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SURVEY OF DANISH FREE LIVING OTTERS *Lutra lutra* – A CONSECUTIVE COLLECTION AND NECROPSY OF DEAD BODIES

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Abstract: During 1979-1993 194 dead Danish otters *Lutra lutra* were received. Of these, 145 were necropsied and the cause of death, sex, age and body condition determined. Traffic mortality (45.4%) and drowning (32.5%) constituted the major cause of death. Shot-gun lead pellets were detected in 5% of the otters. Inclusion bodies indicating distemper virus infection were found for the first time in a free living otter population. *Angistrongylus vasorum* larvae were found in the lungs of free living otters for the first time. No ectoparasites were found. Infectious agents were detected in 22.1 % of the otters although only few otters appeared to have died from infections. The age distribution was not significantly different between the two sexes. Body condition for otters, which died violently in Denmark was comparable to findings in Shetland, where thriving populations exist. The results showed a considerable decrease in number of otters found drowned in fish traps coinciding with the introduction of stop grids in fish traps in 1986. The results suggest that the existing otter population in Denmark is healthy and in good condition but it cannot be excluded that the large number of otters killed by traffic threatens the continued expansion of the species.

Keywords: European otter, *Lutra lutra*, necropsy, causes of death, Denmark

INTRODUCTION

The Eurasian otter *Lutra lutra*, is a highly vulnerable mammal in Denmark as well as in much of Europe (MACDONALD and MASON, 1994). In 1996 a national survey (HAMMERSHØJ et al., 1996) concluded that the species occurs in the northern part of Jutland; in the counties of Nordjylland, Viborg, Ringkøbing, Århus, Ribe and Vejle. On Zealand, in the county of Vestsjælland, no signs of otters were found in the national survey, but in a more detailed survey undertaken parallel to the national survey (LETH and BYRNAK, 1996), signs of otters were found at two sites (Fig. 1).

It has been clai, and mercury have been responsible for the rapid decline in otter populations in Europe (MACDONALD and MASON, 1994). Decreasing otter population in Denmark was thought mainly to be due to river regulation, wetland destruction, drowning in fish traps, and intensified traffic (MADSEN, 1991). med that contaminants such as the organochlorine pesticide dieldrin, polychlorinated biphenyls

Otter carcasses have been collected annually in several European countries. In Germany eg. more than 50 otters were found dead each year, but only a small number of these were necropsied (ZOGALL and REUTHER, 1992). Likewise only 24 of 113 dead otters collected in Shetland were necropsied

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(KRUUK and CONROY, 1991). In south-west England only 77 wild otters were examined post-mortem (SIMPSON, 1997).

In this paper a comprehensive necropsy results of 145 carcasses submitted from a population of free living otters are evaluated to assess current threats to otters.

