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SURVEYING OTTER *LUTRA LUTRA* DISTRIBUTION AT THE SOUTHERN LIMIT OF ITS ITALIAN RANGE

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ABSTRACT - In the last 20 years the otter *Lutra lutra* has expanded its range in the southern part of the Italian peninsula. Populations at the border of otter range suffer a high risk of extinction and need frequent monitoring. Here we report about a survey carried out by the standard method in the central Calabria region (Sila Massif and surroundings), which currently represents the southern limit of otter distribution. Otter presence has been recorded for 7 out of 31 sites (22.6%), all belonging to the catchment of the River Savuto. A previous record for the River Neto has not been confirmed. A total of 22 spraints has been collected and analysed. Salmonids (*Salmo trutta*) formed the bulk of otter diet (Vm% = 52.1). Damming and over-fishing could represent the main obstacles to the recolonisation of the area by otters. Habitat management should be addressed to reinforce the existing population and favour its connection to the core of otter range.

Key words: Distribution, diet, dams, southern Apennines, Mediterranean ecosystems

RIASSUNTO – ***Monitoraggio della distribuzione della Lontra* Lutra lutra *al limite meridionale del suo areale italiano***. Negli ultimi 20 anni, in Italia meridionale si è verificata un'espansione dell'areale della Lontra. Le popolazioni che si trovano al margine dell'areale soffrono un più alto rischio di estinzione e necessitano di un frequente monitoraggio. In questo contesto, si relaziona di un'indagine distributiva svolta con il metodo standard nella parte centrale della Calabria (Massiccio della Sila e aree circostanti), che attualmente rappresenta il limite meridionale della distribuzione della specie. La presenza della Lontra è stata accertata in 7 delle 31 stazioni monitorate (22.6%), tutte appartenenti al bacino idrografico del fiume Savuto. Una segnalazione precedente, riguardante il fiume Neto, non è stata confermata. Sono state raccolte e analizzate 22 feci. I salmonidi, rappresentati dalla trota *Salmo trutta*, costituiscono la frazione predominante della dieta della lontra (Vm% = 52.1). Lo sbarramento dei corsi d'acqua e l'eccessivo prelievo ittico potrebbero rappresentare il principale ostacolo alla ricolonizzazione spontanea dell'area da parte della Lontra. La gestione ambientale dovrebbe essere finalizzata al rinforzo in termini numerici della popolazione di Lontra esistente e a favorire la sua connessione al nucleo centrale dell'areale della specie.

Parole chiave: Distribuzione, dieta, invasi artificiali, Appennino meridionale, ecosistemi mediterranei

INTRODUCTION

The current Italian range of the Eurasian otter *Lutra lutra* amounts to about 12100 km^2 and includes the regions Molise, in central Italy, and Campania, Apulia, Basilicata and Calabria in the southern part of the peninsula (Prigioni *et al*., 2007).

Although some historical reports of otter presence, referred to the18th and 19th centuries, are available for Sicily (reviewed by Tinelli and Tinelli, 1986), since the beginning of the 20th century the Calabria region has been considered the southern limit of otter distribution in Italy (Cavazza, 1911).

Even in the years 1968-1972, the otter was widespread in the northern and central parts of this region, "particularly in the watercourses of the Sila Massif", where the species had been reported for 24 waterways and five lakes (Cagnolaro *et al*., 1975). The following inquiry, carried out during the second half of the 1970s sending questionnaires to all the offices of the Italian Forest Service (Corpo Forestale dello Stato), still confirmed the presence of the species in the whole region (Pavan and Mazzoldi, 1983).

In 1983-85, the first national field census, carried out by the standard method subsequent to the survey by Macdonald and Mason (1982, 1983), bore evidence of a dramatic reduction of the Italian otter range (Cassola, 1986; Fumagalli and Prigioni, 1993).

In Calabria, the otter had disappeared from the central and southern parts of the region, whilst was still reported for the lower course of the River Crati and some of its tributaries (rivers Rosa, Occido, Grondo and Fiumicello). Persecution (otter hunting has been forbidden in 1977), the reduction of fish availability consequent to over-fishing and the alteration of riparian habitats were imputed to be the main causes of otter rarefaction (Arcà, 1986).

Considering the few otter signs found and the sudden decline occurred in a few years, the authors threatened the near extinction of the species in the region (Cassola, 1986).

In contrast, in the last 20 years the otter seems to have substantially recovered in southern Italy, particularly in Calabria, where the widest range expansion has been recorded (Prigioni *et al*., 2007).

The otter has been found again on several rivers (Lao, Esaro, Occido, Rosa, Raganello) which flow down from the southern slopes of the Pollino Massif (Prigioni *et al*., 2005, 2006a), the River Crati and some rivers of the Sila Massif (Neto, Crocchio and, particularly, Savuto; Fusillo *et al*., 2003, 2004).

