Hystrix It. J. Mamm (n.s.) 17 (1) (2006): 37-46

MONITORING OF THE OTTER RECOLONISATION OF POLAND

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ABSTRACT - The Standard Method was used for three field censuses of the otter *Lutra lutra* distribution in Poland. In the first national survey in 1991-1994 evidence of otters was found throughout the country, with 80% of positive sites on 2000 sites visited. Only two areas, Silesia in the south and Central Poland, had very few signs of otters. The following censuses in Central and Eastern Poland (1996-1998 and 2003) showed the otter expanded its range and recolonised much area of Central Poland, including about 700 km of rivers in the catchment of River Bzura. The number of positive 10x10 km UTM squares increased twice as compared to first survey (1991-1994). The rate of expansion was very high in comparison to other studies in European countries. This could be due to the functional cohesion of network of rivers and lakelands in Poland. The expansion of otters was accompanied by change in habitat selection: preference for optimal habitats (unregulated rivers with tree and other vegetation cover) decreased while suboptimal and marginal habitats (e.g. channels, regulated rivers in towns) were occupied more frequently as compared to first survey. The negative side-effect of the expansion of the species is the increase of damages on fishponds, with consequent increase of pressure by fishpond owners to permit shooting of otters and/or to promote damage compensation.

Key words: *Lutra lutra*, field survey, habitat selection, recovering, Poland

RIASSUNTO - ***Analisi della ricolonizzazione della Lontra in Polonia***. Tre censimenti di campo sono stati condotti, mediante metodologia standard, allo scopo di definire la distribuzione della Lontra *Lutra lutra* in Polonia. Il primo rilevamento nazionale, condotto nel 1991-1994, ha evidenziato una presenza diffusa nel paese, con l'80% dei siti positivi su 2000 siti campionati. Solo due zone, la Sislesia nel sud, e la Polonia centrale, avevano evidenziato una scarsa presenza della specie. I censimenti condotti successivamente in Polonia centrale e orientale (1996-1998 e 2003) hanno mostrato come la Lontra abbia espanso il suo areale ed abbia ricolonizzato molte zone della parte centrale, inclusi circa 700 km di corsi d'acqua nel bacino idrografico del fiume Bzura. Il numero di quadrati UTM 10x10 km positivi per la Lontra è raddoppiato rispetto al primo censimento (1991-1994). Il tasso di espansione è stato molto elevato rispetto a quello rilevato in altri studi condotti in Europa, probabilmente a causa della rete molto coesa di corsi d'acqua e laghi presenti in Polonia. L'espansione della Lontra è stata accompagnata da un cambiamento nella selezione di habitat: la preferenza per habitat ottimali (fiumi non regimentati, con alberi e altra copertura vegetale) è diminuita, mentre gli habitat sub-ottimali e marginali (es. canali, fiumi canalizzati all'interno di città) sono stati occupati più frequentemente rispetto al primo censimento. Un effetto negativo dell'espansione della specie è stato l'incremento dell'impatto sugli alleva

menti ittici, con conseguenti pressanti richieste da parte dei proprietari degli allevamenti per il rilascio di permessi di caccia alla lontra e/o per ottenere il risarcimento dei danni.

Parole chiave: *Lutra lutra*, censimenti, selezione di habitat, ricolonizzazione, Polonia

INTRODUCTION

Earlier evidence from questionnaires and rather scarce field data indicated that the otter *Lutra lutra* occurred unevenly in Poland and declined until late 1970s (Romanowski, 1984).

The species was listed as rare and endangered in the first edition of Polish Red Data Book of Animals (Bieniek, 1992). However in the first national survey of Poland in 1991-1994, signs of otters were found at 79.5% of investigated sites, proving improvement in the status of the species (Brzeziński *et al*., 1996). Otters were especially common in the Lakeland (N Poland), along the western and eastern borders, and in Carpathian Mountains (SE Poland), while only a few positive sites were recorded in two large areas: Silesia and Central Poland. Within the latter region, otters were absent in almost the entire catchment of the River Bzura, and the fact was associated with exceptionally high municipal and industrial sewage disposal to Bzura in the late 1980s (Brzeziński *et al*., 1996).

