

# Habitat preferences of the Levant Green Lizard, *Lacerta media israelica* (Peters, 1964)

(Reptilia: Lacertidae)

Jacqueline Loos, Tamar Dayan, Nora Drescher, Tal Levanony, Erez Maza,  
Boaz Shacham, Roy Talbi, Thorsten Assmann

**Abstract.** The Levant Green Lizard, *Lacerta media israelica* (Peters, 1964), is a rare and declining lizard species that is classified as regionally vulnerable in Israel and Lebanon. We found information about historical observations of this species at 42 different locations. During field work at these and 12 additional locations between March and July 2009, we found 35 individuals at 21 different sites. Sixty-six percent of formerly inhabited places appeared not to be inhabited by the species anymore. *L. media israelica* inhabited heterogeneous plots, with an average of 30% herbaceous and shrub layer, moderate slope angle and a high proportion of woodland cover. Most observations occurred at the margins of anthropogenic installations and near woodland sites, such as fruit plantations, car parks, trails and traditional pasture landscape. To conserve populations of the Levant Green Lizard, it will be important to maintain landscape heterogeneity, including extensively used semi-open shrubland areas (such as local garigue or 'batha') for the protection of this species.

**Key words.** Mediterranean Lacertid, microhabitat, landscape heterogeneity, ecotone.

## Introduction

"Green Lizards" (*Lacerta* s. str., also known as the "Emerald Lizards") are a polytypic lineage within the genus *Lacerta*. This complex of closely related species is of considerable conservation concern, and consists of eight species belonging to three groups: *L. agilis* (*L. agilis* Linnaeus, 1758), *L. viridis* (*L. viridis* Laurenti, 1768, *L. strigata* Eichwald, 1831, *L. bilineata* Daudin, 1802, *L. schreiberi* Bedriaga, 1878) and *L. trilineata* (*L. trilineata* Bedriaga, 1886, *L. pamphylica* Schmidtler, 1975, *L. media* Lantz & Cyrén, 1920) (BÖHME & CORTI 1993, NETTMANN 2002, ÜÇÜNCÜ et al. 2004, GODINHO et al. 2005). Green Lizards are distributed throughout Europe, especially in the Mediterranean region, and their southeastern distribution limit is in the Middle East (BERGMANN & FRITZ 2002).

*Lacerta media* is considered to be of 'least concern' in the IUCN Red List, but its population trend is currently declining (IUCN 2010). According to the Israeli Red List, the subspecies *israelica* is 'regionally vulnerable', and its distribution is rapidly diminishing in Israel and Lebanon (BOGIN et al. 2004). For instance, the last recorded sighting of the species in the Judean Mountains was in 1970 (BOGIN et al. 2004, AGASYAN et al. 2008) and the species is also considered locally extinct in other locations, such as Lower Nahal Oren in the Carmel region (NEVO et al. 1996). Reliable data on population size and fluctuations of current populations are lacking, which poses a challenge to the design of appropriate conservation measures.

Geographic isolation negatively affects populations of the Emerald Lizard, both in Israel

(BOGIN et al. 2004) and in Germany (ELBING 2001, FRITZ et al. 2001). Preventing the ongoing decline of any given vulnerable species requires an understanding of its ecological requirements. Especially in heterogeneous environments such as the traditional grazing landscape "batha" in Israel, fine scale data on habitat suitability could greatly enhance conservation planning for the species (BOGIN et al. 21004).

Reptiles are non-randomly distributed in space and therefore presumably select their habitat (HEATWOLE 1977, DIEGO-RASILLA & PEREZ-MELLADO 2003, BOGIN et al. 2004). However, little detailed information is available on the habitat requirements of the Levant Green Lizard *Lacerta media israelica*, and the overarching goal of our study was to characterise the structural features of the preferred habitat of this subspecies. We studied the habitat of the lizard in order to identify which form of physical and vegetational structures it prefers. Because the species is rare, and large sample sizes are difficult to obtain, we combined field surveys with a mapping exercise to characterise the different landscape components used by the species. Our findings have implications for the conservation management of Mediterranean grassland pastures for *L. media israelica*, and provide an informed starting point for future investigations into lizard-habitat relationships in the Levant.

### Material and methods

**Species.** *Lacerta media israelica* (Peters, 1964), commonly called "Levant Green Lizard" (DISI et al. 2001), is a medium-sized lacertid lizard with a body length of up to 42 cm (AMITAI & BOUSKILA 2001, ESTERBAUER 2005), whose autotomic tail gauges twice the snout-vent-length (Fig.1). *Lacerta media* belongs to the polytypic phylogenetic line of *Lacerta trilineata* Bedriaga 1886, and can be distinguished during the juvenile stage by its spotted flank pattern (NETTMANN 2002), pholidosis characteristics (PETERS 1964) and by classification of blood-serum proteins (ÜÇÜNCÜ et al. 2004).

