in the Canaries, *Lacerta dugesii* on Madeira etc., and *Podarcis* and *Lacerta* in the Mediterranean. Their evolutionary history often appears to differ from other well studied island groups, such as West Indian *Anolis*. To find closer parallels it is necessary to increase the range of taxonomic groups and island systems considered. For example, the three main Mascarene islands had no less than 34 reptile species derived from a minimum of eight colonists which arrived from two directions, sometimes travelling over 5000 km. Considerable ecological and morphological diversification occurred, and anti-predator mechanisms were often reduced in the absence of many enemies. Probably because of this, most endemic reptiles declined catastrophically when exotic animals were introduced, becoming extinct or confined to offshore islets. Processes ranged from direct predation to competition. There was also diversification in the Cape Verdes (3 colonists, over 20 species) and the Canaries (3 colonists, 15 species), but decline after human colonisation was far less, being largely confined to a few large-bodied forms. Groups also vary in their detailed dispersal patterns within archipelagos, and how presence of more than one distinctive species on a single island arises. Intra-island speciation, island fusion and multiple invasion by already differentiated species all occur, but there is little evidence for character displacement after the arrival of two similar species. Many of the above phenomena are found in island lacertids, with considerable variation among taxa. Mediterranean forms are distinctive in showing no evidence of speciation and divergence within island situations.

CHEMICALLY-MEDIATED SPECIES RECOGNITION IN *PODARCIS* LIZARDS

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Key words: *Podarcis carbonelli*, *P. bocagei*, mating patterns, chemical recognition.

In some species complexes, such as the *Podarcis* genus in the Iberian Peninsula, features other than morphology may be important in order to identify cryptic species. It is increasingly recognised that, in species with well developed chemosensory systems, chemical recognition may play an important role in reproductive isolation and the maintenance of the species gene pool. Here we describe the results of an experiment designed to evaluate the possible role of chemical stimuli in the mating patterns of two syntopic *Podarcis* species which were considered conspecific until very recently: *P. carbonelli* and *P. bocagei*. Animals were collected in coastal areas of Northern Portugal during May 2003 and experimental trials were performed in June 2003 at the University of Valencia. Trials consisted of putting the lizards either in a clean test terrarium (control) or in a test terrarium previously occupied (and thus chemically marked) by a conspecific female or a heterospecific female. There were significant differences between the number of tongue flicks directed at the terrarium floor between conspecific and heterospecific stimuli. Our results suggest that chemical discrimination can account for the apparent reproductive isolation between *P. carbonelli* and *P. bocagei*.

CONSERVATION OF THE LACERTID LIZARD DIVERSITY IN AGRO-ECOSYSTEMS

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Key words: Lacertidae, Italy, agri-ecosystem.

Our study was performed in the Valdera area, central Tuscany, in both organic and traditional farms. This area is highly subjected to anthropic pressure and the landscape is dominated by wide arable land. The land use is characterised by intensive agriculture, but forested areas are also present.

This study is part of a wider research on animal diversity, which also includes arthropods, amphibian and micro-mammals.

For the present work only lacertid lizards have been considered. The aim was to provide suggestions for the maintenance of the lizard diversity in cultivated areas. Therefore we have tried to determine if there are significant differences in the presence of these reptiles depending on the different microhabitats occuring in agricultural land. The following habitats have been surveyed: meadows, grass stripes, cultivated stripes, riparian habitat, intensive culture fields, forest patches.

The obtained data derive from: lizards occasionally fallen into pitfall traps devoted to arthropod capture and water tanks devoted to hydrological observation, and direct field observations.

All the three Lacertid lizard species present in Tuscany (*Podarcis sicula, P. muralis, Lacerta bilineata*) have been recorded according to a pattern highly related to the microhabitat characteristics.

As a rule in agricultural habitats, *P. sicula* is the most abundant species. It has been mainly found in meadows and in grass stripes between the cultivated fields; it has been also recorded in the cultivated stripes and in the riparian habitat, even if in a smaller quantity. *P. muralis* is relatively less abundant than *P. sicula*, although it has been found in five of the six studied habitats where shrubs or structures like walls and small bridges were present. The common wall lizard was in any case found only along the marginal zones but never observed inside the fields. In the forested area only *P. muralis* occurs. *Lacerta bilineata*, as expected, is less abundant than the two other species and is strictly linked to the meadow and riparian habitats provided by dense grass vegetation cover.

These data suggest how important is the maintenance of ecotonal zones in agricultural land, such as hedgerows, uncultivated field stripes and grass soil cover. The coexistence of these different habitats assures the maintenance of local lacertid diversity.

THE PREDATORY BEHAVIOUR OF *PODARCIS SICULA* (RAFINESQUE-SCHMALTZ 1810) IN CAPTIVITY: PRELIMINARY DATA

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Key words: *Podarcis sicula*, predatory behaviour, laboratory data.

Specimens of *Podarcis sicula* were tested to analyse the predatory behaviour. Lizards were collected by hand in the field (Cosenza Province, Italy). Tests were carried out individually and using the same species of ground beetles as prey model. The trials ran from mid-March to mid-June 2003 for a total of 1980 minutes. Aposematic and non aposematic species have been used as prey, the first also displaying chemical defences. The latency of attack, the number of attacks and whether the carabid beetles were killed or refused was recorded. The tested lizards responded with similar behavioural patterns to each prey. We recorded interesting lizard's behavioural pattern during their attacks to dangerous preys. After some negative experiences, *Podarcis sicula* showed an exceptional behavioural plasticity, learning to limit, with special repertoire, the effects of chemical secretions of some species (species with "warning characteristics") and avoiding those preys which were particularly dangerous. Namely, lizards displayed a behavioural adaptability, with different kinds of attack for prey types.

POPULATION HETEROGENEITY AND CONSERVATION CONCERNS FOR *PODARCIS RAFFONEI*, A CRITICALLY ENDANGERED MEDITERRANEAN LACERTID LIZARD

Massimo CAPULA

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Key words: *Podarcis raffonei*, Lacertidae, allozyme electrophoresis, population heterogeneity, conservation, Aeolian Islands.