Otter occupancy of the northern basins of Calabria region, assessed as mean percentage of positive surveys (N = 12 for each river), seems to be unstable with respect to that of the rivers flowing in the core of the Pollino Massif (Remonti *et al*., 2008a). It is arguable that the otter metapopulations of the central part of the region, for which the River Crati probably represents the only way of connection to the main otter range, may suffer a high risk of extinction, adverse stochastic effects being more prevalent in small, isolated populations (Gilpin and Soulé, 1986).

Here we report about an otter survey carried out at the southern limit of its Italian range with the aim of assessing otter distribution and finding out the

potential ways of southward expansion of the mustelid. The survey was partially included in the project "Tutela e valorizzazione della flora e della fauna nelle zone protette della Sila Grande" ("Protection and exploitation of flora and fauna in the protected areas of the Sila Grande", ZPS IT9310301), promoted by the Sila National Park, funded by Calabria Region POR 2000-2006 and carried out by Agriconsulting S.p.A. (Rome) (AA.VV. 2008).

STUDY AREA

The study area includes the Sila Massif and surrounding areas. The massif belongs to the southern Apennines and covers about 3,300 km^2 of the central part of Calabria region (southern Italy). Altitude ranges from the sea level to 1928 m a.s.l. (Mount Botte Donato). On its western and northern sides, the area is delimited by the valley of the River Crati, which flows northwards to border the southern slopes of the Pollino Massif (Fig. 1). On the eastern side the massif slopes down to the Ionian sea, from which is divided by narrow coastal plains.

The hydrographic network includes five main river catchments: in the north, the River Trionto (43 km) and the River Mucone (54 km), which flows into the River Crati, in the south, the rivers Savuto (60 km), flowing westwards, Neto (92 km) and Tacina (65 km), which flow into the Ionian Sea (Fig. 1). Starting from the 1920s, four main artificial lakes (Cecita, Arvo, Ariamacina, Ampollino) have been formed by damping as many rivers (respectively: Mucone, Arvo, Neto and Ampollino).

The climate is Mediterranean - cool and rainy in winter while hot and dry in summer. At the highest elevations snow cover can be thick and persistent.

For the province of Crotone (catchments of the rivers Neto and Tacina), 15 fish species have been reported, of which eight of either recent (6) or ancient (2) introduction (Fenoglio *et al*., 2003). The study area is partially included in the Sila National Park.

METHODS

The survey was carried out in the period 23rd - 30th May 2008 and involved the river basins of the northern and central parts of the massif. Both rivers and lake shores were monitored, focusing on the waterbodies where otters had been reported in the first half of the past century and on potential ways of migration from neighbouring areas of otter presence. Survey sites were distributed accordingly to the length of each watercourse, but also the facility of access played a role in determining the location and number of monitored sites. Following the standard method (e.g. Macdonald, 1983), each survey site consisted of a 600 m long stretch of watercourse. Otter signs (spraints and anal secretions, footprints, food remains, scrapes) were searched for walking on both sides of the watercourse and, wherever possible, into the water, carefully examining all potential marking sites. A survey site was deemed absent for otters if no certain sign (i.e. spraints or footprints) was found.

A sprainting site was identified as a place with spraints that were at least 1 m from other ones (Kruuk *et al*., 1986). For each watercourse, the sprainting activity was expressed as percentage of surveys positive for otters [P% = (number of positive surveys/total number of surveys per river) × 100)] and as mean number of spraints per 100 m.

All found spraints were stored in silver paper, labelled and frozen. For analysis, they were washed through a sieve of 0.5 mm mesh and gently broken up by hand under a binocular microscope. Fish remains were identified from their vertebrae, jawbones and scales, using personal collections and the keys of different authors (Webb, 1976;

Wise, 1980; Camby *et al*., 1984; Prigioni, 1997). Mammal hairs were compared at 20x and 40x magnifications with the keys of Debrot *et al*. (1982). The undigested remains of insects (wings, legs and cuticle parts) were identified using personal collections.

For each faecal sample, the total numbers and the bulk of each kind of prey as ingested by the otter were counted or estimated according to Kruuk and Parish (1981).

Following Prigioni (1991) results were expressed as per cent frequency of occurrence (F% = number of spraints containing a specific food items / total number of examined spraints x 100), per cent relative frequency of occurrence (FR% = number of occurrences of an item / total number of items x 100), estimated per cent volume (V% = total estimated volume of each food item as ingested / number of spraints containing that item) and per cent medium volume (Vm% = total estimated volume of each food item as ingested / total number of examined spraints).

Trophic niche breadth was estimated by Levins' B index (Feinsinger *et al*., 1981), using the Vm of four main food categories (insects, trout, cyprinids, mammals).

