Eurasian otter *Lutra lutra* in developing countries: a resurvey of Albania 22 years after the fall of communism

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Abstract In countries with emerging and developing economies the need to promote development and the lack of information on the status of the Near Threatened Eurasian otter *Lutra lutra* have given rise for concern about the conservation status of the species. In Albania information about the distribution of this otter dates from 1985. In 2013 we resurveyed 31 sites previously surveyed in 1985, and a further 42 sites throughout the country. At each site nine habitat variables of potential importance to otters were recorded and analysed. Overall the distribution pattern in 2013 did not differ from that recorded in 1985, although a reduction in marking intensity suggested a possible decline in otter numbers. Distribution of the otter has been influenced by land use and human density, suggesting man-induced habitat changes since the fall of communism may have affected the quality and fragmentation of otter habitats.

Keywords Albania, distribution, Eurasian otter, habitat change, *Lutra lutra*, monitoring, standard survey, transitional countries

This paper contains supplementary material that can be found online at http://journals.cambridge.org

Introduction

Following a dramatic decline in both range and population in the second half of the 20th century, the Eurasian otter *Lutra lutra* is recovering in several European countries, including the UK (Crawford, 2003), Sweden (Roos & Rigét, 2011), Denmark (Elmeros et al., 2006), France (Janssens et al., 2006), Spain (Ruiz-Olmo & Delibes, 1998) and Italy (Prigioni et al., 2007). This recovery is probably largely attributable to efforts in the 1970s to ban persistent organic pollutants, especially synthetic pesticides (lindane, DDT) and chlorinated biphenyls (Ruiz-Olmo et al., 2000).

Although most industrially developed countries have made progress in controlling pollution and implementing conservation measures, in transitional or developing economies biodiversity governance is hindered by ongoing institutional change and the need to promote economic development, which often result in overexploitation of natural resources (CEC, 2001; Kluvánková-Oravská et al., 2009). Approximately 60% of the countries within the Eurasian otter's range have been listed as emerging and developing economies by the International Monetary Fund (IMF, 2012), and the species' population trend in the eastern part of its range was the basis for its categorization as Near Threatened on the IUCN Red List in 2004 (Ruiz-Olmo et al., 2008).

Information about the current status of the species in many developing countries is scarce. Although the otter population is increasing in Poland (Romanowski, 2006) and may not have declined in Hungary during the second half of the 20th century (Heltai et al., 2012), the species has reportedly declined in Turkey (Kayaöz, 2002; Özdemir, 2002), the South Caucasus region (Georgia, Armenia and Azerbaijan; Gorgadze, 2011), Belarus (Sidorovich, 2011), Nepal (Bhandari, 2011) and Morocco (Delibes et al., 2012).

In Albania the communist era ended in 1991. The transition from centralized management of land and natural resources to a market-oriented economy has caused widespread damage to the environment (Jansen et al., 2006), especially to aquatic ecosystems of the western lowlands, as a result of increased urbanization, overexploitation of woodland and ineffective waste management (Cullaj et al., 2005; Keukelaar et al., 2006).

Except for a few more recent surveys in the southern part of the country (rivers Seman and Drinos; Bego et al., 2011; Hysaj et al., 2013), information about the distribution of the otter in Albania dates back to 1985, when during 18–27 May Prigioni et al., surveyed 31 sites, mostly in the western lowlands and in the upper catchment of the River Shkumbin (Prigioni et al., 1986). The rationale for the survey method was based on Erlinge's recommendations; stretches of river up to 600 m long were surveyed for otter spraints and footprints on both banks (Chanin, 2003). A minimum