Comparison of these data to questionnaire information did not enable to investigate dynamics of otter population in Poland from 1970s – 1990s (Brzeziński *et al*., 1996). However, in the autumn of 1995, the signs of otter presence were recorded in several sites on the lower River Bzura (Romanowski *et al*., 1997). These first field data, indicating increase of the otter population, prompted two following regional surveys of the Central and Eastern Poland to study recent changes in the otter distribution.

The aim of this paper is to document the recovery of the species and influence of environmental factors on otter recolonisation of Central and Eastern Poland.

STUDY AREA

The study area in Central and Eastern Poland is mostly a lowland country. Agriculture is the most dominant land-use, with the most intensively cultivated fields in the western and south-eastern parts. The area includes Warsaw and several large cities (one holding the largest refinery in Central Poland) along with many other towns and villages. The main rivers, Vistula, Bug, Narew and Bzura, include extended seminatural sections with well preserved bank vegetation. Throughout the area, there are many small rivers, drainage ditches and canals linked to the rivers, except the most western and south-eastern parts, that lack well structured hydrological net. Despite of the pollution of many rivers, existing seminatural riparian vegetation makes good habitats to many types of wildlife, i.e. waterfowl, beavers *Castor fiber* and otters.

METHODS

Between January 1996 and May 1998 a total of 1111 sites in 353 UTM 10x10km-squares (average of 3.2 sites per square) in Kujawy and Mazovia (Central Poland) and

Podlasie (Eastern Poland) were investigated using the standard method (Strachan and Jefferies 1996; Reuther *et al*., 2000). In the 2003 spring survey of Lublin voivodsip (Eastern Poland) 405 sites were checked with the same method. In general, at each site, a maximum distance of 600 m was searched for the spraints and/or tracks of otters. If no otter signs were found then the site was recorded as negative. At majority of sites, as soon as otter signs were found, the search was stopped and the site was confirmed as positive. Searching usually started at a bridge. In order to increase the chances of detection of signs two modifications of the field survey, implemented in national survey of Poland, including spot checks of bridges and extended searches, were used (Romanowski *et al*., 1996; Romanowski and Brzeziński, 1997). The latter modification produced 8 positive sites on 21 surveys of up to 1000m (25 positive sites in 92 surveys in 1991-1994, Romanowski *et al*., 1996). In addition 87 earlier recommended repeated surveys (Strachan and Jefferies, 1996) of possibly false negative sites (where presence of otter was possibly difficult to detect during first visit) were conducted. This modification yielded 21 positive sites, however did not change the overall percentage of positive 10x10km UTM squares (which are defined as positive based on at least one positive site). To compare two surveys (1991-1994 and 1996-1998) the percentage of positive 10x10km UTM squares surveyed was used as an index of otter abundance, as the percentage of positive sites recorded in later survey was positively effected by repeated surveys. As a measure of the otter recolonisation, the rate of expansion index TE (Hengeveld, 1989) was used:

$$TE=S/t$$

where S is an area (in km^2) of new 10x10 km UTM squares occupied in the time t (number of years).

Twenty environmental variables were described during the field observations in order to identify factors affecting the occurrence of otters. The variables were evaluated for the whole 200-600 m section of surveyed bank and separately for its surroundings (up to 300 m) and included the percentage of tree and shrub cover, river width, regulation (embankment reinforcement), water quality, presence of potential shelters and others (buildings, human and livestock activity, presence of forests, meadows, pastures, arable fields, fishponds and other aquatic habitats in surroundings of the site). The presence of trees on the banks, water quality, river width and regulation were used to evaluate the habitat quality of each site in three categories: good, average and poor (Romanowski, 2000). To evaluate the preference of otters towards the environmental factors the following preference index (Robel *et al.*, 1970) was used

$$PI = \frac{n_f^+ x\, n}{n^+ x\, n_f}$$

where is n_f^+ the number of positive sites with the factor observed, n is the number of all sites surveyed n^+ is the number of positive sites, n_f is the number of sites surveyed with the observed factor. When PI<1 the factor is avoided, when PI=1 it is used in proportion to its availability, and when PI>1 the factor is selected.

