

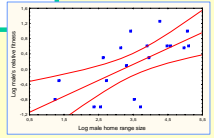


Spatial organization of a population of *Podarcis milensis*

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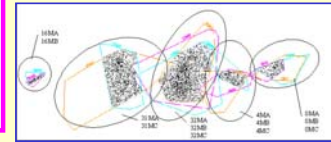
- 3) Number of overlapping males or females was significantly correlated with male home range size ($R^2 = 0.22$, $F_{1,19} = 5.38$, $p = 0.03$, $r = 0.47$ for number of overlapping males & $R^2 = 0.23$, $F_{1,17} = 5.16$, $p = 0.03$, $r = 0.48$ for number of overlapping females).
- 4) The larger a male's home range, the bigger its relative fitness ($R^2 = 0.42$, $F_{1,17} = 12.17$, $p = 0.003$, $r = 0.65$).
- 5) The percentage of a male's home range overlapped by other males was positively correlated with the percentage of the focal male's home range overlapped by the total number of individuals (males + females) ($R^2 = 0.27$, $F_{1,19} = 7.28$, $p = 0.01$, $r = 0.53$). The same was found for the overlapping females on a male's home range: $R^2 = 0.34$, $F_{1,17} = 8.77$, $p = 0.008$, $r = 0.58$.



Home ranges of males & females in October. Yellow: males, red: females



Male home range fidelity. A: May, B: July & C: October, e.g. M: male #4



Some facts about this population^{1,3}

- Adult SVL = 42-70mm
- Sexual Size Dimorphism = 1.13
- Sex Ratio
- winter/spring/summer/fall = 1.22/0.64/0.54/0.51
- Reproductive season: January-August depending on the weather
- Reproductive output: multiple clutches/year
- Mean clutch size: 1.73 eggs (1-3)
- Hatching size: 24-31mm

Methods. **Study area:** an homogeneous, sandy, back-dune ecosystem, but patchy in terms of food and shelter resources. 52% of the study plot (70 x 30 m) is covered by vegetation (*Juniperus oxycedrus* ssp. *macrocarpa*: 62.23% of the vegetation & *Coridothymus capitatus* 22.54%, more than 100 individuals³). The rest of the plot is open area of bare sand. **Field work:** carried out during three different samplings on May, July & October of 2002. Lizards were captured with a noose on the field site marked in an X/Y coordinate system. Standard procedures of marking (toe-clip & paint mark) and measuring [SVL(mm), mass(gr), estimate of black color on male's throat] lizards were followed. Upon sighting of a lizard its exact location was recorded on the map. Behavioral interactions between individuals were also noted. **Data analysis:** Home range area was estimated with the minimum convex polygon method (Calhorne software). Mapping of home ranges and estimation of overlaps were done in AutoCAD MapR3 while for the statistical analysis STATISTICA software was used. For the analysis we have calculated: **Percent overlap:** Percent of the focal individual's home range shared with one or more other individuals of the specified sex. **Relative fitness for an individual male:** the absolute number of females within a male's territory divided by the mean number of females per male territory².

Results

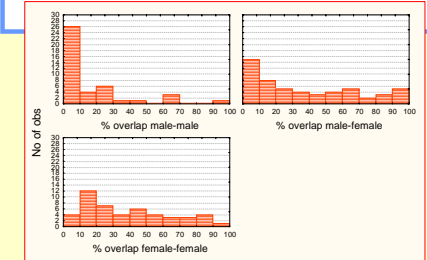
Use of space. The mean home range for males was 48.62 m² and for females 28.98 m² (there was no significant difference between them: Mann-Whitney, U=224, p=0.22). Mean male/female home range ratio was 1.67. (440 observations for 27 males and 316 observations for 21 females).

	Home Range (m ²)		
	Mean	Range	SE
Males	48.62	3.46-144.03	9.05
Females	28.98	2.27-97.07	5.07

• On average, each male overlapped 1.5 ± 0.23 (n=27, range=0-4) other males and 2.0-3.9 (range=0-6) females (there is no significant difference between them: Mann-Whitney, U=353.5, p=0.85) while each female overlapped with 2.57 ± 0.27 (n=21, range=1-6) males and 2.28 ± 0.41 (range=0-5) other females (there is no significant difference between them: Mann-Whitney, U=196, p=0.54).

• On average, 16.22 ± 3.4% (n=42, range: 0.08-100) of a male's home range overlapped with one other male's home range while 37.75 ± 4.41% (n=54, range: 0.18-100) of a female's home range overlapped with one male's home range. Significantly smaller area of a male's home range was overlapped with males than with females (Mann-Whitney, U=679.5, z=-3.35, p=0.0007).

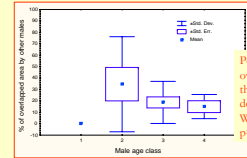
• On average, 38.39 ± 3.78% (n=48, range: 0.97-95.27) of a female's home range overlapped with one other female's home range, which also significantly differs from the male's area overlapped by other conspecifics (Mann-Whitney, U=434.5, z=-4.64, p=0.00004). On the contrary the female's area overlapped with males doesn't differ from that overlapped by other females (Mann-Whitney, p=0.55).