The conservation status of *Podarcis raffonei* (Mertens 1952), native to the Aeolian Islands (north-east of Sicily, Tyrrhenian Sea) (Capula 1994), was assessed evidencing factors affecting the survival of the species and studying its genetic structure by means of standard horizontal starch gel electrophoresis at 23 presumptive enzyme loci (α*Gpd*, *Ldh-1, Ldh-2*, *Mdh-1, Mdh-2*, *Me-1, Me-2*, *Idh-1, Idh-2, 6Pgd*, *Gapd*, *Sod-1*, *Np*, *Got-1, Got-2*, *Ck*, *Ak*, *Ada*, *Ca*, *Mpi*, *Gpi*, *Pgm-1, Pgm-2*) and three unidentified non-enzymatic proteins (*Gp-1, Gp-2, Gp-4*). Genetic variation in the species is quite low (mean number of alleles per locus, A = 1.05; mean proportion of polymorphic loci at the 99% level, P = 4.8; observed mean heterozygosity, H_o = 0.011), and genetic subdivision is high (standardized variance in gene frequency, F_{ST} = 0.610), as compared to other lacertid lizards and to vertebrates in general. Very little gene flow was detected (using the indirect method of Wright (1978), Nm = 0.157), implying little or no contact between populations. The four remaining populations of *P. raffonei* (Vulcano Island, Scoglio Faraglione Islet, La Canna Islet, Strombolicchio Islet) are under severe threat from the effects of: a) habitat alteration, b) interspecific competition, c) collecting and trade, d) inbreeding and very low population density, e) population fragmentation, f) apparent loss of genetic variation. *Podarcis raffonei* is to be categorised as critically endangered as it is facing an extremely high risk of extinction in the wild in the immediate future under the IUCN criteria B1 + 2. Possible management and conservation measures are suggested.

REPRODUCTIVE CYCLES IN MEDITERRANEAN LACERTIDS: PLASTICITY AND CONSTRAINTS

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Key words: reproduction, phenology, spermatogenesis, vitelogenesis, fat bodies, insularity, viviparity.

Reproductive timing is one of the most critical issues for the lacertids inhabiting temperate regions where favourable conditions are restricted seasonally. Cycles of gonads and associated lipidic reserves represent the manifestation of this discontinuous reproductive mode. Although lacertids seem to use both temperature and photoperiod to adjust their reproductive clocks to the environmental conditions, these cues seem to act at different stages of the cycle. Within species, interindividual, interpopulational and interannual variation have been documented. Thermal seasonality, changing between locations and years, determines not only the length of the reproductive season but also the intensity of variation for several reproductive parameters. Except in those species/populations with extremely short reproductive activity, lacertids are rather asynchronous, small adults starting reproduction earlier than large ones. In contrast, the end of the breeding period is less variable and probably associated with photoperiod.

Prior to all these factors, lipid storage of exceeding energy (fat bodies, tail, and carcass) is a necessary condition for beginning reproduction. Lipids peak in late summer or early autumn, are not depleted in winter and are consumed during the reproductive season. Males spent reserves earlier than females in the activities related with breeding (mate searching and guarding, agonistic interactions, copulation) and recover them soon after since mixed-type spermatogenesis distributes energy costs along a prolonged period. Just the final part of the process (spermiogenesis) is highly variable in time depending on the species/population although previous classifications based on it are simplistic. Females mainly behave as capital breeders investing lipids in developing an early (first) clutch but may act as income breeders for the subsequent clutches if any. The degree of iteroparity depends on the same factors but just within the species limits.

Some of the patters observed are, nevertheless, uncorrelated with abiotic environment and may reflect other pressures. Theoretically, any influence able to provoke food shortage would delay reproduction independently of climate conditions. At present, the only study specifically testing for competitive influences in reproductive cycle produced negative results. Finally, some traits could be historical deriving from pressures acting in the past. Long egg retention and viviparism (as adaptations to extreme cold environments) represent

strong constraints since they prolong single reproductive events preventing its repetition even when environmental conditions would allow it. In contrast, thermophilic species evolved under mild conditions are unable to start reproduction when and where other more cold-adapted species do. Finally, insular lacertids enlarge the reproductive period in comparison with their continental equivalents living under similar climate regimes but with different demographic pressures.

OUKAÏMEDEN: SPRING ASPECT OF THE DIET IN AN ALPINE LIZARD COMMUNITY

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Key words: trophic ecology, communities, *Lacerta perspicillata*, *Lacerta andreanszkyi*, *Podarcis hispanica**, *Quedenfeldtia trachyblepharus*, Morocco.

Oukaïmeden Plateau is a rich herpetological locality in the High Atlas Mountains (Morocco) situated at 2600 m. Four lizard species constituting this community are abundant and live in strict sympatry: three lacertids (*Lacerta perspicillata*, *Lacerta andreanszkyi* and *Podarcis hispanica**) and one gekkonid (*Quedenfeldtia trachyblepharus*). Here, we analyse the diet composition of this lizard community during the early spring.

A total of 132 faecal pellets were obtained by handling and could be individually assigned. Every lizard was measured (SVL), sexed and released. Prey items were identified to the Order level (except Formicidae) and intact prey parts were measured.

Prey taxa consumed by the four species show low overlap values (48-84%). *Q. trachyblepharus* consumed the highest prey number and showed the most distinct prey composition based mainly on Coleoptera (62.5%) of small size. This probably indicates consumption of aggregated prey. All three lacertid species had high but similar diet diversities at the population level, which were higher than in *Q. trachyblepharus*. However, our results did not reveal interspecific differences at the individual level. Within species, *P. hispanica** showed moderate taxonomic segregation between males and females (74% overlap) whereas the other species did not (> 94%). Juveniles did not differ extensively from adults regarding taxa eaten. Lizards consumed median prey sizes according to their SVL both at inter- and intraspecific level. The concordance between these dietary traits, the habitat selection and possible foraging strategies is discussed.

INTRASPECIFIC VARIATION OF PREFERRED TEMPERATURES IN THE NE FORM OF *PODARCIS HISPANICA**

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Key words: thermal ecology, preferred temperatures, sex variation, diel variation, pregnancy, *Podarcis hispanica**.

Once considered a single species, *Podacis hispanica** from the Iberian Peninsula, SE France and N Africa is, in fact, a complex of several forms. Ecophysiological traits previously investigated in one form may be no longer generalisable to the others. Preferred body temperature (Tp), in the absence of thermoregulatory constraints, correlates with several physiological optima in lacertids. Two kinds of Tp variability should be considered: among populations/species (evolutionary scale) and within a population (short time scale). Here, intraspecific variation of Tp within a population of the NE form of *P. hispanica** is analysed and compared with the literature.

Sixteen adults (9 males and 7 females) were collected in May 2000 from a thermomediterranean site (Bellaterra, Cerdanyola, NE Iberian). Each lizard was measured (SVL), weighed and exposed to a thermal gradient keeping the normal photoperiod for recording cloacal temperatures at 9 time intervals. Two of the females could be analysed before and after egg laying. Statistical analysis was based on ANOVA with class (sex or pregnancy) and time as time independent factors.