The frequency of otter signs in relation to habitat quality was analysed by χ^2. In 1996-98 survey, the frequency of positive sites and UTM squares, and the number of spraints and tracks per positive site in west-

ern (W, west of River Vistula), eastern (E, east of River Vistula and south of river Narew) and northern (N, north of Vistula and Narew) parts were compared by χ^2 and ANOVA respectively.

RESULTS

1 Otter presence

Signs of otters were found in 790 (71%) sites, corresponding to 296 (84%) UTM 10x10 km-squares sampled in 1996-1998 survey. The percentage of positive sites and UTM 10x10 km squares varied troughout the study area and the highest values were recorded for the eastern and northern parts (Tab. 1). This evidence occurred also comparing the number of spraints and tracks per sites positive for otters (Tab. 1)

Otters were present on all large rivers of the study area (Vistula, Bug and

Table 1 - Otter occurrence (expressed as percentage of positive sites and UTM squares) and number (mean ± SE) of spraints and tracks per positive site in western (W, west of River Vistula), eastern (E, east of River Vistula and south of river Narew) and northern (N, north of Vistula and Narew) parts of the study area in 1996-1998.

	W	E	N	Test	P
N. sites surveyed	495	499	117		
% positive sites	48.1	90.2	87.2	χ^2=230.82	<0.001
N. 10x10km UTM squares	156	150	47		
% positive 10x10km UTM squares	68.6	97.3	91.5	χ^2=49.00	<0.001
N. spraints/positive site	1.07±0.11	1.58±0.12	1.02±0.13	F=5.58	<0.01
N/. tracks/positive site	7.36±1.16	12.41±1.3	7.37±2.52	F=3.99	<0.03

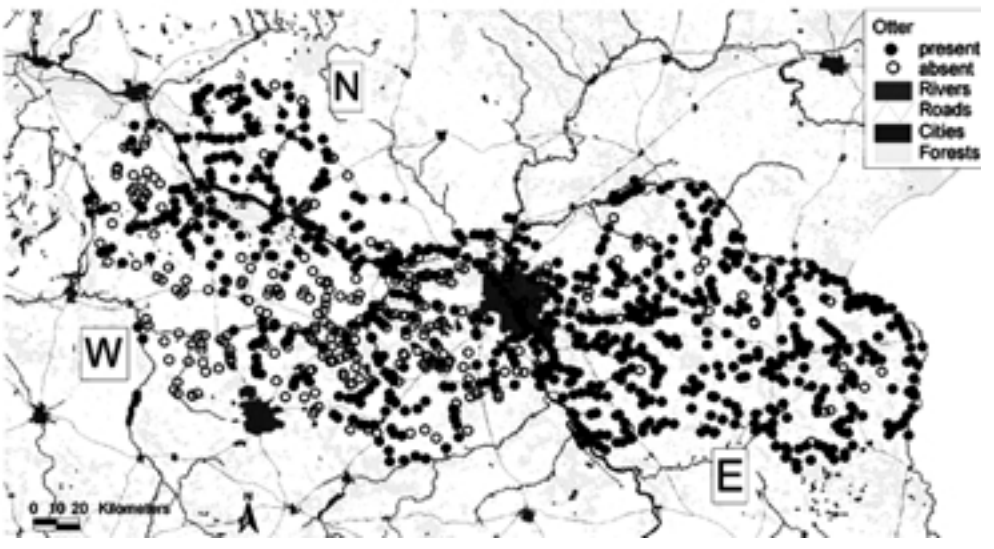

Figure 1 - Otter survey of Central and Eastern Poland in 1996-1998 (W: west of River Vistula; E: east of River Vistula and south of river Narew; N: north of Vistula and Narew).

Narew), and on all medium and small rivers of the area E. In the area W signs of otters were absent on many sites surveyed in the Bzura catchment and in the intensely cultivated area in Kujawy (Fig. 1).

