Hystrix It. J. Mamm. (n.s.) 20 (1) (2009): 45-53

DISTRIBUTION AND DIET OF REINTRODUCED OTTERS (*LUTRA LUTRA*) ON THE RIVER TICINO (NW ITALY)

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Received 10 December 2008; accepted 15 May 2009

ABSTRACT - On the River Ticino (NW Italy), the release, in 1997, of a pair of otters *Lutra lutra*, possibly reinforced by the escape of a further pair, allowed the establishment of a small breeding population. In summer 2008, a survey was carried out using the 'standard method' to determine current otter distribution. Data on otter diet were also collected through the analysis of 36 spraints. Otter presence was recorded at 3 of 10 sampling stations, along a 2.6 km long section of the river. Considering only this stretch, the mean number of sprainting sites per 100 m was 0.10, while the mean number of spraints per 100 m was 0.19. Fish - mainly *Salmo trutta*, *Perca fluviatilis*, *Phoxinus phoxinus* and *Chondrostoma genei* -, formed the bulk of the otters' diet. The prosecution of any reintroduction project requires an updated feasibility study which provides for management actions aimed to favour the expansion of the species in northern Italy.

Key words: marking activity, feeding ecology, feasibility study, conservation

RIASSUNTO – ***Distribuzione e dieta delle lontre* Lutra lutra *reintrodotte sul fiume Ticino (Italia nord-occidentale)***. Il rilascio, nel 1997, di una coppia di lontre *Lutra lutra* sul fiume Ticino, forse seguito dalla fuga di un'ulteriore coppia, ha portato alla formazione di una piccola popolazione riproduttiva. Per ottenere un primo quadro dell'attuale distribuzione della specie, nell'estate 2008 è stata condotta un'indagine tramite il metodo standard. Inoltre, dall'analisi di 36 feci, sono stati ottenuti alcuni dati sulla dieta. La presenza della lontra è stata accertata per 3 delle 10 stazioni monitorate, corrispondenti a un tratto di fiume pari a 2.6 km. Considerando solo le stazioni positive, il numero medio di siti di marcamento per 100 m è stato pari a 0,10, corrispondente a 0,23 feci per 100 m. I pesci - in particolare *Salmo trutta*, *Perca fluviatilis*, *Phoxinus phoxinus* and *Chondrostoma genei* -, rappresentano la principale risorsa trofica della lontra. La prosecuzione del progetto di reintroduzione richiede uno studio di fattibilità che contempli interventi gestionali atti a favorire l'espansione della specie in Italia settentrionale.

Parole chiave: marcamento, ecologia alimentare, studio di fattibilità, conservazione

INTRODUCTION

In Lombardy (northern Italy), the Eurasian otter *Lutra lutra* probably became extinct in the 1980s. The last reliable reports occurred from the lower valley of the River Ticino (next to Pavia), in 1980, and from the Lake of Mezzola, in the northern part of the region, in 1983 (Como and Sondrio provinces) (Prigio-

ni, 1983, 1986a). Water pollution, overfishing and direct persecution have been identified as the main causes of otter extinction (Prigioni, 1986b; Prigioni *et al*., 2007).

Since the end of the 1970s, the reintroduction of the otter in Lombardy has been advocated many times (Prigioni *et al*., 1979) and a feasibility study carried out on the River Ticino (Mason *et al*., 1985; Prigioni, 1986b, 1995), which, in 1991, had been identified as a potential reintroduction area in the Action Plan for the Conservation of European Otters (Macdonald and Mason, 1991). A large part of the Ticino valley is currently protected by two Regional Parks, the Park of the Ticino Valley (Lombardy), covering 906.4 km^2 and the Natural Park of the Ticino Valley (Piedmont), 62,5 km^2.

The main hindrance to otter reinforcement in Italy is considered to be the genetic composition of the founder animals kept in the five Italian otter breeding centres. The analysis of mitochondrial DNA suggested that individuals from south-eastern Asia, belonging to the subspecies *Lutra l. barang*, could have contributed to the first stock of founders (Randi *et al*., 2001), whose descendants represent about 95% of all the otters included in the "European breeding program for self-sustaining captive populations" (Europäisches Erhaltungszucht Programm, EEP; Vogt, 1995). Moreover, Italian captive otters suffer a high level of inbreeding (Randi *et al*., 2001).