RESULTS

Overall 31 sites were monitored, distributed on four main river catchments (Fig. 1). Otter signs were found in 7/31 (22.6%) sites, all belonging to the River Savuto (P% = 87.5%; Tab. 1).

A total of 22 spraints was collected, of

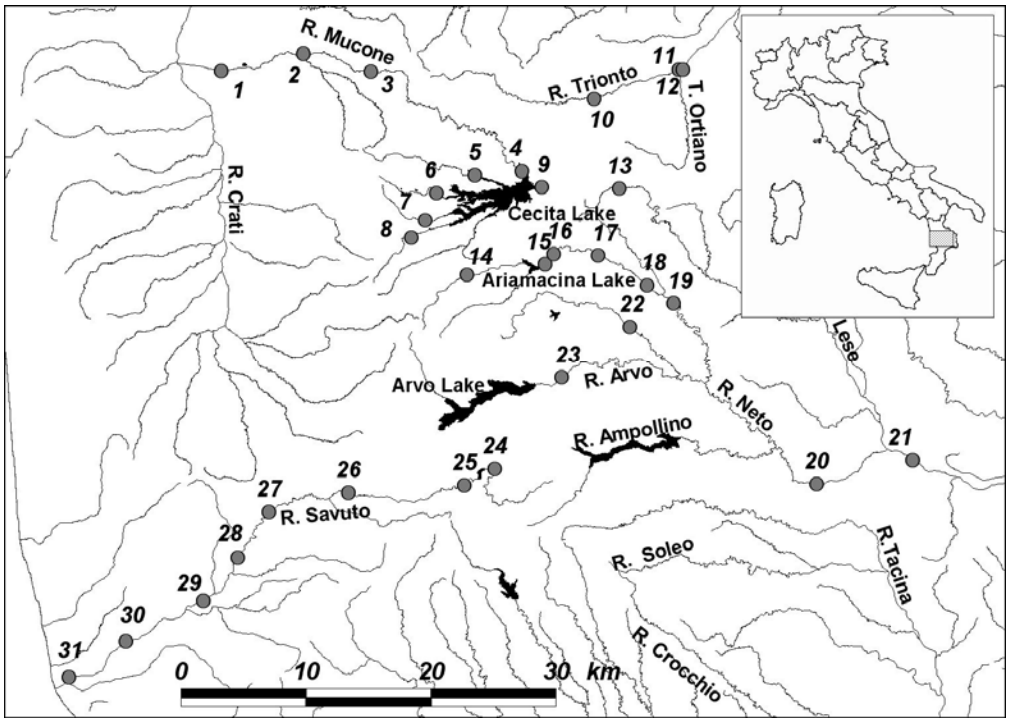

Figure 1 - Study area and sampling stations (numbers correspond to those in Tab. 1).

Table 1 - Location of the sites surveyed for otter signs and number of spraints found (coordinates are expressed in metres - UTM, WGS84, zone 33 -, and refer to the centre of the monitored stretch; dashed lines separate different river catchments).

	Water-body	X	Y	Town	Spraints
1	River Mucone	640945	4349835	Acri	
2	River Mucone	627932	4354006	Acri	
3	River Mucone	634186	4354832	Acri	
4	River Mucone	634824	4355667	Celico	
5	Lake of Cecita	638410	4355524	Celico	
6	Western tributary of the lake	642323	4353164	Celico	
7	Western tributary of the lake	644438	4351705	Spezzano della Sila	
8	Western tributary of the lake	635482	4345739	Spezzano della Sila	
9	Torrent Fosso di Cecita	628522	4361941	Spezzano della Sila	
10	River Trionto	632321	4362265	Longobucco	
11	River Trionto	633894	4360973	Longobucco	
12	Torrent Ortiano	624585	4358338	Longobucco	
13	River Lese	623477	4356969	Spezzano della Sila	
14	River Neto	625496	4360506	Spezzano piccolo	
15	River Neto	640085	4360870	Serra Pedace	
16	River Neto	638098	4368043	Serra Pedace	
17	River Neto	644874	4370337	S Giovanni in Fiore	
18	River Neto	645179	4370336	S Giovanni in Fiore	
19	River Neto	620257	4370183	S Giovanni in Fiore	
20	River Neto	596101	4321798	Cotronei	
21	River Neto	600626	4324681	Belvedere di Spinello	
22	River Garga	606836	4327875	Serra Pedace	
23	River Arvo	612070	4335017	S Giovanni in Fiore	
24	River Savuto	618457	4336525	Lago del Savuto	4
25	River Savuto	627683	4337101	Bocca di Piazza	9
26	River Savuto	630123	4338432	Parenti	1
27	River Savuto	655895	4337235	Marzi	2
28	River Savuto	609590	4331335	Scigliano	2
29	River Savuto	663524	4339142	Martirano	2
30	River Savuto	614820	4371611	S. Mango d'Aquino	2
31	River Savuto	608255	4370281	Nocera	

which 13 (59%) in the two upstream sampling stations. The mean number of spraints per site was 3.14, corresponding to a mean of 0.46 spraints per 100 m.