Results showed an overall Tp (pregnant females excluded) of 33.07 ± 0.27 ºC (26.0-37.3). Nevertheless, there was substantial variation with both class and time interval. Tp values were high in the early morning, decreased in the mid-morning, rose in the early afternoon and decreased again in the late afternoon. Males selected for higher temperatures than females and, in the two cases analysed, females decreased their Tp after egg-laying. Furthermore, Tp in males was positively correlated with body size.

Results corroborate previous studies demonstrating diel adaptability of Tp in lacertids and strong dependence on the individual's condition. Tp should be interpreted as a compromise between different pressures including gonadal changes, embryo development and social behaviour. Differences with the published results on the NW form of *P. hispanica** may also indicate changes at evolutionary level.

A RECORD OF MELANISM IN *PODARCIS CARBONELLI BERLENGENSIS*

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Key words: *Podarcis carbonelli berlengensis*, Lacertidae, melanism, Berlenga Islands.

Berlenga (9º 30' W, 39º 25' N) is the largest island (78.8 ha) of the Berlenga's archipelago and it is 5.67 nautical miles off the Portuguese continental coast, Northwest from Cape Carvoeiro, central Portugal.

The Berlenga's population of *Podarcis carbonelli berlengensis* is quite monomorphic, being constituted of large individuals (snout-vent length: 62.8 ± 3.7 mm in males and 57.6 ± 3.4 mm in females). The ventral coloration is always white to nacreous, with a dark spot on every scale. The gular region is intensely pigmented and the pre-anal scale always has a dark spot. Males have a green back with a black reticulated pattern and the flanks present a blue-turquoise pigmentation. The female's dorsal pattern is black stained brown with lighter and more or less marked dorsal-lateral stripes. Females do not have a blue pigmentation on the flanks.

We report the finding of the first melanic specimen in the population of *P. c. berlengensis* of Island of Berlenga. The specimen and place of capture are described.

The melanic individual was an adult female. The dorsal region was uniformly black, without any distinguishable pattern, the ventral region was lighter due to a grey coloration in the margin of the scales, and the snout and hind limb axillas were dark greyish.

A LONG-TERM STUDY ON THE DEMOGRAPHY OF *PODARCIS CARBONELLI BERLENGENSIS* ON THE ISLAND OF BERLENGA

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Key words: *Podarcis*, Lacertidae, density, demography, insularity, Berlenga.

Berlenga (9º 30' W, 39º 25' N) is the largest island (78.8 ha) of the Berlenga's archipelago and it is 5.67 nautical miles off the Portuguese continental coast, Northwest from Cape Carvoeiro, central Portugal.

The Berlenga Carbonell Wall Lizard *Podarcis carbonelli berlengensis* is an endemic insular subspecies, which occurs in Berlenga Archipelago and at the nearby mainland.

Long-term studies are very important to the understanding of population dynamics. Moreover, they provide useful information for scientifically based conservation management strategies.

The Berlenga's population of *P. c. berlengensis* has been studied since 1985. Data on the demography of the population is presented for some years. The population has very high densities, compared to mainland populations of the species *Podarcis*. Density decreased in the first period of the study and a posterior increase was observed in the only study area followed for the past ten years. Results also show a decrease in the proportion of subadults. The sex ratio was aproximately 1:1. The evolution of the population is discussed and confronted with the major changes in the ecosystem. Studies in other areas of the Island are urgently needed.

THE USE OF SPACE BY *PODARCIS CARBONELLI BERLENGENSIS*

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Key words: *Podarcis*, Lacertidae, space use, Berlenga Island.

Berlenga (9º 30' W, 39º 25' N) is the largest island (78.8 ha) of the Berlenga's archipelago and it is 5.67 nautical miles off the Portuguese continental coast, Northwest from Cape Carvoeiro, central Portugal.

The Berlenga Carbonell Wall Lizard *Podarcis carbonelli berlengensis* is an endemic insular subspecies, which occurs at the Berlenga's archipelago and at the nearby mainland.

The study of the use of space by animals constitutes in some cases a first step and in most cases an important approach to the understanding of their ecology and behaviour.

In this study we use capture points and home range estimations. We report data from fieldwork from several years, from 1985 to 2003. Space use variation in time is studied. Space use and individual characteristics (body size, sex, age) relationships are also analysed. Furthermore, we analyse social structure and mating strategies from space use information.

Podarcis POPULATIONS IN AGRI-ENVIRONMENT OF TUSCANY: THE ROLE OF OLIVE TREE PLANTATIONS

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Key words: *Podarcis*, agri-environment, conservation, Tuscany.

Olive tree plantations are traditional cultures in Tuscany. The fields located on hilly areas are mainly disposed on terraces supported by dry stone walls. Old olive trees are characterised by large and open trunks that offer suitable habitat for many Arthropods and small Vertebrates. *Podarcis sicula* and *P. muralis* have been often observed on olive trees. In order to evaluate the role of these trees in the ecology of these lizards, we started to monitor the behaviour of both species in two fields located on the western slope of an hilly area North off Florence. The two fields are next each other but they differ in soil cover. Field 1 is covered by grass almost all over the year, while Field 2 gets ploughed during the early spring season. Field 1 is more shaded as compared to Field 2 in which the distance between the trees is also larger. The lizards have been recorded in: early spring (air T 15-24 °C), late spring (air T 19-30 °C), summer (air T 21- 35 °C) and fall (air T 20-26 °C).

Preliminary results show that at least during the warm seasons (late spring and summer) both species prefer the olive trees instead of the stone walls. *P. sicula* prefers the more open field (2) while the Common Wall lizard prefers the more shaded one (1).

During the cooler seasons, in Field 1 *P. muralis* prefers the stone walls, while in Field 2 it seems that trees are preferred; an opposite trend has been observed for *P. sicula*, that in Field 2 seems to prefer the stone wall.

Following our results, the olive trees are the substratum on which mainly both lizard species have been observed during their activity.

The association olive tree-stone wall seem to be very important for the maintenance of both *Podarcis* species in agro-ecosystems in Tuscany. Therefore land use conversion would results in loss of lizard diversity.

ACROSS THE STRAITS OF GIBRALTAR: THREE LACERTID LIZARDS TELL THREE DIFFERENT STORIES

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Key words: biogeography, *Psammodromus algirus*, *Podarcis hispanica*, *Acanthodactylus erythrurus*.

