Monitoring the Eurasian otter (*Lutra lutra*) in the National Park of Cilento, Vallo di Diano and Alburni. Research findings and future directions for conservation

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Abstract: - The Eurasian otter (*Lutra lutra* L., 1758) is a top predator in running waters ecosystems and a species of conservation concern. The otter declined dramatically in Europe during post-war decades mainly as a consequence of human-induced alteration (e.g. water pollution) and loss of freshwater habitats. At present the otter is endangered in Italy in reason of its reduced distribution range, restricted to southern regions and isolated from other European otter populations. The National Park of Cilento, Vallo di Diano and Alburni (NPCVDA) includes a relevant portion of the core area of otter distribution range and represents a key area for otter conservation and monitoring at national level. In 2009 emerging issues (e.g. otter road kills) motivated the start of research activities on otters in the NPCVDA, aimed at: developing optimal sampling protocols for reliable and long-term monitoring of otter conservation status in small areas; monitoring mortality, demographic parameters and health status of local otter population based on the post-mortem examination of otters occasionally found dead; analyzing anthropogenic pressures and impacts on otters and running-waters in the protected area. Research projects produced protocols, guidelines and tools for monitoring parameters of otter and habitat status and collecting biological samples and data in a long-term perspective. A baseline estimation of otter occupancy parameters were obtained in rivers of the park, useful for future evaluation of population trends. An indication of exposure of local otter population to environmental contaminants were also obtained, suggesting further investigations on pollutant levels in macrophytes, otter prey and otter spraints along the river gradient in ‘sentinel’ river basins of the NPCVDA. In general, research activities and findings highlighted the importance of an integrated multidisciplinary approach in developing and applying monitoring tools for otter conservation.

Key-Words: - otter surveys, detectability, post-mortem studies, long-term monitoring, running waters ecosystems

1 Introduction
The Eurasian otter (*Lutra lutra* L., 1758) is a semi-aquatic carnivore (Carnivora: Mustelidae), inhabiting mainly freshwater habitat and feeding on aquatic prey. The species was originally found throughout most of Europe, Asia, and North Africa. However, between 1950 and 1980, otter populations declined dramatically throughout the European continent (MacDonald 1996) as a consequence of human-induced alteration (e.g. water pollution) and loss of freshwater habitats, related to the post-war economic boom. When researchers verified this dramatic conservation status, the otter was classified as a threatened species at a global level (Vulnerable, based on the IUCN criteria; Hilton-Taylor 2000). In recent years, otter populations recovered in several European countries (Ruiz-Olmo and Delibes 1998; Kranz and Toman 2000; Conroy and Chanin 2002; Crawford 2003, Marcelli e Fusillo 2009, Clavero et al. 2010, Marcelli et al. 2012) and at present the otter is considered as a “Near Threatened” species by the IUCN Red List (Ruiz-Olmo et al. 2008), although is still endangered in some countries (e.g. in Italy).

Considering the habitat specialization of the otter and its top position in the freshwater ecosystems
(especially running-waters), it seems important to understand how and which human influences on freshwaters may affect otter populations, in order to improve the conservation status of otters in Europe, by addressing adequate actions. In this sense, monitoring both population and river habitats parameters is highly relevant for otter conservation.

2 Problem Formulation

Despite of a recent southward expansion of the otter distribution range (Marcelli and Fusillo 2009), otter populations in Italy are still restricted to southern regions and almost completely isolated from other European populations. For these reasons the otter is classified as endangered (EN) in Italy, according to IUCN criteria (Rondinini et al. 2013).

The National Park of Cilento, Vallo di Diano and Alburni (hereafter NPCVDA) includes a relevant portion (about 20%) of the distribution core area (Marcelli et al. 2004, Marcelli 2006). The core area is important to maintain the peripheral otter populations through source-sink dynamics. Therefore monitoring the otter in the core area is important to address conservation actions at national level.

In order to implement a long-term monitoring of conservation and health status of otters in the NPCVDA, relevant research activities were started in 2009.