The bulk of otter diet consisted of fish,

Table 2 - Otter diet on the River Savuto (May 2008, N = 22, items = 55).

Food items	No	F%	FR%	V%	Vm%
Insects	2	9.1	8.0	1.5	0.2
Coleoptera	1	4.5	4.0	1.0	0.1
Trichoptera	1	4.5	4.0	2.0	0.1
Fish	18	81.8	72.0	99.8	81.7
Salmo trutta	12	54.5	48.0	95.6	52.1
Cyprinids	6	27.3	24.0	91.7	25.0
Rutilus rubilio	1	4.5	4.0	100	4.5
Leuciscus cephalus	2	9.1	8.0	75.0	6.8
Unidentified cyprinids	4	18.2	16.0	100	18.2
Mammals	4	18.2	16.0	100	18.2
Sus scrofa	1	4.5	4.0	100	4.5
Unidentified mammals	3	13.6	12.0	100	13.6

mainly trout (*Salmo trutta*), whilst cyprinids included the chub (*Leuciscus cephalus*) and the Italian orange-fin roach (*Rutilus rubilio*) (Tab. 2). Accordingly, trophic niche breadth was low (B = 0.12).

DISCUSSION

Otter presence in the northern and central part of the Sila Massif is restricted to the catchment of the River Savuto, where the percentage of positive sites does not differ from that reported for 2003 (80%; Fusillo *et al*., 2003). The low number of spraints found supports the conservative estimate by Prigioni *et al*. (2006b), who, on the basis of the results of a genetic survey carried out in the Pollino National Park (Prigioni *et al*., 2006a), assessed the presence of only a couple of animals.

Unfortunately, our survey could not confirm the presence of the species on the River Neto, where only one positive site out of ten surveyed ones had been previously found (Fusillo *et al*., 2003). The otter could have reached the middle course of this river following the water-way represented by the River Ampollino, whose upper course flows in parallel to that of the River Savuto, about 2.5 km apart.

The stronghold otter populations nearest to that on the River Savuto are about 80 km northwards. The River Crati, on which the presence of the mustelid has been shown to be unstable in the last 25 years, probably represents the main otter migration route and could maintain gene flow between populations. Accordingly, in 2003 seven out 15 sites were found positive for otters (Fusillo *et al*., 2003).

As a consequence, the River Mucone could favour the recolonisation of the northern slopes of the Sila Massif, but currently we could not find any certain sign of otter presence on its course.

Although the small spraint sample ana-

lysed, diet data agree with the results of Fusillo *et al*. (2004), who, examining a total of 72 spraints collected in summer, reported the prevalence of trout in the diet of otters. The absence of amphibians, which in southern Italy generally represent a main alternative-to-fish food category (Prigioni *et al*., 2006c; Remonti *et al*., 2008b), as so as the narrow niche breadth found are probably a consequence of our sample size.

Fish availability could represent a limiting factor for otter expansion in the study area, the fish assemblage of many rivers having been deeply modified by the matched effects of over-fishing and damming, which do not allow the recolonisation of impoverished stretches by fish (Gallo *et al*., 2005) and alter the hydrological parameters of watercourses (Lucadamo *et al*., 2007). Secondarily, dams and weirs for hydroelectric purposes could hinder otter dispersal movements along water systems (van Langevelde *et al*., 1998). Illegal fishing, being still widespread (Fenoglio *et al*., 2003), may also represent a direct threaten to otters when carried out by poisons (State foresters, pers. comm.).

On the other side, artificial lakes can act as "attraction points" for otters, offering water and fish also during the recurrent periods of drought which characterised Mediterranean watercourses (Pedroso and Santos-Reis, 2006). Accordingly, in the first half of the 20th century the otter was present on lake shores and the last otter reports for the Sila Massif occurred next to Cecita and Arvo lakes (Arcà, 1986).

Beyond habitat suitability, which needs to be tested more deeply, connectivity between neighbouring river catchments is likely to be a key factor affecting the rate of recolonisation of otter-free habitat patches (Ovaskainen and Hanski, 2002). At the periphery of otter range, watercourses may remain substantially otter-free unless viable source populations are available nearby, although they currently offer suitable environmental characteristics (Remonti *et al*., 2008a).

In these terms, the results of our survey suggest that the survival of otter metapopulation(s) at the southern limit of its Italian range is still at risk, the otter population of the River Savuto probably being too small to act as a source population (Pullian, 1988) for neighbouring river catchments. Management and habitat restoration should be addressed to reinforce the population on the River Savuto and favour its connection to the core of otter range.

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