The subspecies *Lacerta media israelica* can be distinguished from the other subspecies by three green lines on a brown background on the dorsal side of subadults and by the black-spotted camouflage on emerald-green coloured adults (DISI et al. 2001). Elements of sexual dimorphism include larger body size and blue throat colouration in males (TALBI 2007). The phenology of the Levant Green Lizard shows both diurnal and annual bimodal activity (ESTERBAUER 2005). The mating season starts in May and lasts until oviposition in June, and a second reproductive season after aestivation is possible (KABISCH 1990). The geographic range of *Lacerta trilineata* includes Mediterranean ecozones with rainfall exceeding 300 mm in Adria, Iran and Israel, but the southwestern extent of its distribution is unclear (SCHMIDTLER 1986, KABISCH 1990, DISI 1991, ESTERBAUER 2005). The Palearctic subspecies *Lacerta media israelica* is restricted to southern Lebanon, southwestern Syria, northern Israel and northwestern Jordan (BOGIN et al. 2004), where it occurs in a range of different habitats at altitudes between 700 m and 2000 m (PETERS 1964). *L. m. israelica* is thought preferentially to occupy dry subhumid habitats with a moderately developed herb-layer and shrubgrowth within Mediterranean sclerophylic vegetation on limestone hills (SCHMIDTLER 1986, BISCHOFF 2005), where it is found syntopically with *Lacerta laevis* Gray, 1838, *Ophisops elegans* Ménétriés, 1832 (DISI et al. 2001), *Testudo graeca* Linnaeus, 1758, and *Bufo viridis* (Laurenti, 1768) (pers. obs.).

**Study area.** We selected study areas in the north of Israel, within the Mediterranean ecozone (AGASYAN et al. 2008). In total, our surveys took place within an area of 3000 km<sup>2</sup> with altitudinal ranges between 200 m and 1800 m above sea level. According to the Gruenberg-Fertig climatic classification, the study region belongs to the temperate zone within the mesic



Fig. 1. Adult male of *Lacerta media israelica* basking next to the wall of a fruit plantation.

Mediterranean climate. It is characterized by warm, dry summers and cold, wet winters with a mean maximum temperature of 29°C and mean minimum temperature of 4°C. Its mean annual precipitation of 1000 mm is the highest in Israel (YOM-TOV & TCHERNOV 1988).

The natural vegetation in the study area was originally dominated by oak woodlands that have been used and modified by humans for thousands of years (DANIN 1988, LIPHSCHITZ & BIGER 1990), hence mosaics of anthropogenic structures, such as agricultural land, different formations of sclerophyllous *Quercus calliprinos* woodlands (GHAZAL 2008) and xeromorphic shrub-vegetation, induce a broad variety of microhabitats. The vegetation formation “batha”, which is the local name for widely distributed traditional grazing landscapes (similar to Mediterranean “garrigue”) has ligneous semi-shrubs *Sarcopoterium spinosum* and *Cistus* sp. and mesophyll plants, e.g. *Rhamnus* sp. and *Crataegus* sp., and has been widely distributed in the past (DANIN 1988). A mixture of oak and pine forests currently dominates the region as a result of recent reforestation activities (DISI et al. 2001, GHAZAL 2008).

**Data collection.** We selected study sites for field work on the basis of existing observational data compiled since 1950. A total of 42 sites was compiled on the basis of various zoological collections, the Society for Protection of Nature in Israel (SPNI) and personal communication with Israeli herpetologists. At these 42 sites and at 12 additional locations, we conducted Visual Encounter Surveys (BLOMBERG & SHINE 2006) for the presence of *Lacerta media israelica* from March until July 2009. We detected animals visually and identified them in the field. Whenever possible, we took photos of individuals on the substratum occupied. Since the species lives fairly

sedentary, we considered observations located less than 200 m apart to be of the same individual, except in cases of visual distinction by growth stage or by concurrent occurrence. We assumed the average home range of the Levant Green Lizard to be 1225 m<sup>2</sup>, based on the home range of a comparable lacertid lizard by SOUND (2006).

We divided every surveyed plot (35 m x 35 m) into 49 subplots to conduct a ground mapping exercise. For this purpose, we distinguished between the following vegetation formations: woodland, shrubland and pasture with herbs. Within the shrubland category, we distinguished two groups of shrubs: semi-open shrubs, such as *Salvia fruticosa* (which could be looked through easily) versus dense shrubs which were impenetrable, with their leaves directly on the ground (e.g. shrub formations of grazed *Quercus calliprinos* and the semi-shrub *Sarcopoterium spinosum*).

We also visually estimated percentages of bare soil, rocks (>0.2 m), boulders (>1 m), dead wood and other possible reptile microhabitat elements such as leaf litter and moss (KATI et al. 2007), as well as the estimated proportion of canopy cover of vegetation taller than 1.7 m. The height of all environmental elements as well as the minimum canopy height as an indicator for persistent grazing was measured with a ruler. Sun exposure of the patch and soil hardness were categorized by indices (sun index [1 = shady, no direct sun] to [10 = sun from all directions], soil hardness [1 = loose] to [5 = hard]). We measured exposure by compass bearing and intensity of the slope angle by gradient. In addition, we gathered Information of altitude using data from DIVA-GIS 5.2 and spatial data (WORLDCLIM) on global climate (HIJMANS et al. 2006).

