

Environmental Changes and Effects on a Population of Smooth Newt *Lissotriton meridionalis* (Boulenger, 1882) (Amphibia, Urodela) in a Mediterranean Woodland

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Abstract — The population of *Lissotriton meridionalis* in the area of “Bosco di Palo” Natural Park are monitored since 1995. From 2004 to 2005 in the area it was carried out a massive cutting of dead trees with evidence of alteration of the undergrowth. The study aims to verify, through the index of the population estimate, if the species has suffered changes in the size of the population following environmental changes. For the research were chosen three ponds in the wood and the data collection took place from the breeding season of 1995 – 1996 to 2014 – 2015, in each of the seasons was made an estimation of the population density. The data obtained are been compared in order to make assessments on the conservation status and persistence of the species in the site, also as a result of environmental changes suffered by “Bosco di Palo” Natural Park. The analysis of the population estimate, used in this work as an index of the conservation status of the species in the Park, confirms that, in the previous period and in the period following the die-off of trees and cutting plant health, we have substantially the same values of population size.

Keywords — *Biscogniauxia mediterranea*, *Lissotriton meridionalis*, “Bosco di Palo” Natural Park, population estimate, temporary pond, terrestrial phase, wood cutting.

I. INTRODUCTION

The present work aims to contribute to know the dynamics of the population of Smooth Newt *Lissotriton meridionalis* (Boulenger, 1882) as a result of environmental alteration due to human activities.

The Smooth Newt *Lissotriton meridionalis* (Boulenger, 1882) is an Amphibian distributed in the Italian peninsula, with the exclusion of the southern regions (RAZZETTI & BERNINI, 2006). Its ecology, in the Mediterranean, is closely influenced by local environmental parameters. The vitality of the populations is closely linked to the conservation of small wetland, often temporary, that allow egg laying and larval

development (BELL & LAWTON, 1975; ACCORDI & NOBILI, 1999; PIZZUTI PICCOLI, 2008).

The smooth newt breeds in both temporary and perennial waters (ponds, lakes, fountains), never in the flowing waters (BELL, 1977; RAZZETTI & BERNINI, 2006). Given the absence of fish, temporary ponds have the advantage of significantly reducing the number of predators present. The temporary ponds, on the other hand, are extremely unpredictable habitats and often a premature drying can destroy a whole generation of larvae.

Metamorphosed individuals spend about two years in the undergrowth before reaching sexual maturity and return for reproduction in the ponds. The adults make terrestrial life outside of the breeding season (GRIFFITHS, 1984; AGREEMENTS et al., 1990).

Actually their habits in the terrestrial phase are still little known; in particular smooth newts seem to use habitats characterized by old tall forests with undergrowth.

The individuals mostly remain in the vicinity of area of deposition (50% within 100 meters, 100% within 700 meters), though they are rarely found, during terrestrial phase, at less than 30 meters from the ponds (RITTENHOUSE & SEMLITSCH, 2007; SEMLITSCH, 2008).

In the “Bosco di Palo” Natural Park, populations of *Lissotriton meridionalis* are monitored since 1995 and we have seen how their status and their reproductive biology are closely correlated with rainfall, temperatures and seasonal filling of temporary ponds (PIZZUTI PICCOLI, 2008; PIZZUTI PICCOLI, 2010).

Since the 90s, the water table of “Bosco di Palo” has suffered a significant decrease, as underlined by the irregularity of filling of the temporary ponds present. Because of the soil drying and the consequent state of water stress of the trees, since 1999, the mushrooms *Phytophthora sp.* and *Biscogniauxia mediterranea* (De Not.) O. Kuntze have given rise to an epidemic that lead to the death of a high percentage of the trees of the forest (FRATICELLI, 2003; PETRICCIONE, 2003; SCARNATI & ATTORRE, 2014; SOLOMOU et al., 2017).

The pathogen has spread through the vessels of wooden fibers cavity, large and empty due to the lack of water so as to colonize the woody tissues, killing the tree in a single growing season.

Consequently, in 2004 and then in 2005 it was carried out a massive cutting of trees in order to eliminate the fungal pathogens. The cut and the removal of the timber was operated mechanically (with the use of a bulldozer), with evidence of alteration of the undergrowth.