Biogeographical studies often focus on groups of organisms that occur on both sides of a geographical barrier of a known age. Fragmentation of the population by the barrier may have led to genetic differentiation and eventually speciation, and such barriers allow these processes to be studies within a known time frame. The Strait of Gibraltar is one such case. However for such studies sister taxa on both sides of the barrier need to be identified, as well as taxa that are likely to have divided before or after the establishment of the Strait. We present phylogeographic data for three lacertid lizards that are found on both sides of the Strait – *Psammodromus algirus*, *Podarcis hispanica* and *Acanthodactylus erythrurus*. All three show significantly different phylogeographic patterns, indicating that they have not been affected equally by the opening of the Straits. This has also been shown for other non-lacertids in the region. Our results emphasise the biogeographic complexity of the region, and the need for caution in using such geological features as calibration points in phylogenetic studies.

IBERIAN *PODARCIS*: DELIMITING SPECIES BOUNDARIES

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Key words: *Podarcis*, phylogenetic relationships, Iberian Peninsula, North Africa.

Phylogenetic relationships between species and morphotypes of *Podarcis* Wall lizards from the Iberian Peninsula and North Africa were estimated using an enlarged mitochondrial DNA sequence data set and allozyme variation. All species except *Podarcis hispanica* form monophyletic units. *P. hispanica* is paraphyletic with respect to *P. bocagei*, *P. carbonelli* and *P. atrata* and appears to be a species complex. There is a high degree of congruence between morphotypes and lineages identified by the different markers, but with some exceptions. Our enlarged mtDNA data set now gives strong support for relationships between lineages, something that had previously been missing. We also report a new genetic lineage of *Podarcis*, indicating that despite our extensive sampling, more work is needed. The data suggest multiple genetically distinct lineages have invaded North Africa at different times. Hypotheses to explain the high degree of genetic variation and the causes for discrepancies between data sets will be discussed.

BLUE TAIL AND STRIPED BODY: WHY GROWING-UP LIZARDS CHANGE THEIR INFANT COSTUME?

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Key words: ontogeny, antipredatory behaviour, foraging activity, autotomy, parasematism, lizards, *Acanthodactylus beershebensis*.

Ontogenetic changes in colour and pattern that are not directly related to reproduction are very common among many taxa, yet, this still is a poorly studied phenomenon. One example is conspicuous colours in the tails of fish, amphibians and reptiles that fade out later in life, raising the question: Why juveniles evolved these colours, exposing themselves to increased predation risk. Few studies that explored this question manipulatively tested the adaptive value of the conspicuous tails in juveniles. We took a different direction, focusing on the reasons for the subsequent loss of colour and we deal with the alteration in body pattern too. We observed the blue tailed, newly hatched *Acanthodactylus beershebensis* in the field and compared five parameters of their behavior to that of older individuals that already lost their neonate coloration. The striped blue-tailed hatchlings foraged more actively than the three weeks old juveniles and spent longer time in the open microhabitat. The results suggest that an alteration in activity may be a major factor affecting the ontogenetic colour and pattern change. Active lizards that forage in open habitat increase their probability to be attacked by ambush predators. As a result, conspicuous colours that may deflect the predator attack to the expendable tail may increase the prey probability to survive the attack. The results supports the cited relationship between striped pattern and active foraging and thus may suggest that our explanation may be appropriate for many other species that have conspicuous tail accompanied by a striped pattern.

MORPHOLOGY AND REPRODUCTION OF A POPULATION OF *PODARCIS HISPANICA* IN BARCELONA

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Key words: *Podarcis hispanica*, morphology, reproductive biology, life cycle.

Podarcis hispanica is a lacertid lizard distributed throughout the Iberian Peninsula, N Africa and SW France. Its taxonomy is quite ambiguous, since various authors have described a great variety of subspecies and recent molecular studies suggest a polyphyly of the group. Thus, studies on different populations may help in resolving in the future the taxonomic problems of the species. In the present study, a population living in an urban area near the University of Barcelona was sampled during the years 1984-1986, in order for its morphology and reproductive biology to be studied. Comparisons of the morphology of the members of the population showed the presence of a pronounced sexual dimorphism, as well as a clear differentiation in four sex/age classes (females, males, subadults and juveniles). Concerning the reproductive biology, the data collected were more or less in accordance with previous studies on the species, although some differences did exist. The reproductive period begun in March and ended in August or beginning of September. The majority of the individuals reached reproductive maturity within 7-8 months of their birth. Mean clutch size was calculated to be 2,75 eggs, with a mean egg volume of 155,71 mm^3 (SE=8,2 mm^3). The variables describing the reproductive state of the lizards varied throughout the year, generally reaching a maximum in April.

THE MICRO-INSULAR DISTRIBUTION OF THE GENUS *PODARCIS* WITHIN THE AEOLIAN ARCHIPELAGO: A POSSIBLE HISTORICAL INTERPRETATION

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Key words: *Podarcis raffonei, Podarcis sicula*, Aeolian Islands, micro-insular distribution, human introduction.

Two species of lizards of the genus *Podarcis* occur in the Aeolian Archipelago: *Podarcis sicula* and the threatened endemic *Podarcis raffonei*. The present distribution of the latter species is fragmented and restricted to three islets (Strombolicchio, Scoglio Faraglione, and La Canna) and some areas of Vulcano Island. Contrariwise, *Podarcis sicula* is common and widespread on the whole archipelago.

According to Capula (1992) and Capula *et al*. (2002), the current lack of *P. raffonei* on the main islands could be explained by competitive exclusions and extinctions occurred as a consequence of the islands' colonisation by *P. sicula*, which probably have reached the archipelago after its human settlement (7,000 years B.P.). In this perspective, the occurrence of *P. raffonei* in Vulcano could be explained by the belated human colonisation of this island (in 18th century), while for the islets could be explained by their isolation age, which is earlier than the human colonisation of the main islands.

However, several islets of the Aeolian Archipelago (Basiluzzo, Spinazzola, Bottaro, Dattilo, and Lisca Bianca), located off the E and NE coast of Panarea, are occupied by *P. sicula*. By considering that the isolation age of these islets is analogous to the one of the islets where *P. raffonei* still exists, the palaeo-geographical factor can not be used to explain their different faunal composition.

The archaeological investigations (De Fiore 1921, 1925; Bernabò Brea 1949, 1985) showed that all these islets were visited by human in the Upper Neolithic (4th millennium B.C.), and that human settlements occurred during the Hellenistic and Roman ages. More recently, an agricultural use of Basiluzzo was documented from the 17th to the late 19th century, while Lisca Bianca and Bottaro were used as grazing lands for goats and sheep.