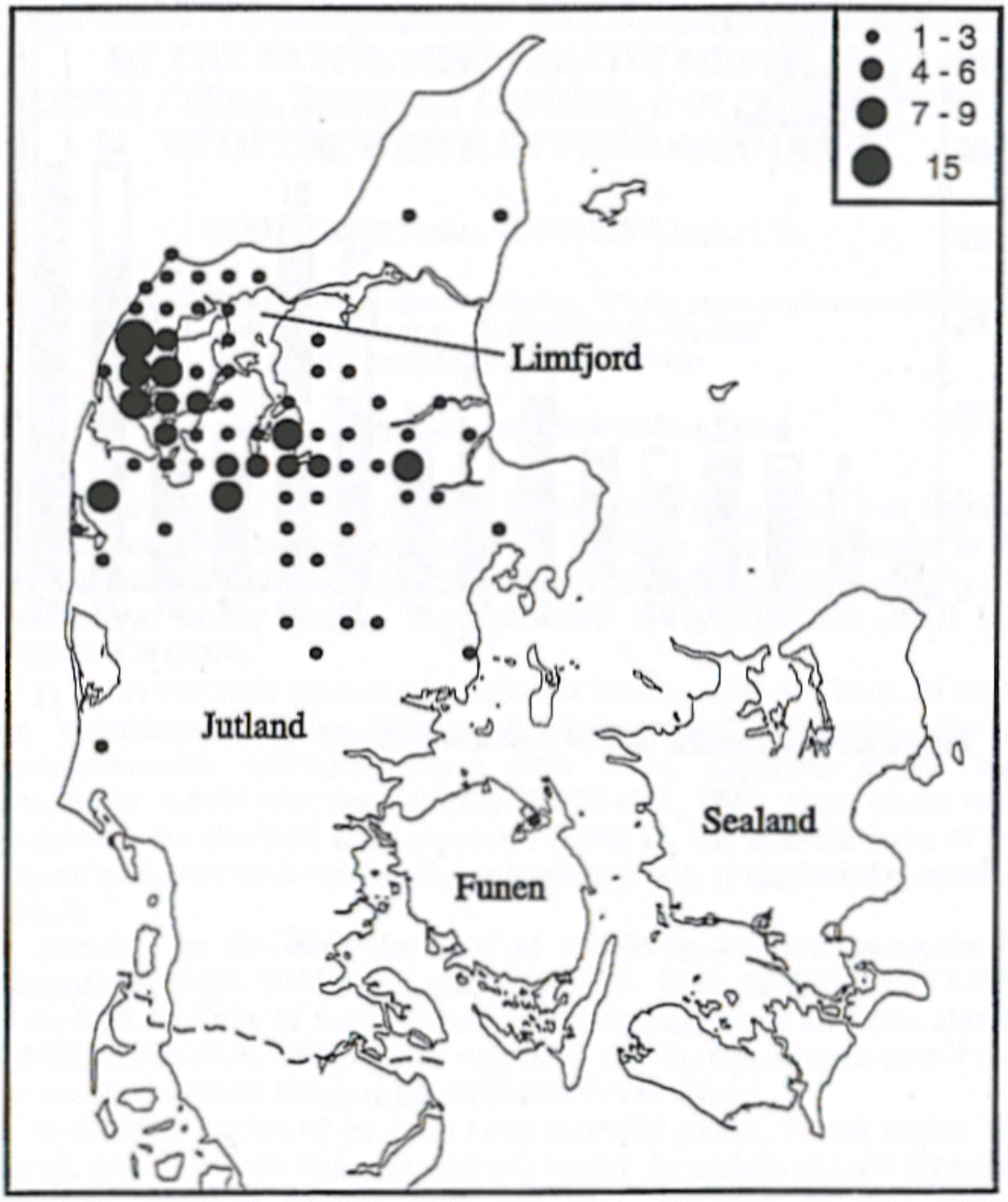

Figure 1. Geographical distribution of dead otters (n=193). The origin of one otter is unknown

MATERIALS AND METHODS

Dead otters were received from hunters, motorists, anglers, forestmen etc. The otters were usually followed by written information about circumstantial evidence like killed on a road, died in a fish trap etc. Carcasses were frozen immediately upon arrival and stored at -18° C until necropsy was performed.

Necropsy

After thawing, the length (nose to tail) and weight was recorded. The animals were pelted followed by a routine necropsy procedure, including a search of the subcutis for lead pellets. Otters were aged as juveniles (less than about 5 months old) if tooth replacement was incomplete, as subadults (5-18 months) if the epiphyseal closure of humerus and femur at their proximal and distal ends was not complete or as adults (older than about 18 months). In males the length of the os penis was also used in ageing (van BREE et al., 1966). The craniums were cleaned from muscles etc. and the upper and lower jaw was inspected by a dentist.

Laboratory tests

Lungs and gut contents were examined for parasites, eggs and larvae from parasites using McMaster and modified Baerman techniques (HENRIKSEN, 1965, HENRIKSEN and KORSHOLM, 1984). Scrapings of epithelial lining from thrachea, lungs, and urinary bladder from otters necropsied later than 1988 were examined for viral inclusion bodies using S3-staining and a routine immunohistochemical method to detect distemper virus. Bacteriological examinations (Aerobic cultures on blood agar), were performed on material from the digestive tract, lungs and kidneys.

The body condition (K) of otters was calculated using the equation $K=W/(a \times L^n)$ where W=weight (kg) and L=total length (m) according to LE CREN (1951). The constants were those calculated by KRUUK et al. (1987) viz. a=5.02 for females, 5.87 for males; n=2.33 for females, 2.39 for males.