The cut has produced the creation of a large clearing in the middle of the forest, characterized by the presence of scattered trees and a uniform layer of sclerophyllous shrubs. The average percentage of coverage of the tree layer, considering the coverage of the upper layer to 8 meters in height, is lower (42%) compared with the computed values for the same site in 1983 (75%) (FRATICELLI & SARROCCO, 2012)

Habitat alteration is now considered one of the possible causes of the decline of amphibian populations in Italy and Europe (D'AMEN & BOMBI, 2009).

The study aims to verify, through the index of the population estimate, if the *Lissotriton meridionalis*, given the importance of the terrestrial habitat during the non reproductive phase of adults and in the period of growth of metamorphosed individuals, has suffered changes in the size of the population following damage to vegetation.

II. STUDY AREA

The "Bosco di Palo" Natural Park (Figure 1) is located 37 km to the north of Rome (Central Italy - IGM Topographic Map Sheet 149 NE IV) and is situated between the sea and the Via Aurelia in locality of Palo Laziale, in the town of Ladispoli (41 ° 56 'N, 12 ° 05 'E). The study area is part of a narrow coastal plain that extends from the delta of the Tiber River and that was formed during the Quaternary period.



Fig. 1: The "Bosco di Palo" Natural Park.

The territory was divided into three longitudinal strips parallel to the sea, a band made up of silt deposits and marshy black lands, an intermediate band characterized by ancient fossil dunes and a third more recent band

formed by coastal dune and beach (currently in strong erosion). The soil wooded area is characterized by clay.

The climate is part of the type mesomediterranean with mild winter, a summer period of about three months of dryness and rainfall regime of maritime type.

The environments that we find in the Park are the Mediterranean scrub, planitial wood and grassland. The planitial wood, characterized by the presence of temporary ponds, consists of a mixed forest of deciduous oaks of about 60 hectares, with the dominance of *Quercus ilex* L., *Quercus cerris* L., *Quercus pubescens* Willd. and *Ulmus minor* Miller (LUCCHESI 1990). The amphibians of the study area are represented by four species: *Bufo bufo* (Linnaeus, 1758), *Hyla intermedia* Boulenger, 1882, *Pelophylax bergeri* (Günther, 1986) / *Pelophylax klepton hispanicus* (Bonaparte, 1839) and *Lissotriton meridionalis* (Boulenger, 1882).

The temporary ponds are temporary water basins whose depth varies between 20 and 150 cm. These environments are extremely precarious because they are influenced by the seasonal weather patterns. Because of the shallow, thermal stratification is absent; the temperature of the water, from surface to bottom, is under the direct influence of the sun and reflects the seasonal and daily variations in air temperature, even if it remains always few degrees below respect to it. The ponds undergo a drying period, from June to September, and freezing at the surface for few days during negative peaks of temperatures in the months of January and February. The oxygen concentration is subject to daily and annual fluctuations and also varies vertically; it is higher in surface for the presence of photosynthetic organisms and less abundant on the bottom for the presence of organisms decomposers. The water pH decreases with the onset of warm weather (GATTA, 1990; MURA & BRECCIAROLI, 2003).

The bottom of the ponds is characterized by a strong decomposing activity; the half-submerged trees growing around the ponds and directly into the water (mainly *Fraxinus oxycarpa* Bieb.) release a considerable mass of leaves on the bottom of ponds. Within the ponds, the vegetation is very scarce and characterized by terrestrial grasses that withstand periods of immersion. After the phytosanitary cut the vegetation composition was altered. For the research were chosen three ponds in the wood that have the following characteristics: Pond 1, called "pond of *Emys*", with a maximum diameter of 20 m, a maximum area of 62.8 sq. m. and a maximum depth of 120 cm; Pond 2, called "pond of newts", with a maximum diameter of 4 m, maximum area of 12.56 sq. m. and a maximum depth of 81 cm; Pond 3, called "pond of reeds", with a diameter of 22 m, maximum area of 69 sq. m. with a maximum depth of 83 cm. The Pond 3 is characterized

by the coverage of rushes, *Juncus sp.* and *Typha sp.* in about a third of the surface (LUCCHESI, 1990).