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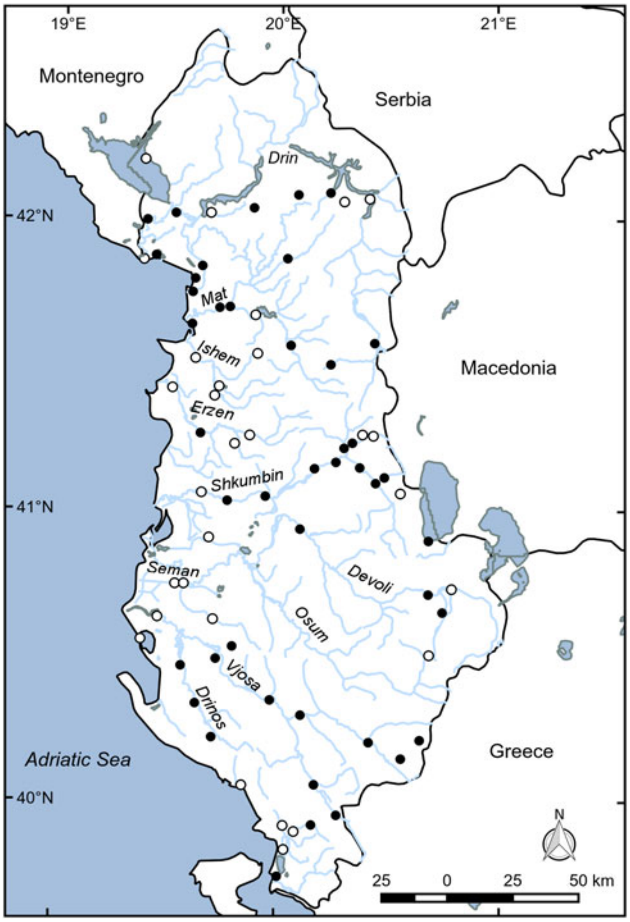

FIG. 1 Sites surveyed for the Eurasian otter *Lutra lutra* in Albania in 2013. Filled and unfilled circles indicate otter presence and absence, respectively.

distance of 200 m was surveyed per site and the otter was presumed absent if no sign was detected along the transect. To update information on the distribution of the Eurasian otter in Albania and to assess the impact of political and economic changes on the species' conservation by comparing current and past range, we resurveyed the major watercourses and coastal lagoons of Albania in summer 2013.

Methods

Following the same protocol used by Prigioni et al. (1986), during 24 June–18 July 2013 we resurveyed the 31 sites surveyed in 1985, and an additional 42 sites, thus surveying all the major river catchments of Albania (Fig. 1). We used a 1 : 200,000 road map to select sites, which were chosen for ease of access, mainly at road bridges, to maximize the probability of finding signs quickly (Chanin, 2003). Sites were separated by at least 5 km. Twenty-nine sites were on main rivers, 26 on tributaries, seven on canals, five on lakes (Shkodrës, Ohrit, Vaut të Dejës, Fierzes) and six on coastal lagoons (Butrinti, Narta, Ceke, Merxhani, Patok, Viluni; Peja et al., 1996). Mean transect length was 587 m (range 380–1000 m). The most thoroughly surveyed catchments were those of the rivers Shkumbin (n = 13), Vjosa (n = 18), Mat (n = 6) and Ishëm-Erzen (n = 7); relative to their total length, few sites were located in the catchments of the rivers where otter occurrence had been confirmed recently. All sites were georeferenced using a global positioning system. To avoid bias as a result of variation in experience with sampling, all surveys were carried out by the same trained staff.

Sprainting sites were identified as places with spraints separated by at least 1 m from other spraints (Kruuk et al., 1986). Following Prigioni et al. (1986) an index of otter marking intensity was calculated as the number of sprainting sites or spraints per 200 m. We assumed marking intensity represented a broad index of relative abundance (Mason & Macdonald, 2004). The percentage of sites where otters were present in 1985 was compared to that found in 2013 (χ^2 test), with respect to both the total number of sites (n = 73) and the number of sites surveyed in both years (n = 31). For the latter sample the distribution of sites with presence and absence was compared using a 2 × 2 summary table of coincidences and discrepancies.

For each site on a watercourse five habitat variables of potential importance to otters (Prenda et al., 2001; Remonti et al., 2008) were recorded visually in the field (Supplementary Table S1). Watercourse width and depth were estimated at intervals of c. 200 m and the mean values for each site were assigned to one of four classes ($\leq$ 2.0, 2.1–6.0, 6.1–15.0 or $>$ 15.0 m, and $\leq$ 0.5, 0.51–1.0, 1.1–2.0 or $>$ 2.0 m, respectively). Water speed was categorized as stagnant, slow or moderate–high. The dominant land use within a 100 m wide belt on both river banks was estimated and categorized as bare soil, crops, pasture/shrubs or woods. Water pollution was categorized as absent (transparent water in $\geq$ 70% of watercourse depth, without any sign of pollution), low (less transparent water, solid waste on the banks), medium–high (clear signs of pollution, such as bad smell, turbidity, foam). Mean altitude was recorded for each site ($\leq$ 250, 251–500, 501–750, $>$ 750 m). To assess the influence of human disturbance on otter occurrence, using *GE-Path v. 1.4.6* (Sgrillo, Ilhéus, Brazil), we assessed the overall percentage cover of agricultural and urban areas in a 4 km^2 area centred on each site, by superimposing a 200 × 200 m grid on satellite images provided by *Google Earth* (Google, Mountain View, USA). Results were categorized as $\leq$ 25, 25.1–50, 50.1–75 or $>$ 75%.