Signs of otters were found at 351 (87%) sites surveyed in 2003 in Lublin voivodsip. The otters were detected on almost all sites along main rivers, including Vistula, Wieprz Bug, and remaining medium sized rivers. Otter signs were absent mostly at the smallest streams and melioration channels, often drying in the summer (Fig. 2).

2 Recolonisation of Bzura catchment

Every February-April in 1996-1998, 54 base sites (the same sites that were surveyed in the national monitoring in 1993, Brzeziński *et al*., 1996) and 100

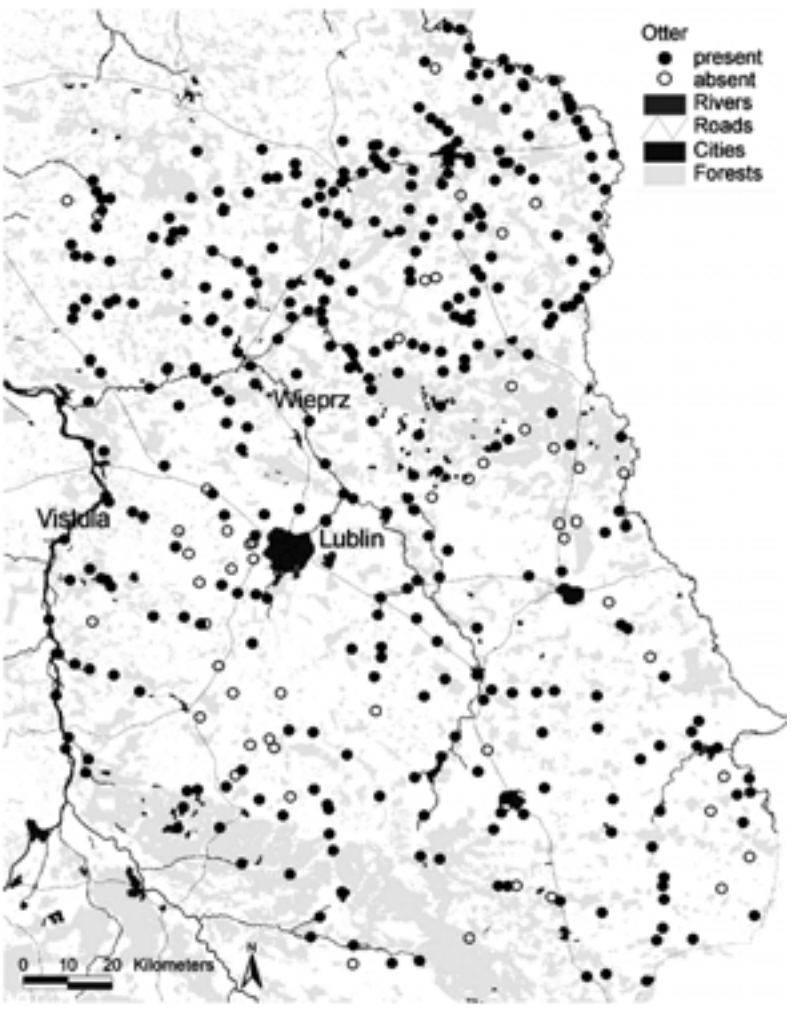

Figure 2 - Otter survey of Lublin voivodship (Eastern Poland) in 2003.

additional sites in the 7800 km^2 catchment of Bzura were inspected. The percentage of positive base sites increased significantly (χ^2= 12.64, d.f. =3 P <0.006,) from 1993 (14.8%) to 1998 (51.8%) (Fig. 3) and the range of otters expanded as well over lower and middle Bzura and majority of secondary tributaries (Fig. 4). A TE of 18.4 was found and the average range of otter recolonisation was 140 km of rivers per year.