III. MATERIAL AND METHODS

The data collection took place from the breeding season of 1995 – 1996 until the breeding season 2014 - 2015, the breeding season is considered the beginning of the filling of temporary ponds until they are completely drained. Samples were taken every fifteen days. The capture of the specimens was performed by dipnetting, according to pre-established transects, by using a net square shape with side of 36 sq. cm, with square mesh of 0.5 cm side.

For each sampling has been established dipnetting mode according to the size of the pond (HEYER, 1988); in the pond of reeds the research was carried out with an average of 80 dipnetting for sampling, in the pond of *Emys* the research was carried out with an average 80 dipnetting for sampling and newts in the pond of newts the research was carried out with an average of 30 dipnetting for sampling.

During the breeding seasons each exemplar of *Lissotriton meridionalis*, after being captured and measured, has been marked by photograph of the ventral pattern and then released.

In each of the seasons, in the two consecutive sampling in which was recorded the highest seasonal presence of individuals, was made an estimation of the population density.

The estimated population density was performed by the Lincoln - Petersen Method modified by Bailey, suitable for small populations of temporary ponds (ACCORDI & NOBILI, 1999). The method assumes that the total population size to be estimated contains N individuals. From this population, take a sample of M individuals, mark and return them to the population. Later, take a second sample of n individuals from the population. This second sample contains R recaptured animals. The Lincoln-Petersen equation for estimating population size, N , is:

$$N = \frac{Mn}{R}$$

This equation overestimates the actual population size. This bias can be reduced by using Bailey's modification of the Lincoln-Petersen equation:

$$N_B = \frac{M(n+1)}{R+1}$$

Bailey's modification is thought to yield a better estimate when sample size is small (less than circa 20) (BAILEY, 1951; GREENWOOD & ROBINSON, 2006).

The long term monitoring allows to compare the population estimate obtained during all the years of study in order to make assessments on the conservation status and persistence of the species in the site, also as a result of environmental changes suffered by "Bosco di Palo" Natural Park.

The field monitoring was conducted in accordance with applicable laws and authorizations provided for this kind of studies. Handling of individuals was made in compliance with the standards necessary to prevent transmission of pathogens between individuals (RAZZETTI & BONINI, 2001).

IV. RESULTS

In Table 1 are shown the number of individuals caught per breeding season and the population size estimated for the site. The data produced can be considered an underestimation of the population of "Bosco di Palo" for the presence of other breeding sites besides those investigated, certainly has been identified the range size of the population.

Comparing the results obtained with the breeding seasons as reported in Figure 2, it is noted that there is not a significant change in the estimated size of the population, the trend line is almost horizontal, with mean values of 284 individuals.

V. DISCUSSION AND CONCLUSIONS

The work aims to highlight if the cutting action and the damage to the undergrowth may have influenced the survival of populations of newts. This habitat alteration may affect adult population during terrestrial phase, and the juvenile population during the sexual maturity development phase, which takes place on the ground in the undergrowth. In particular, the action of tree cutting it was assumed to have altered the component of the understory (low bushes, litter, bark and rotting logs) that are the refuge microhabitat for this species (VILLE VUORIO et al., 2015).

The causes of extinction of the species in many sites of its distribution could be caused by a set of more environmental factors, such as changes in water chemical component and the increase in temperatures (GALLOY & DENOEL, 2010); however, there seems to be more correlation between the disappearance of the species with the destruction of breeding sites that with destruction of sites where the population spends the terrestrial phase.

Smooth newts live on average 6 years old, and a newt newly metamorphosed spends approximately 2 to 3 years in the undergrowth to reach sexual maturity (GRIFFITHS,

1984). The cutting of dead trees occurred in the course of years 2004 and 2005 and it was assumed that if the environmental alteration has affected the fitness of newts in the terrestrial phase, we would have a decrease of presence in breeding sites starting by 2009 – 2010 reproductive season (about 6 years after the cutting).

The analysis of the population estimate, used in this work as an index of the conservation status of the species in the “Bosco di Palo” Natural Park, confirms that, in the previous period and in the period following the die-off of trees and cutting plant health, we have substantially the same values of population size.