Nonetheless, in the Ticino Park, a pair of otters was released in 1997 from a breeding centre (Cameri) located on the Piedmont side of the river (Montanari and Boffino, 2000). A further pair possibly escaped before the end of the century (Prigioni, pers. comm). Additionally, during floods in 1991 and 1993 respectively, a pair and a cub and a pair with two sub-adults escaped from their breeding enclosure on the Lombardy side of the river ("La Fagiana", about 15 km downstream of the first centre). All these animals were, however, recaptured within a few months (Prigioni, unpubl. report).

At present, a small otter population is believed to occur along about a 5 km stretch of the river; this includes the Piedmont breeding centre (Boffino, pers. comm.).

Moreover, in September 2007, a 1-2 years old female was found dead next to the Lombardy centre, where also a footprint was recorded the following December.

Otter reintroduction in the River Ticino valley is still debated and has been the main subject of discussion for a group of experts from the IUCN SSC Otter Specialist Group and Italy during a workshop carried out the 1st-2nd April 2008 at Cameri, on the right side of the River Ticino (Piedmont).

All the experts agreed that the genetic composition of introduced animals had to be clarified, previous feasibility studies reviewed in the light of environmental changes that have occurred in the last 15 years (fish assemblage, pollutants, etc.), while a detailed survey of the river is needed to assess the current otter range and population size (J. Conroy, unpub. workshop report).

Consequently, during summer 2008 an otter survey was carried out with the aim of drawing a picture of the distribution of the species in the reintroduction area. Fish availability affecting

many aspects of otter ecology - from distribution and density to breeding period, reproduction success and mortality (Kruuk, 1995) -, we also collected preliminary data on the diet of the species in the reintroduction area.

STUDY AREA

In Italy, the River Ticino flows southwards through the northern part of the country, from the southern edge of Lake Maggiore to the median course of the River Po, forming a 110 km long and, on average, 7 km wide valley. The river crosses an intensively cultivated and urbanized plain, nonetheless riparian woods, consisting of alder (*Alnus glutinosa*), poplars (*Populus alba* and *P. nigra*) and willows (*Salix* spp), are still widespread inside the weave of meanders, streams, canals and oxbow lakes, which characterise the downstream stretch of the river. On the whole, water-bodies cover an area of about 48 km^2, whilst wet woods account for 87 km^2 (Prigioni, 1995). The climate is temperate with a mean annual temperature of about 13°C. Mean annual rainfall decreases from north (1200 mm) to south (700 mm).

Fish include 50 species, cyprinids (mainly *Leuciscus souffia, L. cephalus*, and *Rutilus erythrophthalmus*) representing the bulk of the fish assemblage (G.R.A.I.A., 1999). Water quality is fairly good, the concentration of heavy metals, PCBs and DDT in fish tissues being lower than the critical levels identified for public health (Marchetti and De Paolis, 1983; Bisogni *et al*., 1992).

METHODS

From June to September 2008, 10 sampling stations (Fig. 1), corresponding to 500 m long reaches, were located on a 5 km long stretch of the River Ticino (4 stations on the main river course and 6 on one of its several tributaries for which otter presence had been reported by the staff of the two Parks. Each station was surveyed 8-11 times by the standard method (Reuther *et al*., 2000); the interval between two consecutive surveys varying from 3 to 17 days (mean ± SD = 8.5 ± 4.9), depending on weather conditions.

Walking in the water along both banks and around small islands, typical otter marking sites (e.g. large stones, bridges, pool banks, confluences; Macdonald and Mason, 1983) were explored for spraints (feaces) and anal secretions.

Sprainting sites were identified as places with faecal material separated by at least 1 m (Kruuk *et al*., 1986). Otter sprainting activity was expressed as percentage of surveys positive for otters [P% = (number of positive surveys / total number of surveys) × 100)] and as mean number of both spraints and sprainting sites per 100 m.

All collected spraints were stored in silver paper, labelled and frozen. For analysis, each spraint was soaked for 12 hours in a solution of hydrogen peroxide. Each spraint was then placed into two identical sieves, with 0.5 mm wide meshes, overlapped so as to match the respective upper margins, and washed by a strong water jet. 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). Amphibians were identified by the keys of Di Palma and Massa (1981), whilst the telson, chelae and thoracopods were the main diagnostic features for the crustaceans.