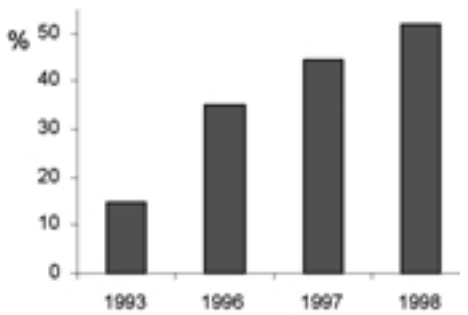

Figure 3 - Percentage of sites positive (%) for otters recorded for the Bzura catchment; 54 base sites were surveyed each year; 1993: after Brzeziński *et al.,* 1996.

3 Habitat selection

The highest values of preference were noted for tree (PI=1.58) and shrub (PI=1.44) cover of river banks at the site surveyed, presence of forests (PI=1.53) and fish ponds (PI=1.33) in the proximity. Sites lacking of potential shelters and bank cover were avoided (PI=0.45 and PI=0.73 respectively) such as those with river regulation (PI=0.63). The sites with tree and shrub cover of river banks and forests and fish ponds present in the proximity were strongly preferred in the area W, while in the area E habitats were used in proportion to their availability (Fig. 5). The highest percentage of otter signs was recorded for habitats of good quality (W: χ^2= 117.78, d.f. =2, P <0.001; E: χ^2= 18.15, d.f. =2, P <0.001) and the selectivity in the utilization of habitats of different quality was higher (χ^2= 40.12, d.f. =2, P <0.001) in the area W comparing to area E (Fig. 6).

DISCUSSION

Results of two regional surveys in 1996-98 and 2003 document increase in percentage of positive sites and in range occupied by otters in Central and Eastern Poland as compared to national survey of 1991-94. The increase is most pronounced in Central Poland, where the percentage of positive 10x10km UTM squares doubled (from 33% to 69%, χ^2= 30.6, d.f. =1, P<0.001) in the period of four years. Within this area Bzura catchment was naturally recolonised by otters inhabiting Vistula and Rawka river. The rate of otter

Table 2 - The expansion rate (TE, see Methods) of otter populations in some European countries; [1]Strachan and Jefferies, 1996; [2]Andrews et al., 1993; [3]Green and Green, 1997; [4]Madsen *et al.*, 1992.

Country	Period	TE
England[1]	1979-1986	9
England[1]	1986-1994	14.4
Wales[2]	1978-1985	8.5
Wales[2]	1985-1991	10.1
Scotland[3]	1985-1994	8.2
Denmark[4]	1986-1991	10.6
Poland (present study)	1994-1998	18.4