To test for differences in age distribution between the two sexes, a Chi^2-test were used. Differences in length and weight of the two sexes and differences in body condition index were tested using a F-test.

RESULTS

194 otters were received of which 145 were necropsied. 52 otters were X-rayed. For some of the animals complete data were not received. Therefore, the number of individuals in the various examinations is inconsistent (Table 1).

Table 1. Salient data and the number of animals included

type of data presented	number of animals
total received	194
origin stated	193
sex determined	192
age determined	178
length and weight determined	158
necropsied	145
x-rayed	52

The geographical origins and densities of the otters are given in Figure 1. The vast majority came from the Limfjord area. One individual found in 1979 came from the island of Funen. Half of the otters were found in or close to marine habitats. The annual number of carcasses received varied from two in 1979 to 31 in 1993 (Fig. 2). Major causes of death were identified as traffic mortality (88=45.4 %) and drowning (63=32.5 %).

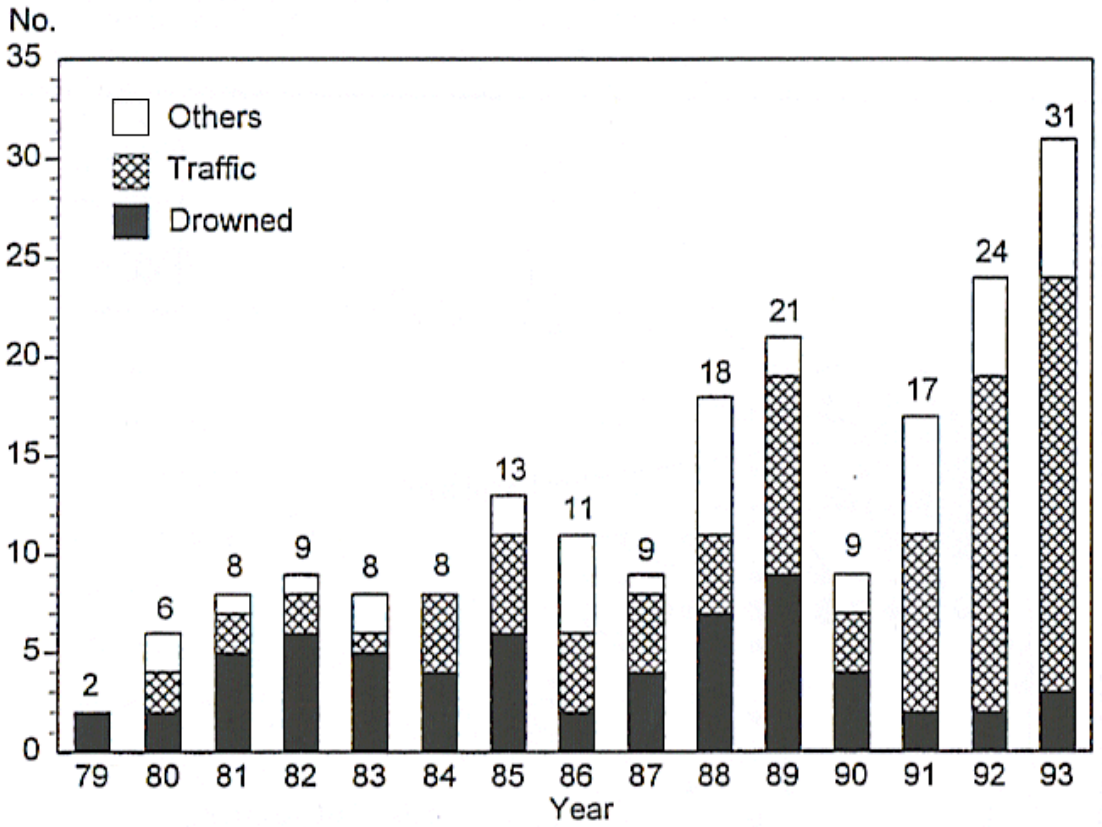

Figure 2. Annual number of dead otters and cause of death (n=194)

No significant difference was found in age distribution between the two sexes, (χ^2=0.43, d.f.=2, N.S.) (Table 2). Considerably more males (113) than females (79) were received during the survey. The weight and length of adult males were significantly larger than for adult females (t=9.60, df=65, *P*<0.001, weight; t=20.35, df=67, *P*<0.001, length). The condition index (K) of the otters had an overall mean value of 1.12, animals that died violently (traffic accidents and fish traps) had a value of 1.16 (Table 3).