Following Prigioni (1991), results were then expressed as percent frequency of occurrence (F% =(number of spraints containing a specific food items / total number of examined spraints) × 100), percent relative frequency of occurrence (FR% = (number of occurrences of an item / total num-

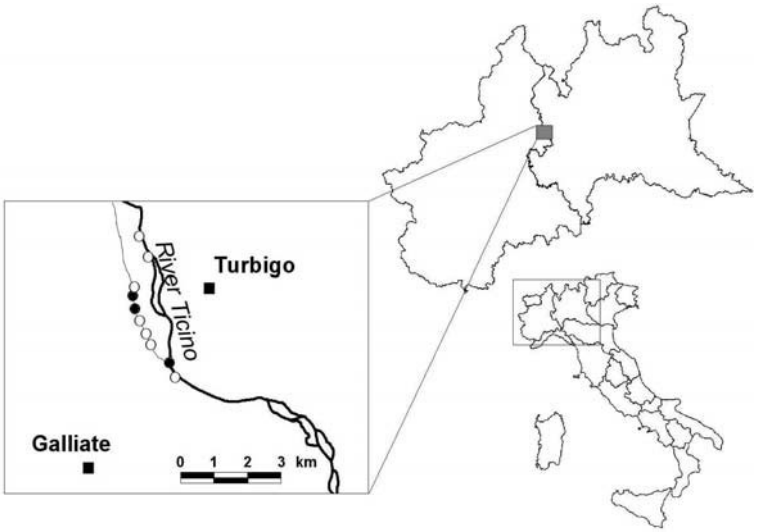

Figure 1 - Study area and sampling stations (white dots: negative, black dots: positive for otters).

ber of items) × 100), estimated per cent volume (V% = total estimated volume of each food item as ingested / number of spraints containing that item) and per cent mean volume (Vm% = total estimated volume of each food item as ingested / total number of examined spraints).

The per cent volume of each prey item was estimated according to Kruuk and Parish (1981), considering the minimum number of individuals of each prey and the estimated weight of each prey "as ingested" by otters. The first was estimated by the number and position (left-right) of diagnostic hard parts (as mouth bones for fish, illions for amphibians). When no diagnostic part was found the remains of a prey were considered to belong to a single individual. The size and weight of main fish species was assessed with reference to Prigioni *et al*. (2003); for the other food categories, a standard weight was assigned: crustaceans 50g, amphibians 30g.

Trophic niche breadth (B) was estimated by Levins' index - $B = 1/(R \sum p_i^2)$ (Feinsinger *et al*., 1981) -, using Vm (p_i) of six (R) main food categories: crustaceans, Centrarchidae, Percidae, Salmonidae, Ciprinidae and Amphibians.

RESULTS AND DISCUSSION

Otter presence was recorded at only three (Fig. 1) of the ten sampling stations, corresponding to about a 2.6 km section of the River Ticino. For the downstream station, P% was 0.18 (N = 11), whilst for the other ones P% was 45.5 (N = 11); in September no station was found positive for otters, probably because of recent heavy rainfall and subsequent flooding.

Considering only that section of river between the two farthest positive stations, the mean number of sprainting sites per 100 m was 0.10, while the mean number of spraints per 100 m was 0.19. Due to the small and time-limited sample, it is hard to compare these numbers to those found in other study areas. As a touchstone, in the core of the Italian otter range (Basili-

cata region, southern Italy) values of 1.28 sites/100 m and 3.17 spraints/100 m have been reported (Prigioni *et al*., 2005). In contrast, at the southern boundaries of otter range (Calabria region, southern Italy), the number of spraints per 100 m attains values of the same magnitude (Balestrieri *et al*., 2008).

In the study area, fish - mainly trout *Salmo trutta* (Vm% = 21.4), redfin perch *Perca fluviatilis* (Vm% = 17.3), Eurasian minnow *Phoxinus phoxinus* (Vm% = 13.6) and South European nase *Chondrostoma genei* (Vm% = 9.4) -, were the main trophic resource for otters (N = 36; Table 1). Whilst in the river stretch where otters are present minnow and nase are probably rather abundant, together with the two *Leuciscus* species, both perch and trout are considered quite rare (G.R.A.I.A., 1999). If the use by otters of perch agrees with the selection for this fish prey high lighted inside breeding enclosures (Fumagalli *et al*., 1995), their predation on trout could be a consequence of recent restocking for angling. Accordingly, the adult female which escaped in 1993 ate mainly cyprinids (F% = 80.4; Prigioni, unpubl. report). Amphibians and crustaceans were resources of minor importance. The latter was represented by the red

Table 1 - Otter diet on the River Ticino (N = 36, items = 55).