The presence of molehills of *Spalax* sp. was considered an indicator for the ploughing of the area. Additionally, we counted the presence of residual stumps as potential perches.

**Data analysis.** The distribution of the 21 data sets was analysed by Kolmogorov-Smirnov-Test. We performed a Levene-Test to check if variances were homogeneous within the study plots. As all variables except moss, mole rat hills and residual stumps were normally distributed, we analysed the data set by descriptive statistics to calculate mean values and standard deviation. We applied Spearman Rank correlation to check for autocorrelation of all variables. Using principal component analysis (PCA), we reduced all the habitat variables to a smaller number of components. We tested the presence of molehills and residual stumps for correlation with the presence of *Lacerta media israelica*. All statistical analyses were conducted on SPSS and R.

## Results

In total, we recorded 35 lizard individuals during the study period, occupying 21 different sites in the Carmel Mountains, Upper and Lower Galilee and Golan Heights (Fig. 2). Of the 42 historical records, *L. media israelica* still occupied 14 sites and we found it additionally at seven new sites. We found no evidence of its presence at 28 sites of previous findings.

Most of the surveyed areas contained a diversity of structural elements, ranging from grasslands, shrublands, woodlands, rocky slopes, cliffs and agricultural land to anthropogenic structures such as car parks, roads and plantations with adjacent walls. Measurement of the sample units showed that the chosen species covered a relatively wide spectrum of habitat types within the Mediterranean biogeographic zone.

Subplots were approximately equally distributed on north-, south- and east-facing slopes. Only three percent were exposed to the west. One quarter of the subplots were located on flat ground, half were located on a moderate slope, and five percent were located on cliffs or steep inclines. Other vertical structures included stone walls and large boulders. The presence of mole rat hills and residual stumps showed no statistically significant correlation with

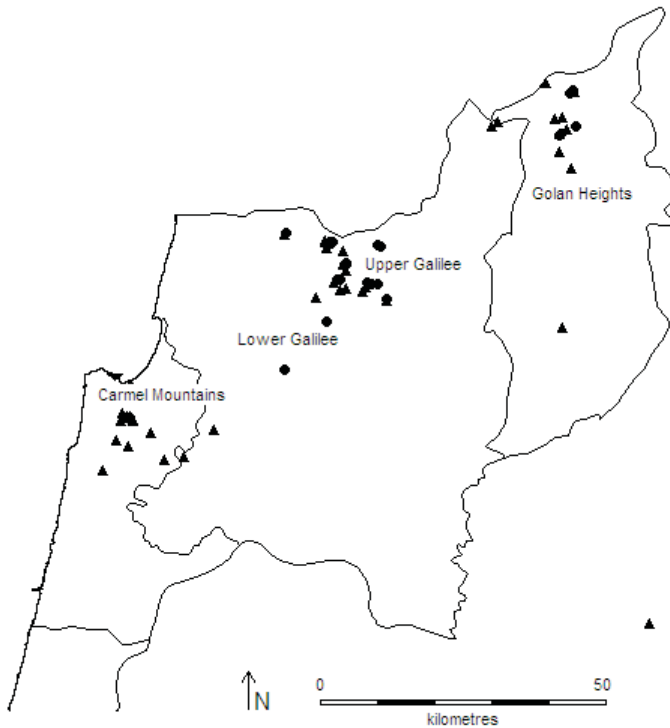


Fig. 2. Records of *Lacerta media israelica* in northern Israel and the Golan Heights. Dots show records of the authors in 2009, triangles refer to previous observations since 1950.

the abundance of lizards. Ground cover and percentage canopy cover showed a high variance with up to 64% at the different plots. All study sites showed high structural heterogeneity. Shrubs of either dense or semi-open growth were present in all plots, and in 67% of the recordings they covered approximately one quarter of the ground. Another distinguishing feature of the habitat was the predominantly dense herbaceous layer, which covered more than half of the whole area in 24% and about one quarter in 42% of the plots. Herbs and grasses covered at least 10% of the ground. Stones and rocks were also present in all areas with values of up to 45%. In the vast majority of areas surveyed, we found some deadwood, which showed a strong correlation with the presence of trees (e.g. next to fruit plantations). All plots contained partial cover of tree crowns. Of these, one-third were covered with less than 10%, one-third with ca. 30%, and two plots were covered with more than 50%. Therefore, we classified the plots predominantly as semi-open areas with traditional agricultural or urban influences.

Sixty-five percent of plots had a high amount of direct sunlight. 25% were moderately sunny and 10% were in shaded sites. We recorded the lowest rate of direct sunlight for a juvenile lizard at the Meron Field School, which was sitting on a narrow path between wooded areas. We assigned the highest sun indices in 4 out of 5 cases to adults.