Table 2. Sex and age distribution of dead otters

	females	males	unknown	total
juvenile	8	12	-	20 (10.3%)
subadult	30	48	-	78 (40.2%)
adult	34	44	2	80 (41.2%)
unknown	7	9	-	16 (8.3%)
total	79 (40.7%)	113 (58.2%)	2 (1.0%)	194 (100%)

Table 3. Weight and length of adult otters and calculated condition indices (K).

	x	s.d.	range	N
weight (kg)				
male	9.07	1.35	5.45-11.40	37
female	6.02	1.17	3.36-7.60	30
length (cm)				
male	112.9	5.06	90.0-130.0	36
female	103.0	3.17	95.5-110.0	33
condition index (K)				
non-violent	0.94	0.18		30
violent	1.16	0.16		124
sum	1.12	0.18		154

The results of necropsy and the corresponding pathological findings are detailed in Table 4. No ectoparasites were found. Signs of endoparasites were found in only 5 individuals viz. two with one egg of *Ascaridae* per gram in the intestinal tract, one with one egg of *Strongylidae* per gram in the intestinal tract and one with *Angiostrongylus vasorum* larvae in the lungs. Two tapeworm *Cestodae* eggs per gram were found in the intestinal tract of one individual.

Table 4. Numbers and types of pathological findings recorded at necropsy of dead otters (n=145).

pathological findings	number of animals	
parodontal disease	11	(7.6%)
endoparasites	5	(3.4%)
Ascaridae	2	
Strongylidae	1	
Angiostrongylus vasorum	1	
Cestodae	1	
viral infections	6	(4.1%)
distemper virus	6	
bacterial diseases	7	(4,8%)
pneumonia	5	
peritonitis	1	
Streptococcus sp.	1	
kidneystone	3	(2.1%)
gallstone/enlarged gall bladder	2	(1.4%)
hepatitis	2	(1.4%)
hypertrophied suprarenal gland	2	(1.4%)
tumour in spleen/enlarged spleen	2	(1.4%)
tumour in the small intestine	1	(0.7%)
umbilical hernia	1	(0.7%)
blindness	1	(0.7%)
total	43	(29.7%)

Inclusion bodies were found in 6 individuals, three females and three males of different age. These otters were all collected in the Limfjord area. The six otters were not believed to have suffered from clinical distemper.

Due to often severe decomposition bacteriological examination could only be applied to eight otters. Pneumonia due to bacterial infection was found in five individuals, four females and one male of which two were juveniles. One abandoned juvenile died from bacterial peritonitis two weeks after taken into captivity. Local infection with *Streptococcus sp.* was recorded in one animal.

Kidney stones consisting of ammonium urate were found in three adults, two males and one female, and two otters had a gall bladder enlarged by gall-stones. Two otters showed hypertrophy of the suprarenal glands. A small intestinal tumour possibly a leiomyoma (severe decomposition) and a minor umbilical hernia was seen in two otters, respectively. The eyes of one adult, male otter were completely opaque, probably causing total blindness.

Lead pellets were found in 9 otters (5%) in numbers from one to five pellets except for one individual carrying 14 pellets. The lead pellets were generally found in the pelt or subcutaneously and none were found in or close to vital organs. Parodontal disease was detected in 11 otters indicating a relatively high proportion of diseased animals.

DISCUSSION

Based on condition (K) of violent death otters there was no significant difference between otters from Denmark (Table 3) and from Shetland (KRUUK and CONROY 1991, K=1.08±0.15, n=49), (t=2.99, d.f.=171, N.S.) where thriving populations exist. The results agree with condition indices estimated by the authors from Danish data collected by JENSEN (1964) (K=1.13±0.16, n=81).