Thus, the occurrence of *P. sicula* on the micro-insular environments of the Aeolian Archipelago seems to coincide with the human settlement (or exploitation) in the islets, while

unexploited or inaccessible islets are still occupied by *P. raffonei*. On the other hand, the differential characteristics of *P. sicula*'s populations of Lisca Bianca and Bottaro suggest to exclude a recent colonisation of these islets by this species.

PRELIMINARY DATA ON THE ECOLOGY OF *PODARCIS FILFOLENSIS* OF LAMPIONE ISLET (PELAGIE ISLANDS, CHANNEL OF SICILY)

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Key words: *Podarcis filfolensis*, ecology, Lampione Islet, Pelagie Islands.

Lampione (35°33'00" N - 12°19'11" E Greenwich) is the smallest islet of the Pelagie Archipelago, with a surface of 2.10 ha and a maximum elevation of 36 m a.s.l. It is situated 17 Km off the western coast of Lampedusa Island, in the Channel of Sicily. The islet is inhabited by a population of the Maltese Wall Lizard, *Podarcis filfolensis* (Bedriaga 1876), which is interesting to study from an ecological point of view because of the unusual characteristics of the study area (extreme isolation and insularity, low human disturbance, etc.).

This population, referred to the ssp. *laurentiimuelleri* (Fejérváry 1924) by Lanza & Bruzzone (1961), is characterised by an intense melanism. As expected, the population body size (SVL, mm) differed significantly among sexes and age classes, males were significantly bigger than females. Three out of five males, and one out of two females had the tail broken or regenerated. These frequencies did not differ significantly at χ^2 test .

A high density characterised the species on this islet, where it is syntopic with *Chalcides ocellatus*: 75-80 individuals of *P. filfolensis* per 100 m^2 were counted in the upper plateau, covered by alo-nitrophilous vegetation (*Salicornietea*).

Vegetal matters were found in 60.9% (total n = 14) of the faecal pellets examined (total n = 23), these exceeded in terms of frequency of occurrence any other food category. In particular, when we compared the frequency of occurrence of vegetal matters in specimens with known sex, it resulted that 4 out of 5 males, 2 out of 2 females, and 1 out of 2 subadults had eaten vegetal matters. This suggests that herbivorous habits are not exclusive of a given sex or age class, but are indeed widespread at all levels of the studied population. The rest of the dietary spectrum consists of small invertebrates (mainly Hymenoptera Formicidae, Coleoptera Tenebrionidae, and other arthropods), as usually found in the small lacertids of the Mediterranean basin.

COMPARED MORPHOLOGY OF TWO INSULAR *PODARCIS CARBONELLI BERLENGENSIS* POPULATIONS

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Key words: *Podarcis*, Lacertidae, compared morphology, insularity, Berlenga Islands.

Berlenga's Archipelago (9º 30' W, 39º 25' N) encompasses two groups of islands with different geological characteristics: granitic Berlengas and gneiss-mica schistic Farilhoes. The Berlenga Carbonell Wall Lizard *Podarcis carbonelli berlengensis* is an endemic insular subspecies, which occurs at both groups of islands and at the nearby mainland.

The morphologic study of two populations of *P. c. berlengensis* from the islands Berlenga and Farilhao Grande revealed the existence of significant differences among these populations. In the Farilhao Grande lizards are larger, have relatively longer members and are more melanistic. Other differences were found concerning head form, folidosis and chromatic pattern. These differences are possibly related to the characteristics of the habitats of each island, different isolation degrees and different selective pressures.

MICROHABITAT SELECTION IN *PODARCIS CARBONELLI BERLENGENSIS*

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Key words: *Podarcis*, Lacertidae, microhabitat selection, Berlenga Islands.

Berlenga (9º 30' W, 39º 25' N) is the largest island (78.8 ha) of the Berlenga's archipelago and it is 5.67 nautical miles off the Portuguese continental coast, Northwest fromCape Carvoeiro, central Portugal.

Podarcis carbonelli berlengensis is an endemic insular subspecies, which occurs at the Berlenga's archipelago and at the nearby mainland.

Microhabitat selection in Berlenga's *P. c. berlengensis* was studied applying two different methods, namely «Availability *vs.* Use of Microhabitat» and «Multiple Logistic Regression». The first method revealed that the Berlenga's wall lizard selects areas where the variables "cement" and "vegetation higher than 25 cm" are present, independently of sex and age class of animals. These preferences of microhabitat seem to coincide, simultaneously, with zones that provide appropriate refuges, food sources and microclimatic conditions that facilitate the individuals' thermoregulatory activity. The second method allowed the construction of a model translated by the regression logistic equation:

$$g(x) = - 0{,}6820 + 0{,}4312.CC - 0{,}4025.VC_{[0,10\ cm]} + 0{,}3866.VC_{[25,\ \infty\ cm]},$$

(where CC stands for cement cover and VC for vegetal cover)

Through this model it is possible to foresee the presence/absence of the lizards on island habitats.

QUANTITATIVE AND MERISTIC MORPHOLOGICAL CHARACTERS REFLECT DISTINCT ASPECTS OF THE EVOLUTIONARY HISTORY OF *PODARCIS ERHARDII* (BEDRIAGA 1876)

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Key words: *Podarcis erhardii*, morphology, phylogeny, evolution, ecology, Greece.

A recent publication on the phylogenetic relationships of Greek species of *Podarcis*, based on partial mtDNA sequences, revealed among others that *Podarcis erhardii* is a paraphyletic taxon. The main distinction found was between populations of the populations from Crete (and its satellite islands) and the Cyclades Archipelago.

In this study we decided to search for corresponding morphological data, which would (or would not) corroborate the relationships inferred by the molecular data set. We measured in total 219 specimens of which 192 *P. erhardii*, 15 *P. muralis* and 12 *P. peloponnesiaca*. We selected 15 characters, 8 quantitative (continuous) and 7 meristic (discrete).

Both principle component analysis (PCA) and discriminant canonical analysis (DCA) on the entire data set failed to reveal any grouping of the species.

We proceeded to the separate analysis of quantitative from meristic characters, based on the hypothesis that they may differ either in their evolutionary history and/or in their comportment in the different multivariate techniques.

Correspondence analysis (CA) and DCA of the meristic characters, fully corroborated the results inferred from mtDNA analysis, i.e. they suggest that *P. erhardii* from Crete differs significantly from *P. erhardii* from the Cyclades archipelago.