Standard surveys for monitoring otter distribution at large geographic scale (Reuther et al. 2000) consist of searching for signs of otters, mainly spraints (otter faeces) but also tracks, on emergent substrates at 600-m long stream sections. The standard protocol (Reuther et al. 2000) suggests selecting survey sites based on 10x10-km UTM grid. Results are therefore expressed as percentage of 10x10-km UTM grid squares where otter signs are found. The method has some drawbacks when applied at small scale, for example in single river basins or protected areas. Moreover, the percentage of positive squares or stream sites where signs are found may underestimate true occupancy due to false absences (i.e. the species is present at the sampling site but is not detected). Implementation of otter standard method generally overlooked the problem of false absences, reflecting a wider neglect of the issue of imperfect species detection in species distribution estimation and modelling (see review in Kéry, 2011). False absences may lead to biases in estimates of occupancy parameters and their relationships with landscape factors (MacKenzie et al., 2006), resulting in misleading ecological inference.

In 2009, research on efficient and optimal monitoring of otters at small spatial scale emerged as a priority for conservation of the otter in the NPCVDA. In the same year, the first three cases of otter road kills were recorded in the NPCVDA making urgent to analyze causes and conditions of mortality and to assess general health of otters. Recording locations of death and performing post-mortem (PM) examination of otters found dead, provide valuable data that can contribute to assess the health and status of populations and to identify threats. However, until recent years the collection and PM examination of dead otters were still inadequate in Italy and a relevant amount of information was lost. In particular, it appeared necessary to develop, acquire and adequately apply procedures for PM analyses and data/biological samples collection and storage, useful to gather in-depth, comparable and shareable data at European level and to implement long-term monitoring. Finally, in order to highlight potential threats to local otter population, it seemed also important to analyze anthropogenic pressures and impacts on otters and running-waters, the otter habitat.

3 Problem Solution

Long-term monitoring of otter distribution and occupancy parameters

In 2011 the Ti-con-Zero Otter project (TZOP) was started in the NPCVDA. The project was aimed at developing adequate and optimal survey protocols for occupancy estimation of otter populations at small spatial scale, by conducting pilot surveys and statistical power analysis.

The TZOP focussed on relevant questions about survey design including forms of data replication (e.g. temporal vs. spatial replicates), site definition and selection, spatial autocorrelation, optimum combination of site and replicate numbers. Moreover, it investigated how sample size affects statistical power to detect occupancy changes. Optimal sampling regimes were identified using real and simulated data under different scenarios. Traditionally, detection data in otter surveys are recorded by identifying spraints of all ages along 600 m stream sections. Discriminating old and recent spraints potentially allows estimating the proportion of sites where the otter physically occurs, a useful state variable. Optimal survey protocols to monitor otter conservation status were applied in 3 river basins (Calore, Alento and La Fiumarella river basins) of the park, in 2012 and are being applied in other basins (Lambro, Mingardo, Bussento river...
Basins) during spring-summer 2014. Results of surveys represent the baseline data for future evaluations of trends in a long-term monitoring perspective.