The increase in the annual numbers of submitted otters during the survey period (Fig. 2) might indicate an expanding population of otters (MADSEN et al. 1992) but a greater public awareness of otters cannot be excluded as the underlying cause of the increasing number of submissions.

The present results show that males achieve a larger overall size than females. MASON and MACDONALD (1986) classified animals weighing more than 4 kg as adults. In our study adults were classified as individuals with fully developed growth. One female with pneumonia but no emaciation weighed as little as 3.36 kg confirming that the weigth and length alone may not be used as an indicator of age.

No ectoparasites and only small numbers of endoparasites were found. This indicates that in the present situation the otter is not parasitised very often, probably due to their solitary living and the relative scarcity of the species. However, decaying before collecting the dead otters combined with freezing might have disintegrated some parasites and larvae.

Except for the larvae of *Angiostrongylus vasorum* all other endoparasites recorded have been described earlier to occur in otters (JEFFERIES et al., 1990; SCHIERHORN et al., 1991; WEBER 1991). Otters forage on frogs, which might act not only as paratenic but also as intermediate hosts for *A. vasorum* (BOLT et al., 1993, 1995). None of the parasites recorded were considered to have influenced the health status of Danish otters.

Distemper virus in captive Eurasian otters was described by GEISEL (1979) and STEINHAGEN and NEBEL (1985). Our study is the first to record distemper virus in a free living population of otters, with the exception of two individuals from Austria (LOUPAL, in press). The fact that the infected otters were collected from the Limfjord area in a period, when distemper virus was present both in the common seal *Phoca vitulina* (BLIXENKRONE-MØLLER et al., 1989) and in major outbreaks of distemper in farmed mink in this area, indicates a wide range of host species for distemper virus. Negative findings in the remaining material may indicate a low propagatory rate of the virus in the population, but may also relate to the solitary life of otters and hence a low contact between animals.

Two cases of hepatitis probably causing severe health problems were seen. Pneumonic changes were found in five of 145 necropsied free living Danish otters. This corresponds to the findings of KRUUK and CONROY (1991) who found one case among 24 necropsied otters. Pneumonia has not hitherto been recorded in captive animals (ROGOSCHIK and BRANDES, 1991). One individual was recorded as blind in our study. WILLIAMS (1989) also reported blind otters from Britain during the period 1957-80.

Based on our study we would argue that only the two animals with hepatitis, and the five animals with pneumonia were likely to have died because of the diseases detected. In addition, one animal with peritonitis definitely died from this disease.

Since 1967, the Danish otters have been protected by law. During the period 1967-1982, fish farmers could be granted a special permission to kill otters at fish ponds but this exemption was terminated in 1982. However, this study shows that totally protected animals are still shot at. To the less experienced hunter an otter may be mistaken for a free living mink of which more than 8.000 are shot annually in Denmark (ASFERG, 1999).

The level of PCBs in otters from Denmark (MASON and MADSEN, 1993) is at the same level as found in 1988 among young common seals in the Limfjord area (STORR-HANSEN and SPLIID, 1993) and much lower than the 50 mg/kg which causes reproductive failure among mink in laboratory studies and which is assumed to be a critical level for otters as well (KEYMER et al., 1988; SMIT et al., 1994).

It is seen (Fig.2) that the number of otters dying in fish traps has decreased. It is believed that this is the successful effect of a 1986 compulsory use of stop grids in fish traps for fishermen (MADSEN and SØGAARD, 1994). It should be noted that traffic mortality constitutes 45% of the total mortality (males as well as females, young as well as adults) indicating the need for preventive measures where roads are crossing rivers in Denmark.

In conclusion, our results suggest that the population of otters seems healthy and in good reproductive condition (ELMEROS and MADSEN, 1999), although traffic mortality may constitute a threat to the spread of the population.

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REFERENCES

Asferg, T. 1999. Nedlagt vildt i sæsonen 1997/98. Vildtinformation 99, Miljø- og Energiministeriet, Skov- og Naturstyrelsen, 21pp.

Blixenkrone-Møller, M., Svansson, V., Have, P., Bøtner, A., Nielsen, J. 1989. Infection studies in mink with seal-derived morbillivirus. Arch. Virol. **106**, 165-170.