On the other hand PCA and DCA analyses of the quantitative characters suggested a grouping, which separates "continental" from "insular" populations, mainly influenced by two characters: length of tibia and length of tarsus+4th toe. Independent contrasts analysis suggests that the two latter characters are adaptive.

In other words, variations of certain meristic characters follow respective phylogenetic history whereas variation of certain continuous characters seem influenced by ecological conditions, especially insularity.

DIFFERENTIATION WITHIN SYRIAN POPULATIONS OF THE LIZARD *MESALINA BREVIROSTRIS*

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Key words: *Mesalina brevirostris*, mitochondrial DNA sequences, taxonomy, Syria, Jordan.

Three more or less different morphotypes of *Mesalina brevirostris* Blanford 1874 have been distinguished within the territory of Syria: (1) Lowland form, (2) Western (intermediate) form and (3) Jabal al Arab form. We sequenced parts of the mitochondrial gene for cytochrome b (836 bp) of *M. brevirostris* samples from four Syrian and two Jordan localities and parts of the 12S rRNA and 16S rRNA genes of two selected Syrian samples to estimate the phylogenetic relationships among the given morphotypes.

Two main clades with a divergence of about 10% in cyt-b were obtained. The first one involves the representatives of all three morphotypes and is divided further into three weakly divergent subclades: (i) Lowland form and partly also the Western form, (ii) J. al Arab form and population from northern Jordan, (iii) population from the eastern Jordan (area of Azraq). This situation indicates a high variability of haplotypes in a relatively small area. The second main clade consists of the remaining representatives of the Western form and reveals a cryptic undescribed taxon being hidden (syntopic occurrence) within the Western form (s.l.).

The results suggest that the Syrian Lowland and J. al Arab forms might represent two different subspecies of *M. brevirostris* which evolved in a comparatively short time. The former form has been traditionally associated with the name *M. b. brevirostris*. The latter can be assigned to the name *M. b. microlepis* Angel 1936. A problem rises from the position of the holotype of *microlepis,* which morphologically fits rather the J. al Arab form than the other morphotypes, although according to the molecular data the today's topotypes belong to the Lowland form. This can be explained by the changes in the distribution of the respective form due to current aridisation process. A particular question concerns the taxonomic position of the Azraq population.

Finally, only the cryptic undescribed taxon in western Syria may be assigned to the intermediate western morphotype. The degree of morphological differentiation of this form is discussed.

RELATIONSHIPS BETWEEN PREDATION PRESSURE, TAIL LOSS PERFORMANCE AND ENERGETICS OF POST-AUTOTOMY MOVEMENT IN CONTINENTAL AND INSULAR POPULATIONS

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Key words: autotomy, predation, insularity, lactate, post-autotomy movement.

Autotomy in lizards, the self-induced tail breakage, is considered an efficient defence mechanism among lacertids. The shed body portion is writhing vigorously so as to distract predator from the escaping individual.

It is generally accepted that autotomy may be lost when costs exceed the benefits of the strategy. From literature it is known that insular species with little predation pressure show reduced proportion of autotomized tails.

Tail-break frequency in natural populations has been interpreted traditionally as a measure of relative predations rates. So lizards from populations with high proportions of broken tails should be subject to a more intense predation.

Tail movement is fuelled by anaerobic metabolism. Anaerobic capacity characterizes species that use autotomy as a principal defensive mechanism. Furthermore it seems that lactate production can be used as an index of trashing activity. Tail break continues to thrash for extended time periods but the duration of the movement varies among species.

In 11 species we tested the hypothesis that lizards from insular populations with little predation intensity should show a lower performance of tail loss. Over and above we hypothesised that the more a species used caudal autotomy, the higher would be the lactate accumulation and the post-autotomy movement duration.

We found that only two insular species (*Podarcis gaigeae* and *Podarcis erhardii* from Crete and the surrounding islets) diverged from the mainland lizards' autotomic capacity, showing very low proportions of tail breakage. In both cases predation pressure was quite low. However no differences for lactate production and tail motion between the species were recorded.

SITE VARIATION IN THE DIET OF THE MEDITERRANEAN LIZARD *LACERTA PERSPICILLATA*

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Key words: trophic ecology, *Lacerta perspicillata*, Menorca, Morocco.

Lacerta perspicillata is an understudied Mediterranean lacertid lizard endemic to Western Mahgreb (Morocco and Algeria), probably introduced at an indeterminate time to Menorca (Balearic Islands, Spain). We analysed the diet of this species in three localities, two Moroccan populations: Oukaïmeden (High Atlas, 2600 m) and Debdou (NE Morocco, 1600 m), and an insular population from Menorca (50 m). Lizards were captured, measured and faecal pellets obtained during handling before being released.

Our results confirm that *L. perspicillata* is basically an insectivorous species, with a scarce consumption of vegetal matter only in the Moroccan localities. Lizards from Menorca fed mainly on terrestrial prey, predominantly Araneae, Coleoptera and Homoptera. Moroccan populations ate more flying items, with a diet based on Diptera, Hymenoptera and Coleoptera. Menorca showed a more diverse diet than both Moroccan sites at the population level. However, diet diversity, evenness and prey richness did not differ between populations when considered at the individual level. Lizards from Oukaïmeden were larger than the others. Nevertheless, after correcting for the body size, lizards from this population still fed on relatively larger terrestrial prey than the others whereas flying prey size was similar in all localities analysed. We also found interpopulational differences in the number of prey consumed. Several hypotheses explaining these results will be discussed.

UNIQUE INTERACTIONS OF INSULAR LIZARDS AND PLANTS. THE CASE OF THE DEAD HORSE ARUM (*Dracunculus muscivorus*) AND THE BALEARIC LIZARD (*Podarcis lilfordi*)

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Key words: *Podarcis lilfordi*, plant-lizard interactions, Aire Islet, Balearic Islands.

The ecological conditions of Mediterranean islands favour the consumption of vascular plants by lizards and, consequently, the raise of several interactions, including plant pollination and seed dispersal.

However, some interactions can be more complicated, with variable benefits or detrimental effects for lizards and plants. In this talk we describe the striking case of the Dead Horse Arum and the Balearic Lizard in Aire, a coastal islet of Menorca (Balearic Islands, Spain).

In Aire islet, the Dead Horse Arum, *Dracunculus muscivorus*, is particularly abundant. From 1999 to 2003 we studied the population of this plant species and its relationships with the Balearic Lizard, *Podarcis lilfordi*. During blooming period, several lizards exhibited a foraging behaviour focused on open inflorescences of dead horse arums. Lizards were able to capture flies attracted by the plants and those trapped in tubules as pollinators, disturbing in some way the complex pollination syndrome of the Dead Horse Arum.