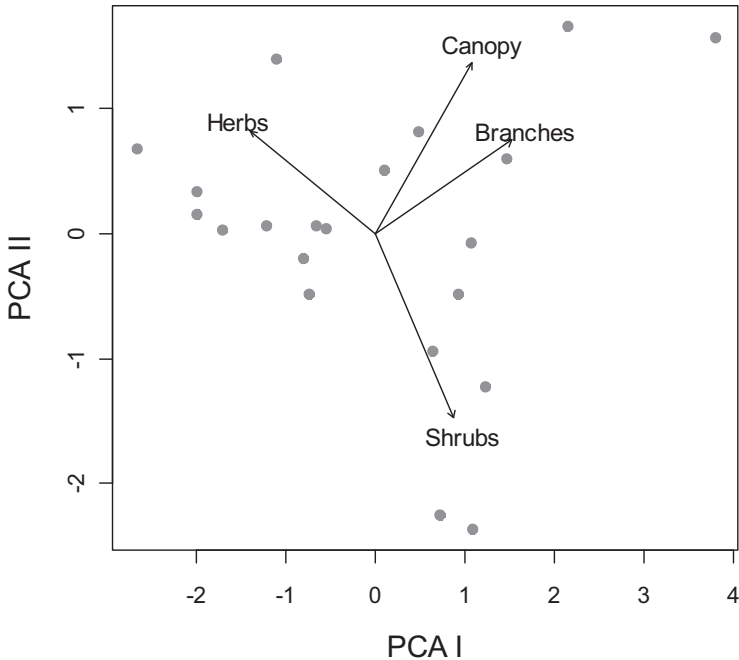


Fig. 3. Result of PCA for significant habitat components of *Lacerta media israelica*. Eigenvalues: PC 1: 2.49, PC 2: 1.13.

Results of the Spearman Rank Correlation and the PCA demonstrated a significant relevance of woodland, represented by canopy cover and litter layer (Fig. 3). Also herb and grass layer played an important role for the occurrence of *L. media israelica*, while bare soil, moss and rock were insignificant. We found no preferences for either dense or open shrub, but we identified the presence of shrubland in general as crucial for the lizard.

## Discussion

We assume a declining population trend for *L. m. israelica* in Israel, because we found it at few of the historical sites. Studies from other countries on related species also show declining population trends (e.g. CHEYLAN & GRILLET 2005, RODDER & SCHULTE 2010). Therefore, it is particularly important to understand its habitat requirements.

**Habitat selection.** Results demonstrated a high heterogeneity in habitats used by *L. m. israelica*, though most elements appeared in broadly similar proportions in all study plots. Lizards actively choose microhabitats because they facilitate certain functions in their life cycles (VANHOODYDONCK & VAN DAMME 2003, SANTOS et al. 2008), including social interaction, thermoregulation and predator avoidance (DOWNES & SHINE 1998). Food availability

and foraging methods also influence spatial distribution (CARRETERO 2004). As an insectivore, *Lacerta media israelica* forages actively on invertebrates in horizontal structures. Patches of grasses and herbs, which appeared in all study plots, therefore provide an optimal habitat structure, because they support high insect abundance and are relatively open (SHENBROT & KRASNOV 1997, ELBING 2001, VANHOODYONCK & VAN DAMME 2003). The Levant Green Lizard's intensive green colouration might serve as camouflage in live vegetation. Nonetheless, its escape tactic (i.e. rapid fleeing) requires shelter in particular hideouts, such as accumulated deadwood, shrubs, rock fissures or burrows (DIAZ 1991, MARTIN & LOPEZ 1999, BERGMANN & FRITZ 2002, MARTIN & LOPEZ 2002). The species also uses these structures for overnight stays and thermoregulation. For the latter, TALBI (2007) described seasonal changes in preferences of microhabitat structures, and the ability of the lizard to occupy various microhabitats during different seasons is crucial for effective thermoregulation (HEATWOLE 1977, SCHEERS & VAN DAMME 2002). In spring, *L. media israelica* needs to spend a lot of time exposed to the sun and therefore uses overnight hideouts that are located close to exposed, sunny spots, although they also climb on vegetation, dry stone walls and rocks to bask. In summer, adjacent shade areas, such as forests, are essential to provide protection from high temperatures. Dense canopy cover induces lower temperatures, lower light intensity and higher humidity (HEATWOLE 1977).

Some authors have noted that they found *L. m. israelica* in semi-open landscapes, such as the so-called 'batha', which has a rich understorey of shrubs and provides tree associations and grassland habitats (DANIN 1988, DISI et al. 2001, MAZA & DAYAN 2007). Our survey supported this suggestion, because in total, about 20% of the mapped area was covered by tree crowns and the PCA designated shrubs and wooded areas as the main components of the lizard's habitat. Also, in most cases woodland existed in the areas adjacent to survey plots.

