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A Population Analysis of the Common Wall Lizard *Podarcis muralis* in Southwestern France

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Within the last twenty years, emphasis has been placed on the quantitative approach to the structure and function of natural populations. Nonetheless, data that document temporal and geographic variation in life histories and demographic patterns among populations and species of European lizards are still very scarce, except for Lacerta vivipara /Pilorge, 1981; Pilorge and Castanet, 1981; Heulin, 1985/. Although it is a common and abundant species in central and southern Europe, the wall lizard Podarcis muralis /LAURENTI/ has been poorly studied from a demographic point of view. If we except a note of Castanet and Roche /1981/ about age structure, the only known demographic study is that of Strijbosch et al. /1980/ for the northernmost population in the Netherlands.

The present study provides data on life history of a population of Podarcis muralis from southwestern France, as a first step of a comparative approach to population dynamics of the species within southern France.

STUDY AREA

The study site was a 0.52 ha cemetery located outside a small town /Juillac, Correze/. The habitat was characterized by numerous regularly spaced tombstones providing the lizards with many refuges and basking places. The vegetation is a lawn dotted with some thickets of hydrangea and various trees. The cemetery is partially enclosed with a wall along the eastern side and a hedge-row along its western side. It was bounded on its northern hedge by a damp meadow within which a heavy grass layer made it unsuitable for the wall lizard.

Within the cemetery the wall lizard coexisted with a small population of Lacerta viridis.

METHODS

The study began in the summer of 1979 and work continued to the summer of 1981 with some occasional checks until July 1985. Censuses were made regularly from early July to early September in 1979, 1980 and 1981, as well as in April 1980 and 1981. The area was surveyed by walking between rows of tombstones until the entire area was covered. Animals were noosed or caught by hand. They were toe-clipped, painted with a unique red dot on the dorsum, weighed and released. Each summer an attempt was made to mark the larger part of the resident lizards within the boundaries of the cemetery.

The size of the population was established from recapture data. Two kinds of recaptures were used: true captures by noosing or handling, which allowed us to assess the identity of the individuals, and "visual captures", by sighting, which did not. Although the first technique could provide richer data than the second, the latter was more frequently used because it allowed us to easily repeat the "recapture" operations over few successive days without disturbing the animals. In July, virtually all animals could be realiably "partially" aged /hatchlings, subadults or yearlings - having overwintered only once - and adults, $\geqslant$ 2 year-old animals/ from size at initial capture.

Information on reproductive cycle, clutch size and clutch frequency was obtained from females collected outside the study area. Animals were autopsied and the number and size of yolking ovarian follicles, oviductal eggs and corpora lutea were noted.

REPRODUCTION

Field collections were limited to April and July. Of 62 mature females collected in April, 51.6 percent had ovarian eggs, 37.1 percent had oviducal eggs. The following data on clutch size were taken from these specimens. There were no significant differences between the years so the data were pooled. Mean clutch size was 6.06 in April /first clutch/, 4.33 in July /third clutch/. The regressions of clutch size on snout-vent length were significant. The reproductive season for females extended from early April to late July, although only a few females laid eggs in July. First clutch deposition would presumably occur between late-April and mid-May. Because some females contained both oviducal eggs and yolked ovarian eggs indicating a future clutch, there is no question that these lizards produce more than a single clutch annually.

Thus, most females would likely produce a second clutch between late May and mid-June /as is the case at Chizé, 200 km at the west, Y. P. MOU personal observation/. Some females /those bearing oviducal eggs in July/ laid a third clutch in late June or in July. Based on Mou´s data from the population of Chizé, we assumed a third clutch was deposited only by the 3-year old or older females.

SIZE AND GROWTH

Young P. muralis hatched between late July to mid-September. The smallest hatchlings were 22 mm SVL. The mean size was 33.4 mm during the second half of August. In early April, the SVL of young ranged betwen 34 mm and 49 mm /mean = 40.59 SD = 3.90/. By early August, they had reached 53.7 mm for males but only 51.0 mm for females /Fig. 1/.

The available intraseason recaptures together with size data from marked animals in different years provide a fairly accurate indication of yearlings and adult individuals growth. Within summer growth rates were calculated for marked individuals upon interval times of 15 to 50 days in 1979, 1980 and 1981 /Tab. 1/. For yearlings average growth rates were very similar in males and females but highly different between 1979 (0.146 mm/days) and 1980/1981 (0.223 mm/days in 1980; 0.224 in 1981). Adult summer growth was clearly slower. In 1979, there was no growth in size for the seven females followed while the ten marked males grew at an average rate of 0.034 mm per day. During the summer of 1980, adults showed growth of 0.041 mm per day for males and 0.038 for females.