The exploitation of pollinators was mainly made by largest males of the population that actively excluded females and smaller males from plants, skewing lizard sex-ratio in areas of maximum plant density. In addition, we observed a clear relation between plant distribution and lizard density over the whole surface of Aire.

During fruiting period, the interaction of lizards and plants is even stronger. The consumption of fruits by lizards was very intense. In a set of experiments, lizards were able to detect ripening fruits of *D. muscivorus* by visual cues, selecting only those in a full maturation state. Hence, lizards consumed an infrutescence following the progressive maturation of fruits. During ripening, the vast majority of lizard population based their diet on this food resource, dispersing seeds over the whole island' surface.

Seeds were intact after lizard' gut passage. In two germination experiments, we detected an enhanced germination of seeds from lizards' faeces, in comparison with those directly taken from ripening fruits. Thus, the Balearic lizard can be considered the main legitimate

disperser of the Dead Horse Arum at Aire islet.

From 1999 to 2003, the density of the Dead Horse Arum increased in Aire from 4800 ind/ha to more than 20.000 ind/ha in some areas of the islet, probably indicating a positive balance of the interaction between plants and lizards.

The case of the Dead Horse Arum and the Balearic lizard is an excellent example of the lizard-plant interactions that can be frequent at Mediterranean islands, where we find a set of common factors including a high lizard density, the absence of a strong predation pressure, a low trophic availability.

GENETIC VARIABILITY WITHIN *PODARCIS TILIGUERTA*: PRELIMINARY EVIDENCE FROM 12S rRNA GENE SEQUENCES

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Key words: 12S rRNA, *Podarcis tiliguerta*, Sardinia, Corsica, phylogeny.

Detailed phylogeographic analyses of some *Podarcis* species, especially *Podarcis hispanica* and *P. erhardii* have indicated extensive subdivision, implying that groups may be species complex. Other *Podarcis* units may similarly include "cryptic species". This may be particularly likely of species that have (a) fragmented distributions, and (b) are found in "southern refugia". For this reason we sequenced 12S rRNA for several populations of *Podarcis tiliguerta* from both Corsica and Sardinia. We re-evaluate both the level of genetic variation within the species, and its probable phylogenetic relationships with other *Podarcis* species by comparing our data with previously published sequences.

ASPECTS OF THE EVOLUTIONARY HISTORY OF *PODARCIS TAURICA* (PALLAS 1814), *P. GAIGEAE* (WERNER 1930) AND *P. MILENSIS* (Bedriaga 1882) IN GREECE

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Key words: *Podarcis taurica*, *Podarcis gaigeae, Podarcis milensis,* molecular phylogeny, mtDNA and nuclear markers, evolution, Greece.

Wall lizards of the genus *Podarcis* (Sauria, Lacertidae) comprises 17 currently recognized species in southern Europe, where they are the predominant reptile group. The taxonomy of *Podarcis* is complex and unstable. Based on DNA sequence data the species of *Podarcis* fall into four main groups that they have substantial geographic conherence (Western Island group, Southwestern group, Italian group and Balkan group). The Balkan species, is divided in two subgroups, the subgroup of *P. taurica, P. milensis*, *P. gaigeae, P. melisellensis* and the subgroup of *P. erhardi* and *P. peloponnesiaca,* which are highly diversified and present great morphological and ecological plasticity, inhabiting many different ecotypes. We address the question of phylogenetic relations among the species of the *Podarcis taurica* subgroup encountered in Greece, as they can be inferred from partial mtDNA (cyt b and 16S) and nuclear (c-mos) sequences. Our data suggest that *P. gaigeae* is closely related to *P. milensis* and both *P. gaigae* and *P. milensis* to *P. taurica.* However the specimens of *P. taurica* are subdivided in two different groups. The first includes the specimens from Russia and Northeastern Greece and the other the specimens from the rest of continental Greece and Ionian Islands. This result suggests that the evolutionary history of *P. taurica* in Greece is more complex than a single evolutionary invasion. The data analyzed stress the need for a reconsideration of the evolutionary history of Greek *Podarcis* species and help overcome difficulties that classical taxonomy has encountered at both the specific but mostly the subspecific level of this genus.

GEOGRAPHIC VARIATION IN SEXUAL SIZE DIMORPHISM IN THE SAND LIZARD, *LACERTA AGILIS*

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Key words: body length, *Lacerta agilis*, *Lacerta agilis boemica*, life- history, lizards, sexual size dimorphism, geographic variation.

Sexual size differences (SSD) were examined using original data on age-specific snout-vent length (SVL) in five populations of the south-eastern North Caucasus (subspecies *L. a. boemica*) and published data on mean and maximum SVL in different parts of the species range. The West European populations exhibited a clearly female-biased SSD (females are the larger sex). For the East Europe and most of the Caucasus, a weak female-biased SSD or no SSD was found. In contrast to this, some populations of *L. a. boemica* showed a pronounced male-biased SSD.

Two non-alternative hypotheses to explain the male-biased SSD pattern in some *L. agilis* populations of the North Caucasus are proposed. (1) Taking into account a pronounced morphological (Roitberg 1987) and genetic (Kalyabina et al. 2001) separation of *L. a. boemica* from the rest of the species, the distinctive SSD pattern might have phylogenetic determination. (2) The male-biased SSD in these populations can be determined by proximate factors (Stamps 1993, Adolph & Porter 1996). A hot and dry climate of the lowland North Caucasus might accelerate maturation, and females would begin to allocate energy to egg production (at the expense of energy available for body growth) at younger ages than their conspecifics living at cooler climate.

INHERENT DIVERGENCE REVEALED IN GENETIC VARIATION AMONG MTDNA SEQUENCES FROM THREE POPULATIONS OF *OPHISOPS ELEGANS* IN PSARÀ, GREECE

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Key words: *Ophisops elegans*, isolation, variation, divergence, mtDNA, NDII.

Ophisops elegans, a Mediterranean lacertid, is found abundantly on Psarà, a small, sparsely populated Greek island approximately 150 kilometers from Athens. In this study, specimens were collected from each of three populations, isolated from one another by both distance and geographical barriers. Using a PCR-based approach, mitochondrial DNA (mtDNA) from the NDII genes of approximately thirty individuals was sequenced and analyzed to determine population heterogeneity within and among populations. We expect to find a correlation between genetic and geographic distance. Results are demonstrating sequence variations.

Such incipient findings are evidence of genotypic change occurring prior to any morphological variation among the three study populations.