Lizards need sun-shade and sunlit patterns and a high amount of structural alternations. This emerges as a life on the edge of cool habitats, such as forests, and warm habitats, such as open grassy pastures or bushland (HEATWOLE 1977, TALBI 2007). The high heterogeneity of inhabited plots and the high variance of occupied places (Fig. 3) indicated that *L. m. israelica* is not restricted to any particular vegetation type, but needs a combination of different microhabitat elements, which can include anthropogenic elements. The species may be termed a "soft-edge" species, because it shows flexibility in its behaviour regarding the range of occupied perches if suitable habitat is lacking (HEATWOLE 1977, SANTOS et al. 2008). NEVO et al. (1996) found *L. m. israelica* on north-facing slopes, but in this survey we found higher tolerance of the lizard to slopes facing other directions.

**Comparison with other Green Lizards.** In Turkey, SCHMIDTLER (2001) found few differences in preferred habitat structure between the six taxa *L. media*, *L. strigata*, *L. trilineata*, *L. viridis*, *L. agilis*, *L. pamphylica*. All these species lived in semi-open, shrubby habitats, near water. *L. schreiberi*, which is endemic to Iberian mountain ranges, also needs places with relatively high humidity (BÖHME & CORTI 1993, GODINHO et al. 2001, CARRETERO 2004). AGASYAN et al. (2008) confirmed the restriction of *Lacerta media* to humid or moist areas in the south of its range. On the other hand, in this survey we found water bodies only in four cases, hence we concluded that there is no direct relationship although the existence of woodland in or near the observation sites might indicate a preference for relatively high humidity. *L. m. israelica* occurring in the vicinity of trees uses woodland structures for thermoregulation. In this survey, we observed one female lizard running up a tree in order to take refuge, but for all other observations we infer a mainly ground-based lifestyle.

Woodland type may play an important role for egg-laying crawlers because of soil acidity and insolation circumstances. Though we found most of the lizards in this study near deciduous forests, we also saw individuals at the edge of coniferous woodlands. Other Mediterranean lizards also occur in coniferous woodland, in spite of lower refuge availability and worse thermal quality (AMO et al. 2007). SANTOS et al. (2008) stated that another typical lacertid from the Mediterranean, *Psammodromus algirus* (Linnaeus, 1758), appeared more often in deciduous woodland because of its higher supply of arthropods in the leaf litter layer. In Israel, abundance does not seem to meet this assumption, because most of the observed lizards were related to evergreen oak woodlands. CORBETT (2001) equally detected reliance on leaf litter for *L. viridis* and *L. bilineata*, and the present study gives a similar impression, as in most study plots leaf litter plays a considerable role.

Even in woodland sites, the most important element for the presence of *Lacerta* spp. is the understorey of grasses and shrubs (AGASYAN et al. 2008). *L. strigata* was found to inhabit semi-shrubs and sparse shrubby vegetation with rocky microsites. In contrast to our conclusion that semi-open landscapes represent the preferred habitat, KATI et al. (2007) found that *Lacerta trilineata* preferentially occupied open habitats in Greece and did not occur syntopically with *Ophisops elegans*, which prefers semi-open landscapes. *Lacerta viridis* can be counted an arboreal species in xerothermic nutrient-poor open pine forests which uses steep slopes on humic soils but also populates margins of man-made installations, such as railways, streets and plantations, which provide a stable composition of appropriate open ground vegetation structures (ELBING 2001, MIKÁTOVÁ 2001, COVACIU-MARCOV et al. 2009). For *L. bilineata* and *L. viridis*, various authors observed a strong association with the borders between different structural elements, such as open habitats, like dense grassland in combination with shady areas, such as pine woodland (CORBETT 2001, BERGMANN & FRITZ 2002, VANHOODYDONCK & VAN DAMME 2003, SOUND 2006).

The most widespread Green Lizard, *L. agilis*, shows different activity patterns and habitat uses (ELBING 2001). Whereas COVACIU-MARCOV et al. (2009) noticed *L. agilis* in more humid areas and in heights above 700 m vegetation, STUMPEL (2004) allocated it to forest margins and openings in heathlands on dry, sandy soil in open areas.

**Conservation implications.** There is a lack of detailed quantitative information on the ecology of the Levant Green Lizard. ESTERBAUER (2005) suggested the existence of small and isolated relict populations on the Golan Heights, and our study further reinforces suggestions that Galilee and Carmel populations most likely have declined. To assess the process of potential local extinction, more surveys with mapping and reliable repetition of population counts are indispensable. Understanding dynamics and movements of cryptic species with sparse population densities is time-consuming and difficult, but necessary for their effective protection (CORBETT 2001, STUMPEL 2004).

A species-specific conservation plan has not yet been established, though the Levant Green Lizard appears in the Israeli National Red List of Vertebrates and is protected by general wildlife legislation. A conservation management plan tailored to local conditions is needed, because of ongoing habitat destruction due to Israel's intense rate of urbanization and industrialization. The implementation of a "Green-Lizard Action Plan" would need to include appropriate habitat treatment. It is imperative to maintain structurally variable and heterogeneous environments, which are at risk from large-scale agriculture or reforestation. Structural variability is important for biodiversity conservation and can be ensured by the ongoing extensive use of semi-open landscapes (e.g. REDECKER et al. 2002, BUSE et al. 2008).