Otter presence/absence was then modelled against the predictor variables by backward stepwise logistic regression, using Wald's test to examine the statistical significance of each coefficient in the model. To avoid collinearity, which can inflate the standard errors of the estimates of model coefficients and produce unreliable results (Hosmer &

Lemeshow, 1989), the correlation between the predictors was measured by Spearman's coefficient. Model variables were then selected, omitting those that represented redundant information; when two variables were correlated ($P < 0.01$), the one to be rejected was chosen according to the strength of its correlation with the dependent variable. Analyses were performed only for sites on watercourses, as most habitat variables could not be assessed precisely for lakes and lagoons.

Finally, from the last human population census (INSTAT, 2011) we obtained the population density (inhabitants per km^2) of the counties (*qarku*; n = 12) and municipalities where sampling sites were located. For sites in the same administrative area the results were pooled to avoid pseudoreplication (Hurlbert, 1984), and mean values for positive and negative sites were compared using the Mann–Whitney test. The relationship between marking intensity and either altitude or population density was examined using Spearman's correlation test.

Results

Otter signs were detected at 44 (60.3%) of the 73 survey sites. From north to south, the species was widespread in the catchments of the rivers Drin, Mat, Shkumbin and Seman (where the otter occurred in the plain of Coriza) and absent on the rivers Gjanica and Vjosa. Otter signs were not found in the downstream stretches of the rivers Shkumbin, Seman and Vjosa, which cross the intensively populated plain facing the Adriatic Sea. No otter sign was found in the catchments of the rivers Ishëm (which runs through the counties of Durazzo) or Tirana and Bistrice, in the south, whereas otter presence was detected at one of four sites in the catchment of the River Erzen (Fig. 1). Otters were present in five of six lagoons and in the Lake of Ocrida (Ohrit), and absent from the Lake of Scutari (Shkodrës) and two of three artificial lakes (Liqueni Fierzes and Liqeni i Vaut të Dejës).

The percentage of surveyed sites where otters were present did not differ from that recorded in the 1985 survey (60.3 vs 54.8%; $\chi^2 = 0.27$, $P = 0.61$), even considering only the sites surveyed in both years (61.4 vs 54.8%; $\chi^2 = 0.26$, $P = 0.61$). The distribution of presence and absence was also similar: otter status in 2013 was the same as in 1985 for 71% of sites ($\chi^2 = 10.9$, $P = 0.001$). In contrast, marking intensity was lower in 2013 than in 1985 (Table 1).

Logistic regression identified percentage cover as the main variable affecting the occurrence of the otter (Table 2). Pecentage cover was negatively correlated with mean altitude ($\rho = -0.42$, $P = 0.0006$, n = 62) and positively correlated with water pollution ($\rho = 0.44$, $P = 0.0003$, n = 62).

Marking intensity was not correlated with any of the variables tested. Mean human population density of municipalities was significantly lower for sites where otters were present than sites where they were absent (62.3 vs 250.5 inhabitants per km^2; U = 311, $P = 0.028$).

Table 1 Otter *Lutra lutra* mean marking intensity along seven major rivers in Albania (Fig. 1), and at all sites surveyed for otters in 1985 (Prigioni et al., 1986) and 2013 (blank cells indicate unsurveyed sites).