Food items	N	F%	FR%	V%	Vm%
Crustaceans	3	8.3	5.5	63.3	5.3
Procambarus clarkii	4	11.1	7.3	60.0	6.7
Fish	33	91.7	60.0	93.9	86.1
Salmonidae	9	25.0	16.4	85.6	21.4
Salmo trutta	9	25.0	16.4	85.6	21.4
Centrarchidae	1	2.8	1.8	50.0	1.4
Micropterus salmoides	1	2.8	1.8	50.0	1.4
Percidae	7	19.4	12.7	89.0	17.3
Perca fluviatilis	7	19.4	12.7	89.0	17.3
Ciprinidae	22	61.1	40.0	70.8	43.3
Barbus sp.	2	5.6	3.6	67.5	3.8
Rutilus erythrophthalmus	1	2.8	1.8	40.0	1.1
Chondrostoma genei	4	11.1	7.3	85.0	9.4
Leuciscus sp.	1	2.8	1.8	10.0	0.3
Tinca tinca	3	8.3	5.5	71.0	5.9
Phoxinus phoxinus	13	36.1	23.6	37.6	13.6
Unidentified cyprinids	6	16.7	10.9	71.7	11.9
Amphibians	4	11.1	7.3	65.0	7.2
Rana sp.	4	11.1	7.3	65.0	7.2

swamp crayfish *Procambarus clarkii*, which was first introduced to northern Italy in 1990 (Gherardi *et al*., 1999) and has progressively replaced the native crayfish *Austropotamobius italicus* from the plain areas of Lombardy (Fea *et al*., 2006). Red swamp crayfish seem to represent a profitable prey for both mammalian carnivores and herons (Correia, 2001) and, where available, are exploited by otters according to their seasonal availability (Beja, 1996). The index of trophic niche was B = 0.56.

On the whole, on the basis of marking parameters, the otter population on the River Ticino should consist of a few, probably 2-3, individuals. Otters prey upon a relatively large number of fish species, suggesting that the area is suitable from the point of view of trophic availability. Otter survival since its reintroduction in 1997 supports this hypothesis.

Reintroduction is a common management tool for river otters *Lutra canadensis* in the USA (Serfass *et al*., 1993). In Europe, reintroduction programs started in the 1980s in England and Sweden, where newly established populations seem to be spreading (Strachan and Jefferies, 1996; Sjöåsen, 1996; White *et al*., 2003). More recently, the otter has been successfully reintroduced in north-eastern Spain and The Netherlands, while some experimental releases have been carried out in France and central Italy (Saavedra, 2002; Lammertsma *et al*., 2006). Otter current presence on the River Ticino subsequent to the release of only one pair eleven years ago (possibly supported by the two escaped individuals), suggests that an updated reintroduction project would be successful.

Passing over the problem of the founder stock, the establishing in northern Italy of an isolated otter population – the Italian range of the species is restricted to the southern part of the peninsula and to Molise region in its central part (Prigioni *et al*., 2007) -, would raise some ethical questions.

The creation of a breeding centre in the Gran Paradiso National Park and the reintroduction of the otter in Aosta Valley region (north-western Italy) was discussed extensively at the end of the 1990s, but, even if considered practical, the reintroduction still requires a sound feasibility study (Prigioni and von Hardenberg, 1996). In neighbouring Switzerland, reintroduction programs have been stopped until the concentration of PCBs in Swiss rivers decrease to below threshold levels for otters (Weber, 1990). In contrast, otter signs have been recently found in Alto Adige next to the Austrian border (M. Fattor, pers. com.). In the next few years, this expanding population could colonize the best preserved part of the water system of north-eastern Italy (A. Krantz, pers. comm. in Cameri Otter Workshop).

Bearing in mind the status and potential for expansion of the otter in neighbouring areas, any feasibility study concerning of otter reintroduction in the valley of the River Ticino should provide for management actions aimed to favour the expansion of the species in northern Italy. The restoration of complete biocenoses and habitat networking need a multi-disciplinary approach; these are, however, time-expensive (Reuther, 1995). Thus, the immediate future research into the restoration of suitable living conditions

for otters and reintroductions will have to be carried out in parallel.

ACKNOWLEDGEMENTS

We are grateful to Jim Conroy, Anna Loy and Christopher Mason for their suggestions and comments on an earlier draft of the manuscript.

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