Grazing can be used to prevent overgrowth and create stable vegetation composition. Traditional extensive goat-grazing on a small scale is more conducive for maintaining lizard habitats than intensive cow pasturing (MARTIN & LOPEZ 2002, TALBI 2007). The protection and conservation of 'batha' is a prerequisite for the maintenance not only of the Levant Green Lizard populations but also of a species-rich fauna in the same habitat (cf. TIMM et al. 2009). It is crucial for future conservation of the lizard to maintain some patches devoid of vegetation and to connect small isolated habitats. In particular, ruderal areas near plantations and housing developments should be maintained, because they play an important role for overall structural richness of the landscape. Creating additional habitats suitable for *L. m. israelica* enhances the viability of the species (STUMPEL 2004). These arrangements could be profitable for other reptile species as well. Special attention should also be paid to the predators: increasing populations of wild boars prey on lizard egg clutches and feral cats are one of the main threats for Israeli wildlife in general (BRICKNER-BRAUN et al. 2007). Furthermore, we recommend a comprehensive public education campaign. This would incorporate prevention against intentional killing of alleged venomous animals, illegal trapping, and "genetic pollution" by introductions of non-native species (ESTERBAUER, pers. comm., MIKÁTOVÁ 2001). In the long term, the impacts of measures on the population development must be checked by continuous monitoring.

**Acknowledgements.** JL was kindly supported by a student scholarship of the German Academic Exchange Service (DAAD). License No. 32964 of Nature and National Parks Protection Authority in Israel was obtained to conduct observatory trespassing in the field. We thank the Meron Field School of the Society for the Protection of Nature in Israel for allowing us to use their facilities. We are grateful to Jörn BUSE, Kerstin ELBING, Hans ESTERBAUER, Tamar MARCUS, Hans-Konrad NETTMANN and Silke RYKENA for collaboration and for providing helpful information. Many thanks to Joern FISCHER for comments on an earlier version of the manuscript and to Henrik VON WEHRDEN for comments on the analysis.

## References

- AGASYAN, A., B. TUNIYEV, D. COGALNICEANU, J. WILKINSON, N. ANANJEVA, N. ORLOV, P. LYMBERAKIS, P.-A. CROCHET, A. M. M. DISI, S. HRAOUI-BLOQUET, R. SADEK, Y. WERNER, V. TOK, I. UĞURTAŞ & M. SEVINÇ (2008): *Lacerta media*. IUCN Red List of Threatened Species. Version 2009.2. – Retrieved 27.xii.2009, from [www.iucnredlist.org](http://www.iucnredlist.org).
- AMITAI, A. & A. BOUSKILA (2001): Handbook of amphibians and reptiles of Israel. – Keter Publishing House Ltd.
- AMO, L., P. LOPEZ & J. MARTIN (2007): Natural oak forest vs. ancient pine plantations: lizard microhabitat use may explain the effects of ancient reforestations on distribution and conservation of Iberian lizards. – *Biodiversity and Conservation* 16(12): 3409-3422.
- BERGMANN, F. & K. FRITZ (2002): Das Vorkommen der westlichen Smaragdeidechse (*Lacerta bilineata*) am Tuniberg. – *Naturschutz am südlichen Oberrhein* 3: 179-184.
- BISCHOFF, W. (2005): Die echten Eidechsen der Familie Lacertidae - eine Übersicht. – *Draco* 21(5): 4-27.
- BLOMBERG, S. & R. SHINE (2006): Reptiles. In: W. J. SUTHERLAND (Ed.), *Ecological census techniques. A handbook*. – Cambridge, p. 218-226.