In the present work the Author uses the parameter of the population size as an indicator of species stability following the alteration of the ecosystem. Also if declining causes may be various, the result of study doesn't detect a substantial alteration of the size of the population, the Author assumes that even the die-off and cutting of trees can be excluded as a cause of declining of the species in the area.

In conclusion, the environmental alteration occurred at the “Bosco di Palo” Natural Park does not seem to have an effect on the population of *Lissotriton meridionalis*. The present work is thought to contribute to the understanding of the dynamics of the species in locations submitted to anthropogenic disturbance such as forests subjected to practices of wood cutting.

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Table.1: The data of the breeding seasons from 1995 – 1996 to 2014 – 2015.

Breeding season	Number of caught individuals	Males	Females	Male percentage	Female percentage	Population estimate (numbers of individuals)
1995 – 1996	100	43	57	43%	57%	257
1996 – 1997	172	52	120	30%	70%	246
1997 – 1998	80	29	51	36%	64%	221
1998 – 1999	145	52	92	48%	52%	267
1999 – 2000	131	61	70	46%	54%	329
2000 – 2001	104	53	51	51%	49%	295
2001 – 2002	114	55	59	48%	52%	387
2002 – 2003	134	47	87	35%	65%	256
2003 – 2004	-	-	-	-	-	-
2004 – 2005	-	-	-	-	-	-
2005 – 2006	-	-	-	-	-	-
2006 – 2007	154	51	103	33%	67%	294
2007 – 2008	165	63	102	38%	62%	232
2008 – 2009	136	56	80	41%	59%	267
2009 – 2010	145	63	82	45%	55%	360
2010 – 2011	109	46	63	42%	58%	342
2011 – 2012	130	48	82	37%	63%	259
2012 – 2013	112	52	60	46%	54%	212
2013 – 2014	147	71	76	48%	52%	324
2014 – 2015	138	50	88	36%	64%	287

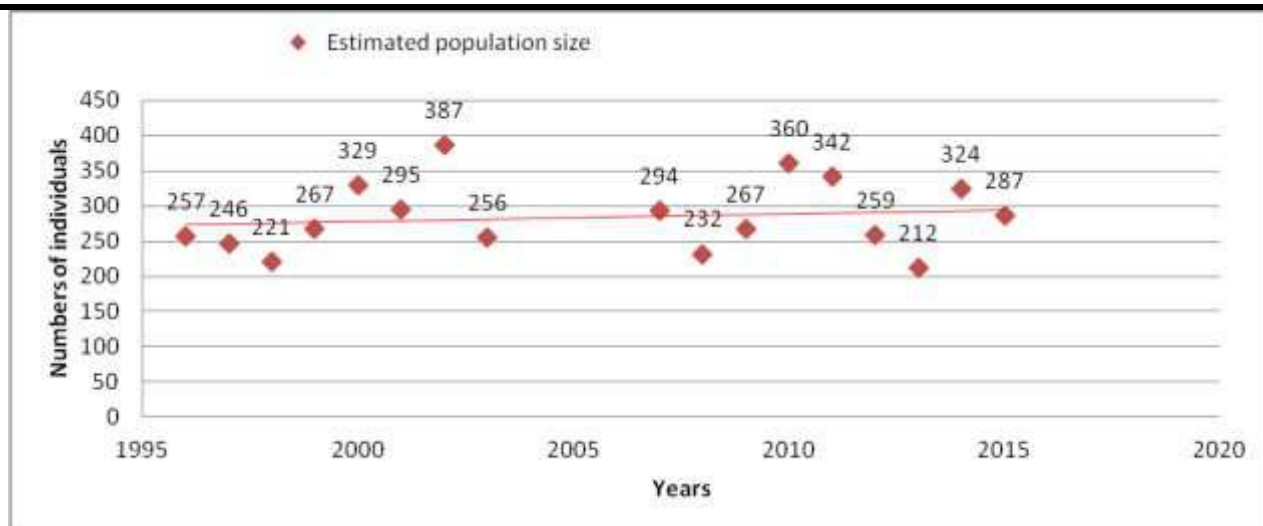


Fig.2: Values of population size from 1995 to 2015.