River	1985		2013	
	Sites per 200 m	Spraints per 200 m	Sites per 200 m	Spraints per 200 m
Drin/Buna	0.8	0.8	0.4	0.4
Mat	3.6	5.8	1.0	1.4
Shkumbini	0.7	2.6	0.8	1.1
Devoll/ Dunacecit			0.7	2.6
Vjosa			0.7	2.6
Shushice			0.9	1.1
Bistrice	3.3	7.3		
All surveyed sites	1.7	3.6	0.78	1.1

Discussion

The distribution of the otter in Albania in 2013 was similar to that recorded by Prigioni et al. (1986) in 1985. Otters were absent on the coastal stretches of the rivers Gjanica, Seman and Vjosa, where oil extraction and refinement remain the primary source of water pollution (Cullaj et al., 2005), whereas urban and industrial waste, together with increased urbanization, probably prevent colonization of the catchments of the rivers Ishëm and Erzen. The largest difference was recorded in the River Bistrice, the river with the highest marking intensity in 1985, where otters are now absent from two of three sites where they were present in 1985. In a report by the Government of Albania, direct killing has been indicated as the main threat to otters in the Southern Coastal Plain, but the River Bistrice has been canalized for much of its length and the whole watershed area has been degraded by uncontrolled urbanization (PAP/RAC-SOGREAH, 2005), suggesting that habitat alteration may have been a significant factor in the decline of the otter.

Although no habitat variable seemed to affect distribution at a local scale, confirming that otters are tolerant of a wide range of habitat conditions (Chanin, 2003), at the landscape scale the effect of land use and human population density may be regarded as an index of the impact of human activities on otter occurrence. Similarly, on the Iberian Peninsula otter distribution was reported to be affected by human variables such as distance to major urban centres and to highways, which were related to water pollution downstream (Barbosa et al., 2003).

TABLE 2 Results of backward stepwise logistic regression with otter presence/absence as the dependent variable and five habitat variables of potential importance to otters as independent variables.

Variables	B[2]	Wald statistic	df	P	Exp(B)[3]
% cover[1]	0.021 ± SE 0.008	7.207	1	0.007	1.022
Constant	−1.487 ± SE 0.508	8.564	1	0.003	0.226

[1]% cover of agricultural and urban areas in a 4 km^2 area centred on each survey site
[2]Logistic coefficient
[3]Odd ratios

Although there is no direct relationship between numbers of spraints and numbers of otters, sprainting activity reflects changes in the distribution of otters (Chanin, 2003) and increases with otter numbers (Lanszki et al., 2008) and habitat use (Clavero et al., 2006). In general, 200–600 m surveys are effective for ascertaining otter presence (Chanin, 2003); to assess marking intensity, however, constant-length surveys are recommended (Balestrieri et al., 2011). Nonetheless, the numbers of spraints and sprainting sites did not differ from those recorded in surveying a 60 km stretch of the River Drinos (Hysaj et al., 2013), and corresponded to those reported for peripheral areas of the otter's range in Italy (Prigioni et al., 2006; Balestrieri et al., 2008). Although two surveys are insufficient to assess any trend in the otter population in Albania, variation in marking intensity suggests that changes in socio-economic policies during 1986–2013 may have had a greater impact on otter numbers than on the large-scale distribution of the species.

During the early transitional period from communism to democracy, lack of control and effective management policies exacerbated the environmental problems inherited from the previous centralized planning political model. Privatization of land has led to the urbanization of plains and the conversion of land-use from broadleaved forests to herbaceous crops in hilly areas, with detrimental effects on the environment (Jansen et al., 2006). Uncontrolled fishing, deforestation, river-bed excavation and pollution of rivers by wastewater from tanneries and petroleum refineries are still considered major threats to the otter (Cullaj et al., 2005; Hysaj et al., 2013). The burning of urban waste in the open air is the main contributor of PCDD/PCDF (polychlorinated dibenzo-p-dioxin and dibenzofuran) emissions into freshwater (Kleger et al., 2006).

Nonetheless, since the beginning of the 21st century there has been increased awareness of environmental problems, and some progress has been made in policy and legislation. A National Strategy and Action Plan for Biodiversity was approved in 2000, and in 2007 the otter was included in the Red Data Book of Albanian fauna, categorized as Vulnerable (Cullaj et al., 2005; Hysaj et al., 2013), although it can still be hunted under permit, to prevent damage to fisheries. The Stockholm Convention was signed in 2001 and a National Implementation Plan for the reduction and disposal of persistent organic pollutants was approved in 2006.

The otter is still widespread in Albania, and effective pollution management policies may favour the reinforcement of otter populations in the future, as has occurred in several European countries (Ruiz-Olmo et al., 2000). As shown by the systematic monitoring of otter populations in the UK (e.g. Strachan, 2007), annual otter surveys, complemented by effective statistical analysis of pollution data collected by environment protection agencies, can identify habitat changes and guide conservation programmes.

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