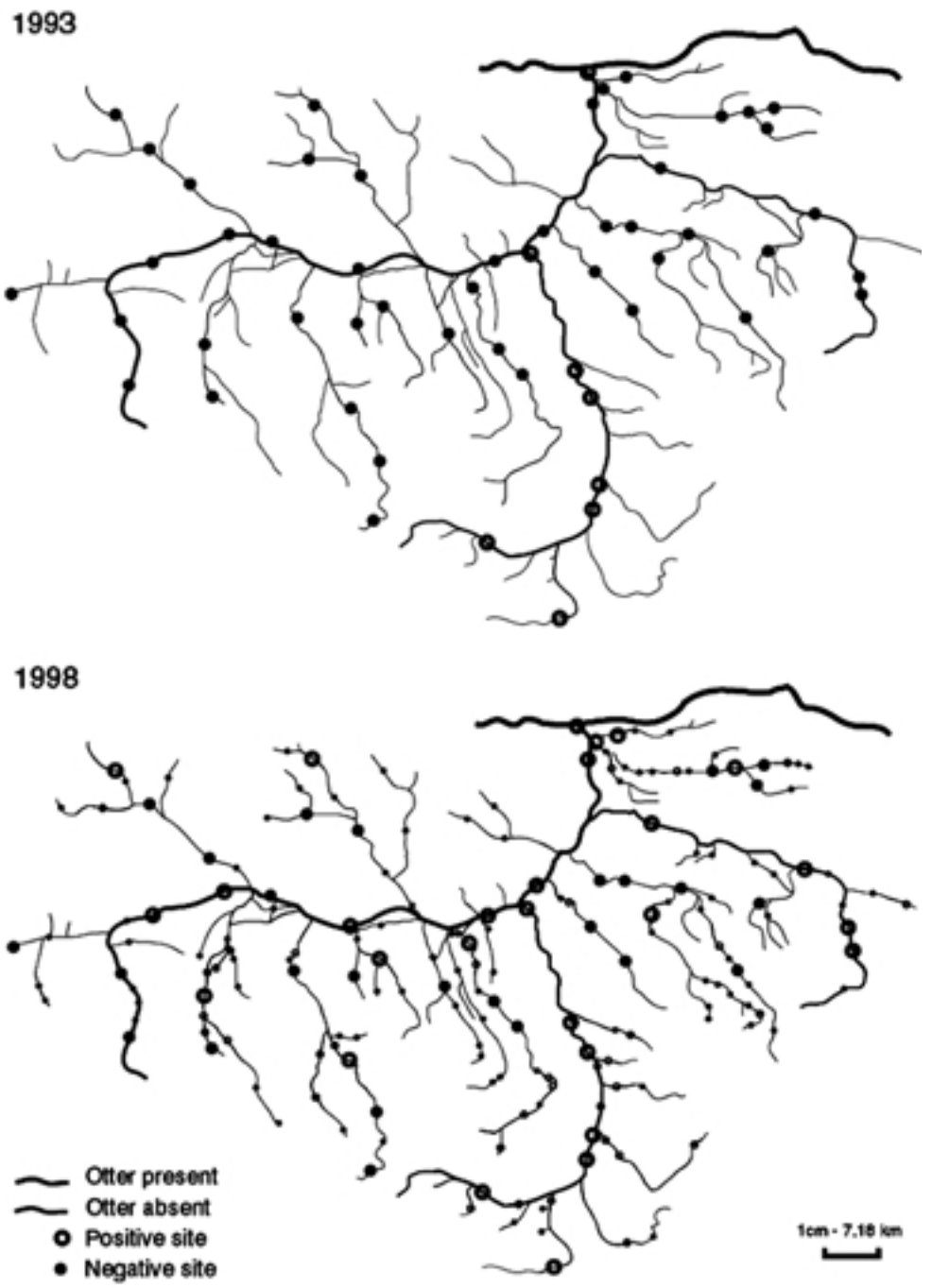

Figure 4 - Recolonisation of the Bzura catchment in Central Poland in 1993-1998.

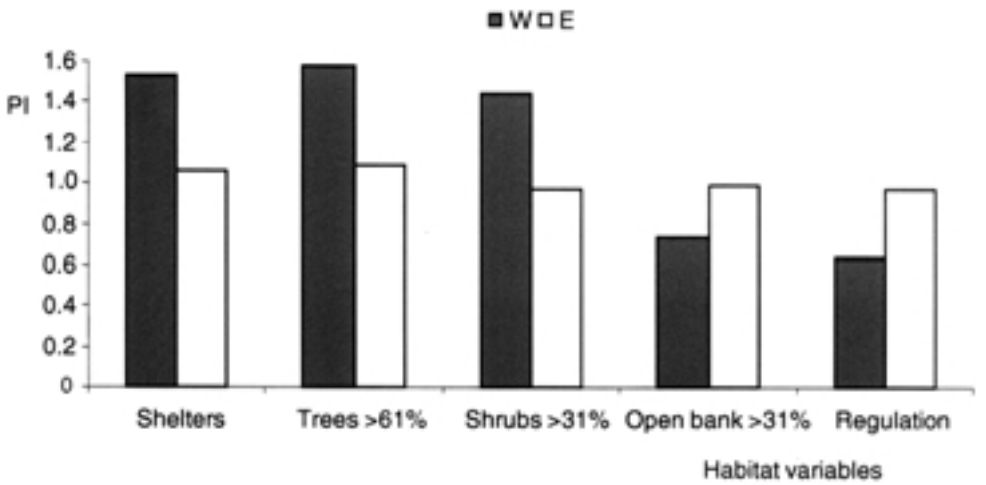

Figure 5 - The preference of otters (PI, see Methods) towards habitat variables of the surveyed sites in western (W) and eastern (E) part of the study area.

expansion in the study area is higher than in any other parts of Europe (Tab. 2) most probably due to survival of thriving population in the Eastern Europe, and functional cohesion of network of Vistula, Narew, Bug and other seminatural rivers in Poland. During recolonisation otters occupy increasing range of habitats including melioration channels and heavily regulated sections of rivers (Romanowski, 2000).