Table 1. Mean summer growth rates for marked animals /first row: yearlings; second row: adults/.

	Males				Females			
	N	$\overline{SVL}$	growth rate mm.d^{-1}	SD	N	$\overline{SVL}$	growth rate mm.d^{-1}	SD
79	13	53.4	0.143	0.048	20	52.1	0.148	0.216
80	27	53.5	0.225	0.099	22	49.8	0.222	0.111
81	17	54.4	0.227	0.055	19	51.1	0.222	0.092
79	10	63.6	0.034	0.029	7	64.1	0.001	0.004
80	9	65.2	0.041	0.046	9	62.9	0.038	0.041

Adult growth data are difficult to interprete since they were too few, moreover they concerned two-year old individuals as well as older ones.

SIZE AND AGE AT SEXUAL MATURITY

The smallest female showing signs of sexual maturity was 54 mm SVL /15 April 1981/. She contained ova in early stages of vitellogenesis. The smallest female containing oviducal eggs was 57 mm SVL /16 April 1981/. Data from marked females indicated that only two-year old females could exceed 54 mm by April. Thus, all the females do not mature until they are nearly two-year old.

POPULATION AGE STRUCTURE

The age structure of the population can be partly derived from size distributions among the animals handled in July and August /Fig. 1/. Their SVL were adjusted for July 20th using the average growth rates calculated for each demographic category. Setting the minimum adult size to 57 mm for females, and 59 for males, the percent of yearlings was 65.9 in July 1979, 70 in 1980 and 71.3 in 1981. Among adults it was not possible to accurately derive age from size. Therefore, age structure of the adult subpopulation was derived from recapture samples of aged individuals. Pooling 1980 and 1981 data, it appears that the percent of two-year old individuals was 46.9 for males and 65.9 for females. It was not possible to assess accurately the age of older individuals except for the small 1981 sample: 6 of the 7 recaptured females were three-year old while among 10 males, 6 were three-year old, 2 were four-year old or older and 2 uncertain / $\geqslant$ 3 years/. The oldest animals recaptured in this study were five-year old /one female/ or older /one individual of each sex/.

DENSITY

Density estimates were made for the second half of July /1979, 1980/ or a period extending from mid-July to mid-August /1980, 1981, 1984/. In 1979, 1980, 1981 and 1984, 203, 199, 168 and 140 animals were handled respectively. These figures are exclusive of hatchlings. Applying the Bailey estimator for multiple recaptures we found, between 1979 and 1981, an average of 276 lizards /hatchlings excluded/ on the study area /5250 m^2/ or about 525 per hectare /Tab. 2/. The population size was slightly lower in 1984, with 239 lizards in the cemetery area /but after removing many adult individuals in 1982 and 1983 for controling age determination by the skeletochronological method upon known-age marked individuals/.

Table 2. Size and density of the cemetery population estimated by mark recapture for mid-July /newborns excluded/. M: maximum number of marked individuals / ≥ 1 year-old/ observed in that summer; N: estimated number of individuals living in the cemetery with corresponding SD; Na: number of adults / ≥ 2 years-old/; ♀ : number of adult females.

Year	M	N	SD	N_a	♀	N/ha	SD
VII.1979	205	273	17	93	52	520	32
VII.1980	203	291	64	85	45	554	122
VII.1980*		273*	21			519	40
VII.1981	168	273	67	78	34	520	127
VIII.1984	140	239	27	90	45	456	51

*This second value was given from several recapture-samples obtained in mid-August and may be considered as estimating the population size for late-July or early-August.

Estimates of hatchling production were made for 1979 and 1983. We used the hatchlings handled in late July and through August as the capture sample and the yearlings collected in the next July as the recapture-sample. If the average survival probability of the hatchlings emerging in September was different from that of those marked earlier such estimates would be biased. We found 426 /SD = 107.9/ hatchlings were produced in 1979 on the study area and 595 /DS = 124.3/ in 1983. The corresponding densities per ha were 811 and 1133 respectively.

SURVIVORSHIP

Interannual survivorship schedules were computed for known aged animals between successive summers by two ways.

Table 3. Recaptures rates of marked individuals.

Age at t_0	Males			Females		
	n_0	n_1	rate	n_0	n_1	rate
(< 2 months)	107*	18	0.170	108	40	0.370
(1 year old)	133	18	0.135	134	32	0.239
(≥ 2 years)	59	15	0.254	76	14	0.184

*newborns were not sexed. We assumed there was 50 % females in the sample.

