

0,559, $P < 0,0001$, $n=619$; correlazione di Pearson). La dimensione di covata di uova sferiche è significativamente diversa tra le varie aree geografiche ($Z = 22,317$; gdl. 3; $P < 0,0001$), mentre la dimensione di covata delle uova ellittiche non varia tra le varie aree geografiche ($Z = 3,951$; gdl = 3; $P = 0,267$).

Abstract. The reproduction of *Podarcis siculus* has been studied in depth only in the '70ies, underlining all the developmental cycle of ovaries, follicles and of oocytes throughout the whole seasonal cycle, clearly describing the ovulatory period. Even though *P. siculus* is an Italian widespread lizard, variability of its reproductive patterns, as number of clutches per season, clutch size (some anecdotal notes in the '80ies) as well as egg size, geographical and altitudinal variation in the Italian country is virtually not known. Our research has been aimed at presenting for the first time the largest available reproductive data set of *P. siculus* females, representative of the whole Italian distributive area and of some other localities. We have considered preserved specimens. We selected females of March-August, the known ovulation period. We analysed not only adult mature females ($SVL \geq 50$ mm), but also many smaller ($SVL \geq 40$ mm), and some others outside reproductive period, as outgroups. A female (RF) was considered as reproductive when at least one follicle was grey-yellow-brown in colour and larger than the other, usually whitish, undeveloped follicula. When ovary was evidently not developing, the specimen was coded as not reproductive (NRF). Eggs were of two main shapes, rounded or elongated. Rounded eggs are those developing (follicles in ovaries at the beginning of the ovulatory period and oocytes in ovaries at a late stage of vitellogenesis). Elongated eggs are oocytes in the ovarian ducts. We measured only those follicles and those oocytes that appeared not modified in size and shape. We took the diameter of rounded follicles and we took the maximum length of elongated oocytes. We discarded the maximum width of oocytes to limit any possible bias in size due to damage or other causes occurred during sampling or during fixation in alcohol. Elongated eggs were unshelled or partially shelled. No egg was completely shelled. Females did not differ in both SVL and trunk length (TRL) between continent and large islands, while RF were significantly longer than NRF, and RF and NRF were longer in large islands than in continent (reproductive status \times area interaction). SVL significantly and positively increased from West to East ($\rho_{\text{longitude}} = 0.199$, $P < 0.0001$, $n = 645$) and from North to South ($\rho_{\text{latitude}} = -0.327$, $P < 0.0001$, $n = 645$). Clutch size averaged 4.4 ± 1.6 eggs (1-11). Both SVL and TRL positively correlated with clutch size ($r_{\text{SVL}} = 0.557$, $P < 0.0001$, $n = 619$; $r_{\text{TRL}} = 0.559$, $P < 0.0001$, $n=619$; Pearson correlation). Clutch size with rounded eggs was significantly different among geographical basins ($Z = 22.317$; d.f. = 3; $P < 0.0001$), while clutch size of elongated eggs did not vary among geographical basins ($Z = 3.951$; d.f. = 3; $P = 0.267$).

Una volta qui era tutta campagna: asimmetria fluttuante e stress ambientale nella lucertola muraiola (*Podarcis muralis*)

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Riassunto. Quando le popolazioni in natura sperimentano condizioni sub-ottimali di sopravvivenza, i meccanismi coinvolti nella regolazione del fenotipo durante l'ontogenesi possono essere sottoposti a dura prova. L'effetto principale di questo stress è un incremento della variabilità fenotipica che può essere il risultato sia di modificazioni dell'espressione genica, sia di un deterioramento dei meccanismi che regolano lo sviluppo. Lo sviluppo di *biomarkers* che siano poco costosi, affidabili e facili da investigare, è di primaria importanza nel monitoraggio degli impatti dei fattori di stress ambientali sui sistemi biologici. I *biomarker* morfologici sono particolarmente promettenti in quanto economici, richiedono poco tempo e non sono invasivi. Tra essi l'asimmetria fluttuante (FA) è quello più utilizzato poiché funziona come *proxy* per l'instabilità dello sviluppo indotto dall'ambiente. Alcuni autori hanno recentemente proposto di utilizzare la FA nei tratti morfologici della lucertola muraiola (*Podarcis muralis*) come utile strumento per valutare lo stress ambientale in ambienti urbani. I risultati tuttavia non possono essere generalizzati perché oltre ad essere stato testato precedentemente in una sola città, l'effetto dello stress non è stato convalidato da misurazioni indipendenti. In questo studio abbiamo effettuato le stesse analisi replicandole in tre città del Nord Italia comparando l'intensità della FA in 4 tratti morfologici tra popolazioni urbane e naturali. Sono state anche misurate le condizioni di salute delle lucertole tramite la formula leucocitaria. La correlazione tra FA e habitat è risultata molto debole se non del tutto assente. Le lucertole appartenenti alle popolazioni urbane non erano in condizioni fisiologiche peggiori di quelle appartenenti ad ambienti naturali. Infine abbiamo rilevato che parte della variabilità associata alla FA e alle misure ematiche dipendono da una o più variabili latenti non direttamente osservate nello studio, ma comunque non collegate all'habitat. I nostri risultati ci suggeriscono che è troppo semplicistico affermare che le FA siano un *biomarker* affidabile per investigare lo stress dato dall'ambiente urbano sulle lucertole muraiole. Nonostante tutto, la FA nella morfologia di questa specie ha il potenziale per essere usato come *biomarker* di stress a patto che siano prima chiariti i meccanismi di sviluppo, le reali cause dello stress, le loro interazioni e i loro effetti sulla fisiologia della specie.

Abstract. When population goes undersub-optimal conditions of survival, mechanisms involved in regulating the phenotype during ontogenesis can be subjected to strain. The main effect of this stress is an increase in phenotypic variability that can be the result of changes in gene expression and deterioration of the mechanisms regulating the ontogenetic development. The development of *biomarkers* that are cheap, reliable and easy to investigate, is of paramount importance in monitoring the impacts of environmental stressors on biological systems. Morphologic *biomarkers* are particularly promising because they are cheap, require a little time and are not invasive. Among them, the fluctuating asymmetry (FA) is one of the most used because it works as a *proxy* for the developmental instability induced by environment. Some authors have recently proposed to use the FA in morphological traits of the common wall lizard (*Podarcis muralis*) as a useful tool to assess environmental stress in urban environments. However, the result cannot be generalized because in addition to being previously tested in a single city, the effect of stress has not been validated by independent measurements.

In this study we performed the same analyses replicating them in three cities of northern Italy comparing the intensity of the FA in 4 morphological traits between populations from urban habitats and from natural habitats. The health conditions of lizards have also been measured by blood

sampling analyses.

The correlation between FA and habitat was very weak if not completely absent. The lizard belonging to the urban populations were not in worse physiological conditions than those belonging to natural environments. Finally, we found that some of the variability associated with to the FA and the blood measurements depend on one more latent variables not directly observed in the study, but still not related to the habitat.

Our results suggest that it is too simplistic to say that the FA is a reliable *biomarker* to investigate the stress given from the urban environment in the common wall lizards. Despite everything, the FA in the morphology of this specie has the potential to be used as a stress *biomarker* provided they are first clarified mechanisms of development, the real causes of stress, their interactions and theirs effects on physiology of the species.

Praia
1998

TWENTY YEARS AFTER

Cosenza
2018