- BOGIN, Y., A. BOUSKILA, D. HAWLENA, Z. KULLER & B. SHAHAM (2004): The Red Book of Vertebrates in Israel. – Nature Parks Authority and Society for the Protection of Nature in Israel, Jerusalem.
- BÖHME, W. & C. CORTI (1993): Zoogeography of the lacertid lizards of the western Mediterranean basin. In: VALAKOS, E. D., W. BÖHME, V. PÉREZ-MELLADO & P. MARAGOU (Eds), Lacertids of the Mediterranean region. – Athens, Hellenic Zoological Society, p. 17-33.
- BRICKNER-BRAUN, I., E. GEFFEN & Y. YOM-TOV (2007): The domestic cat as a predator of Israeli wildlife. – Israel Journal of Ecology & Evolution 53: 129-142.
- BUSE, J., T. LEVANONY, A. TIMM, T. DAYAN & T. ASSMANN (2008): Saproxyllic beetle assemblages of three managed oak woodlands in the East-Mediterranean. – Zoology in the Middle East 45: 55-66.
- CARRETERO, M. A. (2004): From set menu to à la carte. Linking issues in trophic ecology of Mediterranean lacertids. – Italian Journal of Zoology, Suppl. 2: 121-133.
- CHEYLAN, M. & P. GRILLET (2005): Former and current status of the ocellated lizard *Lacerta lepida* in France. Implications in terms of conservation. – Vie et milieu - Life and Environment 55: 15-30.
- CORBETT, K. (2001): Status, threats and conservation requirements of *Lacerta bilineata* on Jersey. In: K. ELBING & H. K. NETTMANN (Eds). – Mertensiella 13: 98-104.
- COVACIU-MARCOV, S. D., A. S. CICORT-LUCACIU, F. DOBRE, S. FERENTI, M. BIRCEANU, R. MIHUT & A. STRUGARIU (2009): The herpetofauna of the Jiului Gorge National Park, Romania. – North-Western Journal of Zoology 5: 1-78.
- DANIN, A. (1988): Flora and vegetation of Israel and adjacent areas. p. 129-159. In: Y. YOM-TOV & E. TCHERNOV (Eds), The zoogeography of Israel. The distribution and abundance at a zoogeographical crossroad. – Dordrecht.
- DIAZ, J. A. (1991): Temporal patterns of basking behavior in a Mediterranean lacertid lizard. – Behaviour 118: 1-14.
- DIEGO-RASILLA, F. J. & V. PEREZ-MELLADO (2003): Home range and habitat selection by *Podarcis hispanica* (Squamata, Lacertidae) in Western Spain. – Folia Zoologica 52: 87-98.
- DISI, A. M. (1991): A contribution to the herpetofauna of Jordan. 4. Lizards of Jordan. – Zoology in the Middle East 5: 25-36.
- DISI, A. M. & W. BÖHME (1996): Zoogeography of the amphibians and reptiles of Syria, with additional new records. – Herpetozoa 9(1/2): 63-70.
- DISI, A. M., D. MODRÝ, P. NEČAS & L. RIFAI (2001): Amphibians and reptiles of the Hashemite Kingdom of Jordan. An atlas and field guide. – Frankfurt a.M.
- DOWNES, S. & R. SHINE (1998): Heat, safety or solitude? Using habitat selection experiments to identify a lizard's priorities. – Animal Behaviour 55: 1387-1396.
- ELBING, K. (2001): Die Smaragdeidechsen- Zwei (un)gleiche Schwestern. – Bochum.
- ESTERBAUER, H. (2005): Zur Ökologie und Terrarienhaltung der Östlichen Riesensmaragdeidechse, *Lacerta media israelica*, Peters 1964. – Draco 6(1): 42-47.
- FRITZ, K., P. SOWIG & H. LAUFER (2001): Verbreitung und Bestandssituation der Westlichen Smaragdeidechse (*Lacerta bilineata*) in Baden-Württemberg. – Mertensiella 13: 111-122.
- GHAZAL, A. (2008): Landscape ecological, phytosociological and geobotanical study of Eu-Mediterranean in West of Syria. – Ph.D. thesis, University of Hohenheim, Faculty of Agricultural Sciences, Stuttgart-Hohenheim.
- GODINHO, R., E. G. CRESPO, N. FERRAND & D. J. HARRIS (2005): Phylogeny and evolution of the green lizards, *Lacerta* spp. (Squamata: Lacertidae) based on mitochondrial and nuclear DNA sequences. – Amphibia-Reptilia 26: 271-285.
- GODINHO, R., N. FERRAND & E. G. CRESPO (2001): Phylogeography of the Iberian Schreiber's Green Lizard (*Lacerta schreiberi*): preliminary data on mitochondrial and nuclear markers reveal discrepant patterns. – Mertensiella 13: 33-39.
- HEATWOLE, H. (1977): Habitat selection in Reptiles. P. 137-156. In: C. GANS & D. W. TINKLE (Eds), Biology of the Reptilia. Ecology and Behaviour. Vol. 7. – Michigan.
- HIJMANS, R. J., S. E. CAMERON, J. L. PARRA, P. G. JONES & A. JARVIS (2006): The WorldClim Interpolated Global Terrestrial Climate Surfaces, version 1.4. (Retrieved 10.12.2009, from [www.worldclim.org](http://www.worldclim.org)).