Bolt, G., Monrad, J., Frandsen, F., Henriksen, P., Dietz, H.H. 1993. The common frog (*Rana temporaria*) as a potential paratenic and intermediate host for *Angiostrongylus vasorum.* Parasitol. Res. **79**, 428-430.

Bolt, G., Monrad, J., Frandsen, F., Bindseil, E., Henriksen, P., Dietz, H.H. 1995. Angiostrongylose hos hund. I. Biologi og patologi. Dansk Veterinær Tidsskrift **78**, 387-390.

Elmeros, M. and Madsen, A.B. in press. On the reproduction biology of otters *(Lutra lutra*) from Denmark. Z. Säugetierk.

Geisel, O. 1979. Staupe bei Fischottern (*Lutra lutra*). Berl. Münch. Tierärztl. Wochenschr. **92,** 304.

Hammershøj, M., Madsen, A.B., Bruun-Schmidt, I.Ø., Gaardmand, B., Jensen, A., Jensen, B., Jeppesen, J.L., Laursen, J.T. 1996. Overvågning af odder (*Lutra lutra*) i Danmark 1996. Otter (*Lutra lutra*) Survey of Denmark 1996. Danmarks Miljøundersøgelser. 40 s. Faglig rapport fra DMU, nr. 172.

Henriksen, S.A. 1965. En forbedret teknik ved undersøgelse for lungeormelarver i faeces. Nordisk Veterinær Medicin, **17**, 446-454.

Henriksen, S.A., Korsholm, H. 1984. Parasitologisk undersøgelse af fæcesprøver. Dansk Veterinær Tidsskrift **67**, 1193-1196.

Jefferies, D.J., Hansson, H.M., Harris, E.A. 1990. The prevalence of *Pseudoterranova decipiens* (Nematoda) and (*Corynosoma strumosum*) (Acanthocephala) in otters, *Lutra lutra* from coastal sites in Britain. J. Zool. **221**, 316-321.

Jensen, A. 1964. Odderen i Danmark. Danske Vildtundersøgelser 11. Vildtbiologisk Station, Kalø, Rønde, 48 pp.

Keymer, I.F., Wells, G.A.H, Mason, C.F., Macdonald, S.M. 1988. Pathological changes and organochlorine residues in tissues of wild otters (*Lutra lutra*). Vet. Rec. **122**, 153-155.

Kruuk, H., Conroy, J.W.H. 1991. Mortality of otters (*Lutra lutra*) in Shetland. J. Appl. Ecol. **28**, 83-94.

Kruuk, H., Conroy, J.W.H., Moorhouse, A. 1987. Seasonal reproduction, mortality and food of otters (*Lutra lutra* L.) in Shetland. Zool. Symp., The Zoological Society of London, **58**, 263-278.

Le Cren, E.D. 1951. The length-weight relationship and seasonal cycle in gonad weight and condition in the Perch *Perca fluviatilis*. J. Animal Ecol. **20**, 201-219.

Leth, P., Byrnak, E. 1996. Odder (*Lutra lutra* L.) genfundet på Sjælland. - Flora og Fauna **101**, 41-46.

Loupal, G. in press. Distemper in free-living otters. In: **Dulfer, R., Gutleb, A.C., Nel, J.A.J.** (eds.) Proc. VIIth Int. Otter Coll. Trebon, Czech Republic, 13-19 March 1998.

Macdonald, S.M., Mason, C.F. 1994. Status and conservation needs of the otter (*Lutra lutra*) in the western Palaearctic. Council of Europe Press, Strasbourg. 54 pp.

Madsen, A.B. 1991. Otter (*Lutra lutra*) mortalities in fish traps and experiences with using stop-grids in Denmark. In: **Reuther, C., Röchert, R.** (eds.): Proceedings of the V. International Otter Colloquium. – Habitat **6**, 237-241.

Madsen, A.B., Christensen, N.C., Jacobsen, L. 1992. Odderens (*Lutra lutra* L.) forekomst i Danmark 1991 og udviklingen i bestanden 1986-1991. Flora og Fauna **98**, 47-52.