DISTRIBUTION AND ECOLOGICAL PREFERENCES OF LACERTIDS IN CALABRIA

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Key words: Calabria, lacertids, altitudinal distribution.

Calabria represents the southernmost part of the Italian Peninsula. Its territory is mainly hilly (49%) and mountainous (42%) and has a Mediterranean climate, whose temperature and annual average rainfall show remarkable differences among the Tyrrhenian and the Ionian slopes. In this area three species of lacertids occur: *Podarcis sicula*, *Podarcis muralis* and *Lacerta bilineata*.

The first is certainly the most abundant species. It is also the one with the largest ecological amplitude: on the basis of the collected data, this species can be considered eurytopous and basically thermophilous, being more common at middle and low altitudes.

Podarcis muralis and *Lacerta bilineata* are more poorly distributed: the first, which in Calabria reaches the southernmost limit of its Italian distribution, is common from middle to high altitudes (over 800 m a.s.l.) and prefers mountain environments or humid areas situated at the foot of mountains (above all woods of mesophilous decidous trees and mountain grasslands). The second has a wide altitudinal distribution; it is very common in sclerophillous or riparian woods and in Mediterranean scrubs.

P. sicula and *L. bilineata* reach the peak of their annual activity in May, while *P. muralis* does so in June. For all these species, however, a spring activity peak is observed, followed by a summer fall off and by a successive smaller peak in autumn, to coincide with hatching time. Winter activity of lacertids has been occasionally observed at low altitudes.

MILLENNIUM ECOSYSTEM ASSESSMENT INFORMATION TO CONSERVE ECOSYSTEMS AND ENHANCE HUMAN WELL-BEING

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The Millennium Ecosystem Assessment (MA) is an international work program designed to meet the needs of decision makers and the public for scientific information concerning the consequences of ecosystem change for human well-being and options for responding to those changes. The MA was launched by UN Secretary-General Kofi Annan in June 2001 and it will help to meet assessment needs of the Convention on Biological Diversity, Convention to Combat Desertification, Ramsar Convention on Wetlands, and the Convention on Migratory Species, as well as needs of other users in the private sector and civil society. The Millennium Ecosystem Assessment is a multi-scale assessment consisting of interconnected assessments at the global, sub-global and local scales. If the MA proves to be useful to its stakeholders, it is anticipated that an assessment process modelled on the MA will be repeated every 5-10 years and that ecosystem assessments will be regularly conducted at national or sub-national scales.

The MA focuses on ecosystem services (the benefits people obtain from ecosystems), how changes in ecosystem services have affected human well-being, how ecosystem changes may affect people in future decades, and response options that might be adopted at local, national, or global scales to improve ecosystem management and thereby contribute to human well-being and poverty alleviation. The specific issues being addressed by the assessment have been defined through consultation with the MA users.

A NOVEL APPROACH TO THE PHYLOGENETIC STUDY OF *LACERTIDAE*: CORRELATION OF IMMUNOLOGICAL RESPONSES WITH MORPHOLOGICAL CHARACTERISTICS

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Key words: phylogeny, immunology, lymphocytes, *Podarcis*.

The phylogenetic relationships within the *Lacertidae* family are currently subject to intense research. Various methods, including morphological, biochemical and molecular analyses, have been performed in order to clarify the evolution of the species belonging to this specific family. Particularly for Eastern Mediterranean species, lacertids' DNA sequence and genetic loci analysis were used to assess phylogenesis of lizards.

Species that have a close relationship should show a high affinity concerning their immune system. Given the relationships of the Greek species, we explore this idea by using a method, novel in the study of lizards.

Herein, using two-way mixed lymphocyte reaction (MLR), we report on the *in vitro* proliferative responses of lizard spleen-derived lymphocytes. Initial experiments defined the separation techniques for the isolation of relatively pure lymphocytes, established appropriate *in vitro* culture conditions and showed that lizard lymphocytes respond to T cell mitogens (e.g. phytohemagglutinin, concanavalin A) routinely used in mammalian systems. Moreover, lizard splenocytes isolated from various species, when co-cultured, recognize major histocompatibility complex molecules on allogeneic T-like cells and subsequently proliferate. Indeed, splenocytes from two phylogenetically distant species (i.e., *Podarcis erhardi* and *Cyrtopodion kotsyi*) were isolated in RPMI-1640 culture medium supplemented with 0,1% fetal calf serum, 2 mM L-glutamine, 10 mM Hepes, 5 x 10^{-5} M 2-mercaptoethanol and 100 μg/ml gentamycin. Splenocytes were cocultured at various ratios and concentrations in 96-well plates for 5 days in a 37° C, humidified, 5% CO_2 incubator. During the last 18 h, cells were pulsed with 1 μCi/well ^{3}H-thymidine, harvested and radioactivity incorporation was measured in a ß-counter. Calculation of stimulation index (SI) revealed that optimal MLR responses were observed at a concentration of 2,5 x 10^5 cells/well and at a 1:1 ratio between splenocytes from different species. Furthermore, using splenocytes from two phylogenetically-related species (*Podarcis peloponnesiaca* and *Podarcis erhardii* from Crete)

and two more distant species (*Podarcis taurica* and *Lacerta graeca)* we show that the former present reduced SI, whereas increased T-like cell proliferation can be observed between distant species. These preliminary data support the use of two-way MLR to further evaluate the phylogenetic diversity within the *Lacertidae* family.

DEVELOPMENTAL STABILITY OF SAND LIZARD (*LACERTA AGILIS* L.) UNDER OPTIMAL AND NON-OPTIMAL CONDITIONS IN EXPERIMENT AND IN NATURA

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Key words: developmental stability, population variability, developmental conditions, *Lacerta agilis*.

In this study we analyze developmental stability (DS) of *Lacerta agilis* under different experimental and natural conditions. Thirteen morphological characters (the number of scales on different parts of the head and the number of femoral pores) were used for assessing fluctuating asymmetry (FA) in 364 new-born laboratory juveniles hatched from eggs incubated at various temperatures, and in 805 wild specimens from 32 European populations. FA is inversely related to DS and is believed to be lowest under optimal developmental conditions. In the experiment optimum incubation temperatures for lizards originating from populations from different parts of the range proved to be the same. Relationship between FA and incubation temperature was U-shaped, the minimum of the curve corresponding to optimum t°. In natural populations DS decreased from the central part of the range towards its ecological periphery, this decrease being most pronounced northwards. Thus the geographical pattern followed the experimentally established dependence of DS from incubation temperature.

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