- KABISCH, K. (1990): Wörterbuch der Herpetologie. – Leipzig.
- KATI, V., J. FOUFOPOULOS, Y. IOANNIDIS, H. PAPAIOANNOU, K. POIRAZIDIS & P. LEBRUN (2007): Diversity, ecological structure and conservation of herpetofauna in a Mediterranean area (Dadia National Park, Greece). – *Amphibia-Reptilia* 28: 517-529.
- LIPHSCITZ, N. & G. BIGER (1990): Ancient dominance of the *Quercus-Calliprinos Pistacia-Palaestina* Association in Mediterranean Israel. – *Journal of Vegetation Science* 1(1): 67-70.
- MARTIN, J. & P. LOPEZ (1999): When to come out from a refuge: risk-sensitive and state-dependent decisions in an alpine lizard. – *Behavioral Ecology* 10: 487-492.
- MARTIN, J. & P. LOPEZ (2002): The effect of Mediterranean dehesa management on lizard distribution and conservation. – *Biological Conservation* 108: 213-219.
- MAZA, E. & T. DAYAN (2007): Reptiles' diversity in three habitats: pine plantations, natural maquis and Mediterranean batha in the Meron mountain range. – M.Sc. thesis, Tel Aviv University, Department of Zoology, Tel Aviv.
- MIKÁTOVÁ, B. (2001): The Green Lizard, *Lacerta viridis* (Laurenti, 1768), in the Czech Republic: distribution, ecology and conservation aspects. – *Mertensiella* 13: 138-149.
- NETTMANN, H. K. (2002): Die Smaragdeidechsen (*Lacerta* s. str.). – Eine Übersicht über Verwandtschaft und Formenvielfalt. – *Mertensiella* 13: 11-32.
- NEVO, E., S. RAZ & A. BEILES (1996): Biodiversity of reptiles at "Evolution Canyon", Lower Nahal Oren, Mount Carmel, Israel. – *Israel Journal of Zoology* 42(4): 395-402.
- PETERS, G. (1964): Studien zur Taxonomie, Verbreitung und Oekologie der Smaragdeidechsen. III. Die orientalischen Populationen von *Lacerta trilineata*. – *Mitteilungen aus dem Zoologischen Museum Berlin* 40: 185-249.
- REDECKER, B., P. FINCK, W. HÄRDTLE, U. RIECKEN & E. SCHRÖDER (2002): Pasture landscapes and nature conservation. – Berlin.
- RODDER, D. & U. SCHULTE (2010): Potential loss of genetic variability despite well established network of reserves: the case of the Iberian endemic lizard *Lacerta schreiberi*. – *Biodiversity and Conservation* 19(9): 2651-2666.
- SANTOS, T., J. A. DIAZ, J. PERÉS-TRIS, R. CORBONELL & J. L. TELLERIA (2008): Habitat quality predicts the distribution of a lizard in fragmented woodlands better than habitat fragmentation. – *Animal Conservation* 11: 46-56.
- SCHAEERS, H. & R. VAN DAMME (2002): Micro-scale differences in thermal habitat quality and a possible case of evolutionary flexibility in the thermal physiology of lacertid lizards. – *Oecologia* 132: 323-331.
- SCHMIDTLER, J. F. (1986): Orientalische Smaragdeidechsen: 2. Über Systematik und Synökologie von *Lacerta trilineata*, *L. media* und *L. pamphylica*. – *Salamandra* 22: 126-146.
- SCHMIDTLER, J. F. (2001): Zur Verbreitung, Habitatwahl und Chorologie der türkischen Smaragdeidechsen (*Lacerta* s. str.). – *Mertensiella* 13: 165-187.
- SHENBROT, G. & B. KRASNOV (1997): Habitat relationships of the lizard fauna in the Ramon erosion cirque, Negev Highlands (Israel). – *Journal of Zoology* 241: 429-440.
- SOUND, P. (2006): Räumliche und zeitliche Einbindung einer strukturierten Population der Westlichen Smaragdeidechse (*Lacerta bilineata*, Daudin 1802). – PhD Thesis, Johannes Gutenberg University, Mainz.
- STUMPEL, A. H. P. (2004): Reptiles and amphibians as targets for nature management. – PhD Thesis, Wageningen Universiteit, Wageningen.
- TALBI, R. (2007): Life cycle and habitat preferences in *Lacerta media israelica* in the Carmel, Israel. – *Hardun* 7: 97-98.
- TIMM, A., J. BUSE, T. DAYAN, W. HÄRDTLE, T. LEVANONY & T. ASSMANN (2009): At the interface of historical and present day ecology: Ground beetles (Coleoptera: Carabidae) in woodlands and open fields in Upper Galilee (Israel). – *Zoology in the Middle East* 47: 75-104.
- ÜÇÜNÇÜ, S., M. TOSUNOĞLU & S. ISISAG (2004): Electrophoretic comparison of blood-serum proteins of *Lacerta trilineata*, *Lacerta media* and *Lacerta pamphylica* (Sauria, Lacertidae) from Turkey. – *Biologia* 59(2): 297-300.

- VANHOOYDONCK, B. & R. VAN DAMME (2003): Relationships between locomotor performance, microhabitat use and antipredator behaviour in lacertid lizards. – *Functional Ecology* 17: 160-169.
- YOM-TOV, Y. & E. TCHERNOV (1988): Zoogeography of Israel. p. 1-6. In: Y. YOM-TOV & E. TCHERNOV (Eds), *Zoogeography of Israel*. – Dordrecht.

**Authors' addresses:** Jacqueline Loos, Nora Drescher & Thorsten Assmann, Leuphana University Lüneburg, Institute of Ecology, Lüneburg 21335, Germany. – Tamar Dayan, Tal Levanony & Erez Maza, Tel-Aviv University, Department of Zoology, Tel Aviv 69978, Israel. – Boaz Shacham, Hebrew University of Jerusalem, Department of Evolution, Systematics and Ecology, Jerusalem 91905, Israel. – Roy Talbi, University of Haifa, Faculty of Science and Science Education, Haifa 31905, Israel. – Email contact: loos@leuphana.de.