Long-term monitoring of mortality and health of otters

In 2009 the RECAL (REcovery and post-mortem Analyses of otters Lutra lutra) project was started in the NPCVDA. Short-term objectives of the project are: 1. Increasing the number of carcasses submitted for necropsy and post-mortem analyses; 2. Collecting tissue samples and organs for future analyses. Long-term objectives of the project are: 1. Analysing causes and conditions of mortality, and identifying threats and mitigation measures; 2. Assessing the health status of the otter population; 3. Estimating biometric parameters; 4. Collecting relevant data (i.e. sex, age, reproductive status) for population modelling; 5. Evaluating the exposure of otter population to environmental contaminants. In order to contribute filling the gaps in the ‘reporting-recovery-necropsy’ system for otters in Italy, standardized procedures for the collection of carcasses and description of scene of death, sample collection and analyses, were developed in the RECAL project. PM examinations were carried out by a multi-disciplinary team including otter ecologists and animal pathologists, to a standard protocol developed for Lutra lutra (Simpson 2002) and agreed in the Otter Specialist Group/IUCN context. Otters received were sexed and aged based on teeth cementum analysis, body and organs were measured and weighed; tissue and organ samples were taken for genetic, chemical and histological analyses; the nutritional condition and reproductive status were evaluated; parasites were identified and diseases and the cause of death were determined. Research activities included the analysis of pollutant concentrations in otter tissues and organs. A relational electronic database was created for storing data from all above PM steps, from carcasses collection to lab analyses of samples (e.g. ageing, contaminants etc.). A leaflet on ‘what to do’ in the event of finding a dead otter in the NPCVDA was disseminated to volunteers and environmental organizations.

Assessment of pressures and impacts on otter river habitats in the NPCVDA

The UAOC (Urgent Actions for Otter Conservation) project was started in 2010 in the NPCVDA. It was aimed at analyzing potential threats to otters related to water uses, physical alteration and reduction of river habitats, roads and infrastructures development, riparian vegetation management. At present, following indications provided by preliminary results of the RECAL project, an integrated long-term monitoring plan of water quality, flows, otter occupancy parameters and exposure to contaminants, in ‘sentinel’ rivers of the park, is under discussion.

4 Conclusion

Optimal and long-term monitoring of otter distribution and occupancy

A recently developed spatial auto-correlation model in a Bayesian framework was applied and adapted during the TZOP in order to evaluate the possibility of estimating otter occupancy at small spatial scale. Detectability of otters and the segment length at which detection of spraints ceased to be dependent on detection in the preceding segment have been estimated.

Simulations showed that precise occupancy estimates can be obtained in most situations using at least 4 independent 200 m segments.

Based on the application of the modelling approach to data collected at 59 river sites in the Calore and Alento river basins in early summer 2012, otter occupancy of 62.6% (IC 95% 51.7 – 72.4%) was estimated in two basins. This estimate represents a reliable baseline value for future comparisons and for the evaluation of trends and potential threats.

Long-term monitoring of mortality and health of otters

Nine otters found dead in the NPCVDA and its buffer zones, were collected and examined in the context of the RECAL project since the beginning of the research activities. Post-mortem examination and analyses were also conducted on 6 otters found dead in the Matera and Potenza provinces. Most (67%) of otters examined were males and 60% was less than 4 years old. The majority of otters was killed in road traffic accident, but at least three otters died for natural causes. Three males showed lesions compatible with intraspecific aggressions, that represent a significant cause of death for otters in other countries. One female found dead in June showed 2 placental scars, indication of a recent pregnancy. Two females found dead in November and December didn’t show any breeding sign. PM analyses provided useful information for conservation actions and to indicate novel research directions. In particular, the investigation of the scene of death revealed what forced otters to travel out of the water and move over the road, suggesting mitigation measures, such as otter passages under the bridges and otter proof fences along road segments. Contaminants (PCBs, PAHs, pesticides,
dioxins and heavy metals) concentrations in liver or muscle samples of otters revealed relatively high levels of PCBs and lead and mercury in some otters from the park, suggesting further investigations on pollutant levels in macrophytes, otter prey and otter spraints along the river gradient in ‘sentinel’ river basins of the NPCVDA.

**Assessment of pressures and impacts on otter river habitats in the NPCVDA**

The UAOC project has identified and examined several critical situations, in particular relative to: misuse/overuse of hydraulic works (both transversal, as weirs, and longitudinal works, as banks regulation/consolidation), even when realised using bioengineering techniques; water intakes/discharges and power plant hydropoeaking; bad practice in riparian vegetation management; problems with wastewater and especially stormwater treatment in the Park. This work has produced guidelines for ecological river management, restoration of stream habitat and mitigation of impacts. Furthermore a map of potential risk for otter road-kills was produced.

**References:**