Madsen, A.B., Søgaard, B. 1994. Stop-grids for fish traps in Denmark. IUCN Otter Spec. Group Bull. **9**, 13-14.

Mason, C.F., Macdonald, S.M. 1986. Otters - ecology and conservation. Cambridge University Press, Cambridge, 236 pp.

Mason, C.F., Madsen, A.B. 1993. Organochlorine pesticide residues and PCBs in Danish otters (*Lutra lutra*). Science Total Environ. **133**, 73-81.

Rogoschik, B., Brandes, B. 1991. Diseases among captive otters. In: **Reuther, C., Röchert, R.** (eds.): Proceedings of the V. International Otter Colloquium. - Habitat **6**, 309-315.

Schierhorn, K., Stubbe, M., Schuster, R., Heidecke, D. 1991. Helminthofauna of the otter (*Lutra lutra* L., 1758) in East Germany. In: **Reuther, C., Röchert, R.** (eds.): Proceedings of the V. International Otter Colloquium. - Habitat **6**, 133-142.

Simpson, V.R. 1997. Health status of otters (*Lutra lutra*) in south-west England based on postmortem findings. Vet. Rec. **141**, 191-197.

Smit, M.D., Leonards, P.E.G., van Hattum, B., de Jongh A.W.J.J. 1994. PCBs in European otter (*Lutra lutra*) populations. Report no. R-94/7 from Institute for Environmental Studies, Vrije Universiteit, Amsterdam. 77+44 pages.

Steinhagen, P., Nebel, W. 1985. Staupe beim Steinmarder (*Martes foina*) in Schleswig-Holsten. Dtsch. tierärztl. Wochenschr. **92**, 176-181.

Storr-Hansen, E., Spliid, H. 1993. Coplanar polychlorinated biphenyl congener levels and patterns and the identification of separate populations of harbor seals (*Phoca vitulina*) in Denmark. Arch. Environ. Contam. Toxicol. **24,** 44-58.

Weber, J.-M. 1991. Gastrointestinal helminths of the otter, *Lutra lutra*, in Shetland. J. Zool. **224,** 341-346.

Williams, J. 1989. Blindness in Otters. IUCN Otter Spec. Group Bull. **4**, 29-30.

Zogall, A., Reuther, C. 1992. Zur optimalen wissenschaftlichen Verwertung tot aufgefundener Fischotter. In **Reuther, C**.: Otterschutz in Deutschland. Habitat **7**, 171-174.

van Bree, P.J.H., Jensen, B., Kleijn, L.J.K. 1966. Skull dimensions and the length/weight relation of the baculum as age indications in the common otter, *Lutra lutra* (Linnaeus, 1758). Dan. Rev. Game Biol. **4,** 97-104.

RESÚMEN : Relevamiento de nutrias danesas *Lutra lutra* en libertad. Una colecta y necropsia consecutiva de cuerpos

Durante 1979-1993 fueron recibidas 194 nutrias danesas *Lutra lutra* muertas. A 145 de estas se les realizaron necropsias y se determinaron la causa de muerte, sexo, edad y condiciones corporales. La mortalidad debida al tráfico (45,4%) y el ahogamiento (32,5%) constituyeron las principales causas de muerte. Perdigones de armas de fuego se detectaron en el 5% de las nutrias. Se encontraron por primera vez en una población en libertad de nutrias cuerpos inclusivos indicando infección por virus. Se encontraron larvas de *Angistrongylus vasorum* en pulmones de nutrias de vida libre por primera vez. No se encontraron ectoparásitos. Se detectaron agentes infecciosos en el 22,1% de las nutrias, aunque pocas nutrias parecen haber muerto por infecciones. La distribución de edades no fue significativamente diferente entre sexos. Las condiciones físicas de las nutrias que murieron violentamente en Dinamarca fueron comparables con los hallazgos en Shetland, donde existen poblaciones prosperas. Los resultados muestran un decrecimiento considerable en el número de nutrias halladas ahogadas en trampas para peces con la introducción de rejillas de detención en las trampas para peces en 1986. Los resultados sugieren que la población de nutrias en Dinamarca es saludable y está en buenas condiciones, pero no puede descartarse que el gran número de muertes por tráfico amenaza la continua expansión de la especie.

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