For Poland, our results indicate that the otter could be excluded from the list of threatened species according to the new, more restrictive IUCN categories (critically endangered, endangered, vulnerable), that apply only to species with observed, calculated or anticipated reduction in population numbers and range (IUCN/SSC Criteria Review Working Group, 1999). The otter is not endangered also in countries neighboring Poland: it is widespread in Belarus and Lithuania (Sidorovich and Lauzhel, 1992; Baranauskas and Mickiewicz, 1995) and is expanding in Slovakia and Germany (Kadlecik, 1992; Reuther, 1992).

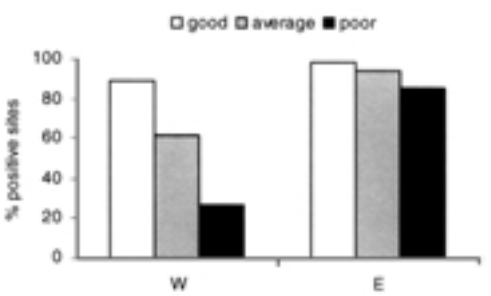

Figure 6 - Differences in otter occurrence in habitats of different quality in western (W) and eastern (E) part of the study area.

The otter habitats include fish ponds and the problem of otter damage to fish farming is increasing with the recovery of the species in Poland. While in 1988-89 the otter was reported at 62% of fish farms in Poland, in recent survey in Eastern Poland it was reported at 89% of visited fish ponds (Romanowski, 2005). The illegal

killing occurs but can not stop the expansion of the species, however the fishpond owners express increasing pressure to permit shooting of otters and/or develop state system for damage compensation (Romanowski, 2005).

In Central Poland (area W with low percentage of positive sites and few otter signs/site) otters prefer unregulated rivers with vegetated banks that provide potential shelters, located in the proximity to forests and fish ponds. However in Eastern Poland (area E with high percentage of positive sites and many otter signs/site) otters occupy all types of aquatic habitats according to their availability. The differences in habitat selection documented for the two areas with presumably different otter numbers are in accordance to Fretwell (1972) model: when the population is low in numbers, the individuals select habitats of highest quality (strong preference towards optimal habitats), when the population is high and optimal habitats are occupied, some individuals settle in marginal habitats. Similar evidence comes from Scotland, where the increase in percentage of positive sites in consecutive national surveys was accompanied by the recolonisation of high altitudes and relatively polluted, intensively farmed and industrialised area of the Dornoch and Moray firths (Green and Green, 1997). This evidence could lead to a conclusion that disappearance of the otter from many transformed and "destroyed" aquatic habitats in Europe in 1970-80 could be, according to Fretwell (1972) model, a side effect of the decline. When the population was going down, the surviving individuals selected habitats with best potentiality. Recolonisation of regulated rivers in industrialized areas, channels and melioration ditches, observed in recent otter surveys of Poland and other countries (Green and Green, 1997; Romanowski, 2000) should be viewed as a pattern of habitat occupancy predicted by the general ecological model of habitat selection (Fretwell, 1972).

ACKNOWLEDGEMENTS

I would like to thank B. Gruber, C. Walkland, N. White and H. Sikorska for their participation in the field surveys. K. Kowalczyk and K. Kosko provided assistance in the preparation of figures, and M. Barkowska in the statistics. The field surveys were cofinanced by Regional Funds for Environment Conservation in Biała Podlaska, Płock, Skierniewice, Warsaw and Włocławek. The manuscript was improved thanks to constructive comments from the Editor and anonymous reviewers.

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