In 85.71% of the cases, less than 30% of a male's home range was overlapped by another male. However, in one occasion, 100% of a male's home range was overlapped by another male while in three other, 64.95, 65.66 & 62.97% of the area of the focal male was overlapped by another conspecific (all during fall). These cases were the following:

	#31 covers 64.95% of #75		#31 covers 65.66% of #84		#73 covers 62.97% of #82		#86 covers 100% of #75	
	#31	#75	#31	#84	#73	#82	#86	#75
SVL	62	52	62	50	61	51	61	52
Age class	3	2	3	2	3	2	3	2
Home range (m ²)	164.03	3.88	164.03	15.29	88.05	12.88	27.11	3.88
% Black	95	5	95	5	90	40	95	5
Relative fitness	1.84	0.74	1.84	0.74	1.84	0.37	1.1	0.74
Nest	5	2	5	2	5	1	3	2
overlapping females (and their dips)	(#57,74, 76,79,80)	(#76,79)	(#57,74, 76,79,80)	(#74,80)	(#7,35, 77,80,7*)	(#80)	(#74, 76,79)	(#76,79)

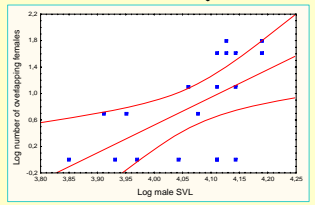
- Note that males #75, 84, 82:
- 1) they all belong to age class 2 (namely age 1+) which means that they were born the previous spring (or summer) and became sexually mature during the subsequent summer (or fall) –males mature in about one year- approximately 15 months^{1,3}.
 - 2) they all have small values of relative fitness and share with the large males 1 or 2 of their females (see # of overlapping females),
 - 3) they all have only a small area of black color on the throat. In fact, the percentage of black color on a male's throat is strongly correlated to the body size (SVL) of the focal male ($R^2 = 0.85$, $F_{1,19} = 112.43$, $p = 0$, $r = 0.92$).



Percentage of a male's home range overlapped by conspecifics according to the age class he belongs (percentages don't differ between them, Kruskal-Wallis ANOVA: H (3,N=27)=2.39, p=0.49)

Correlations

- Males**
- 1) Male body size (SVL) was not correlated with male home range size ($F_{1,25} = 1.06$, $p = 0.31$).
 - 2) Male body size explained 33% of the variation in the number of females overlapped by a male's home range ($F_{1,17} = 8.34$, $p = 0.01$, $r = 0.57$). Thus, males with larger body sizes had more females in their home ranges.



- Females**
- 1) Female body size (SVL) was: 1) marginally not correlated to female home range ($F_{1,19} = 4.15$, $p = 0.05$), 2) positively related to the percentage of overlap from neighboring females ($R^2 = 0.43$, $F_{1,14} = 10.47$, $p = 0.006$, $r = 0.65$). Thus the bigger the female, the more her home range area was shared with female neighbors.
 - 2) The percentage of a female's home range overlapped by males was positively correlated with the percentage of the focal female's home range overlapped by the total number of individuals (males + females) ($R^2 = 0.39$, $F_{1,19} = 12.33$, $p = 0.002$, $r = 0.63$). On the contrary, the same was not found for the overlapping females on a female's home range: $F_{1,14} = 0.46$, $p = 0.5$. Thus, the overall area of a female's home range shared with other individuals (males & females) didn't augment with an increase in the area shared only with neighboring females, a result probably suggesting a clumped distribution of females in space.
 - 3) Female home range size was positively correlated to the number of overlapping males ($R^2 = 0.39$, $F_{1,19} = 12.5$, $p = 0.002$, $r = 0.63$).

Discussion

Males maintain larger territories than females, even if not significantly different. In territorial species and/or populations this is interpreted as a male's effort to get access to as many females as possible⁴. This seems to be the case in this population, since the larger a male's home range the bigger its relative fitness- thus, at least theoretically, home range (territory) size correlates with male mating opportunity. Then again, females of this population are found in small, widely overlapping home ranges. They share the territory of one or more males, fight or chase each other (pers.obs.) but don't seem to defend some area. On the contrary, they occur in a clumped distribution which probably indicates the existence of dominance hierarchies among them.

In a polygynous system few adult males will accomplish most of the reproduction while many others will not be successful^{5,6}. *Podarcis milensis* males attain sexual maturity as yearlings (age 1+), most often though, they do not participate in reproduction until the next year (age 2+) because they are unable to win the contests with older, larger males (field obs. & tetherings, unpubl.data-see also^{7,8}). In the lack of habitat heterogeneity which denotes the absence of marginal or sub optimal habitats where younger males can move to establish a territory, there is no other choice but be within an older male's territory, sharing one or two of its females. This phenomenon together with the increased territory overlap and the acceptance of subordinates has been widely reported for insular species⁹. In our case subordinate males are sexually mature, lightly colored yearlings (age 1+).

Still, male body size was not correlated with home range size. In our system females form groups within a small area (formations maybe favored by the clumped resources^{2,10,11}). This spatial arrangement allows males to maximize number of females in their territory and minimize costs associated with defending additional space- beyond the optimal territory size⁴. However, it is unclear whether males defend females, recourses important to females, or both. It is clear though that males with larger body sizes had more females in their home ranges, a result that could imply female choice: spatially grouped females will attract defense of males with the largest body size and greatest fighting ability¹².

Ecological factors (population density, food supply, visibility, etc) are thought to shape spacing patterns within species and/or populations¹³. In general, lacertids were thought to sporadically present territorial behavior precisely for this reason¹³ (many species inhabit dense areas and have low densities). This population of *P. milensis* reaches 500-600 ind/ha in an open, uniform, sandy habitat-yet patchy in its resources. Visibility is very good and foraging doesn't seem to be a problem since, although in an arid ecosystem, lizards utilize the clumped resources situated in bush patches¹⁴. Another important feature is that home range sizes are small, thus it is quite easy for a male to detect intruders and defend territories. All factors mentioned favor the evolution of territoriality in this population¹⁴. Indeed, our data indicate a territorial, polygynous mating system.

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