From recapture data of marked individals we had got only subestimations of survivorship rates, since some marked individuals might escape recapture operations. There were consistent overall differences in survivorship between the sexes /Tab. 3/: they were higher in females for hatchlings /0.370 against 0.168 in males/ and for yearlings /0.239 against 0.135/ but the reverse was true for adults /0.254 in males against 0.184 in females/. Although there were significant variations between years these trends remained.

A second way to assess mean survival rates for known aged cohorts was to compute them from the average age-structure of the 1979-1981 mean population assumed to be roughly stationnary. With an average size of 276 individuals /hatchlings excluded/ the population of the cemetery had an average of 85 adults, 44 of which were females. Among these adults 48 may be assumed to be two-year old, 29 females and 19 males. From these data, we find an average survivorship of 28.15% for females /29 two-year females compared to 103 yearling/ and of 21.6% for males /19:88/.

CONCLUSION

The dynamics of this population is characterized by an overall striking stability of numbers between years, despite the variability of climatic conditions, a high turnover rate among the adult subpopulation, clear differences in apparent survivorship between the sexes, as well as in newborn in adults.

The differences of recapture rate between males and females, particularly among hatchlings, is questionable. The overall recapture rate for young between 1979 and 1980 /0.390/ is consistent with the survivorship rate estimated as the quotient of yearlings living in the cemetery in July 1980 /197/ to the number of hatchlings produced in the summer of 1979 /426/: 0.462. However, the sex ratio among yearlings was exactly 1/1 in 1980.

Why did we obtain such a higher recapture rate for females between 79 and 80/0.490 against 0.288 for males/? Since the hypothesis of unequal capturability between sexes among yearlings is very unlikely it may be thought that such a difference results from a differential mobility between young males and young females: there was higher dispersability in males than in females. If there is a statistical balance between the number of males leaving the cemetery and those entering into it the sex ratio among yearlings can remain unchanged.

REFERENCES

BAILEY, N. T. J. /1952/: Improvements in the interpretation of recapture data. - J. Anim. Ecol., 21 : 120-127.

CASTANET, J., ROCHE, E. /1981/: Détermination de l'âge chez le lézard des murailles, Lacerta muralis /Laurenti, 1768/ au moyen de la squelettochronologie. - Revue suisse Zool., 88 : 215-226.

HEULIN, B. /1985/: Démographie d'une population de Lacerta vivipara de basse altitude. - Acta Oecologica, Oecol. gener., 6 : 261-280.

PILORGE, T. /1981/: Structure et dynamique d'une population du lézard vivipare. - Publ. Lab. Zool., E. N. S., 18 : 1-152.

PILORGE, T., CASTANET, J. /1981/: Détermination de l'âge dans une population naturelle du lézard vivipare /Lacerta vivipara Jacquin 1787/. - Acta Oecologica, Oecol. gener., 2 : 3-16.

STRIJBOSCH, J. J., BONNEMAYER, A. M., DIETVORST, P. J. M. /1980/: The northernmost population of Podarcis muralis /Lacertilia, Lacertidae/. - Amphibia-Reptilia, 1 : 161-172.

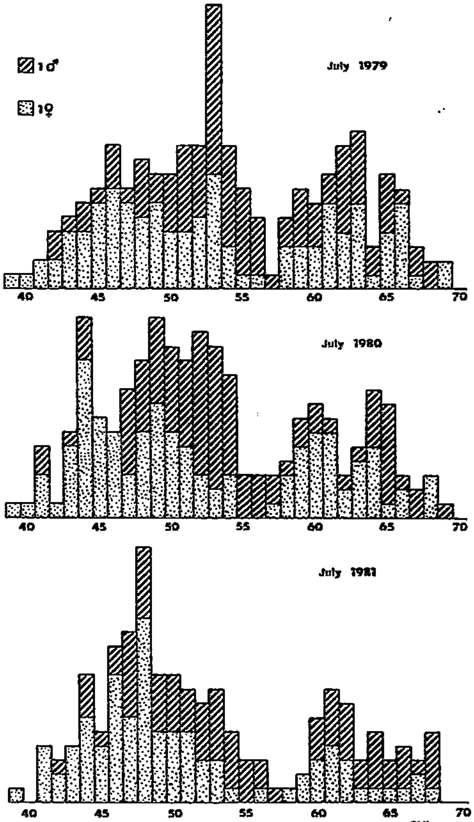

Fig. 1: Size structure of the lizard population in July 1979, 1980 and 1981.