Genetic management of European otters (*Lutra lutra*) in European zoos

Alfred Melissen[1] & Frank P.G. Princée[2]

[1]Safari Beekse Bergen, Beekse Bergen 31, 5081 NJ Hilvarenbeek, The Netherlands,
e-mail: curator@beeksebergen.nl
[2]Strathyre 2, Rue de la Piece Mauger, St. Saviour, Jersey JE2 7HW, Channel Islands, British Isles

Abstract: The European otter (*Lutra lutra*) is considered an endangered species in Europe. Therefore European zoos started a co-operative breeding programme – a so called European Endangered species Programme (EEP) - for this species in 1990. An important goal of the European otter EEP is to maintain an *ex-situ* (i.e. captive) population without imports of animals from the wild. Moreover, this population will be an important resource for reintroduction projects for this species. A reintroduction project of European otters in The Netherlands started in July 2002. Genetic management to avoid inbreeding and to maintain genetic variation is a pre-requisite to maintain a viable population. Examples of management strategies are described in this paper.

Keywords: *Lutra lutra*, European otter, captivity, EEP, genetics, management, zoo.

Introduction

The European otter (*Lutra lutra*) is considered to be an endangered species in Europe. Although healthy populations still remain in several East European countries, Portugal, and Great Britain, this species went extinct in most of the continental West European countries. The threats are numerous and differ per country or region, but in general the main causes for the disappearance of the otter from our wetlands and rivers are the loss of suitable habitat, fish traps, traffic casualties and bio-accumulation of toxic agents in the food chain causing decreased fertility and increased susceptibility to disease.

The European otter has been adopted as the ambassador for freshwater habitats by several countries in recent years. These countries aim to conserve and restore sufficient areas, linked with corridors, to maintain viable otter populations in the wild. Several reintroduction projects have been established in Sweden, Spain and Great Britain, and other countries have planned releases within the next few years (France, Italy). Reintroduction of seven European otters in The Netherlands took place in July 2002. A second group of eight animals was released in October 2002. Reintroduction involves both translocation of otters from other wild populations and releases of captive-born animals.

Guidelines for reintroduction require that animals which are to be introduced should be as closely related genetically with the original native population as possible (IUCN 1995). This means that the origin of each of these animals should be known. Information on the capture site will be sufficient for animals which will be translocated. Data on parentages in order to trace origins of the founders are required for zoo-born animals which will be released. Such data are stored in studbooks. An international studbook for European otters was established in 1986.

Captive animals to be used in reintroduction must be from populations which have been soundly managed both demographically and genetically, according to the principles of contemporary conservation biology (IUCN 1995). A co-operative population management programme, i.e. European Endangered species Programme (EEP), for European otters in European zoos was

© 2001 Vereniging voor Zoogdierkunde en Zoogdierbescherming. Lutra abstracts on the internet: http://www.vzz.nl

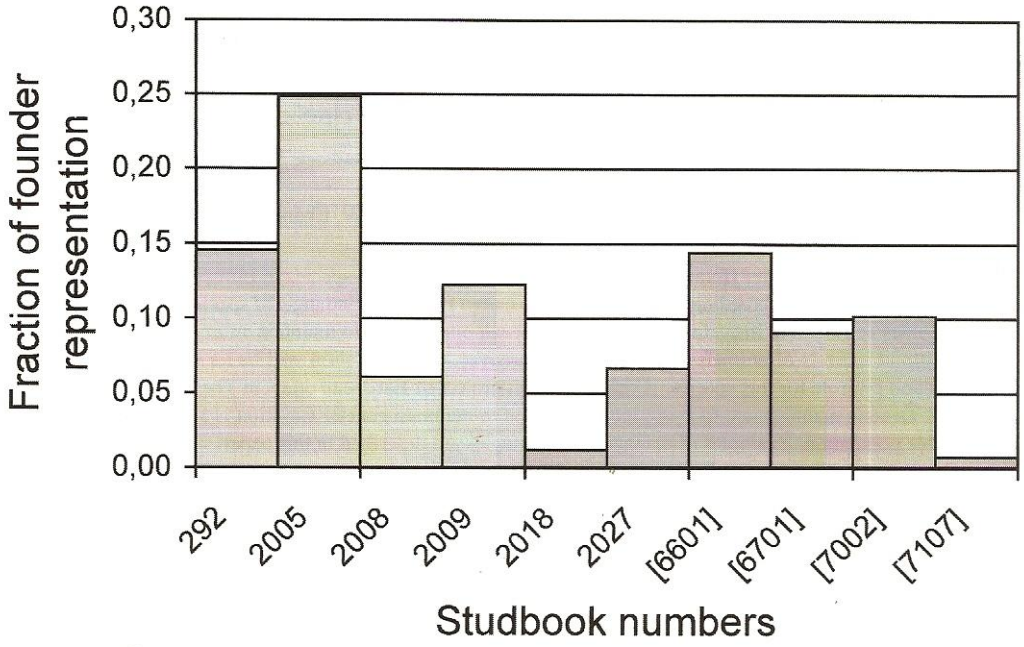

Figure 1. Founder representation in the Dutch zoo population of European otters (*Lutra lutra*) as on 1 January 2001. Studbook numbers between brackets refer to pseudo-founders.

established in 1990. The goals of this programme are to maintain a viable zoo population that does not depend on imports from the wild and that serves as a resource for reintroduction projects. For example, a reintroduction programme in The Netherlands will require 45 otters within the next five years. The first release of European otters in The Netherlands, in July 2002, involved two animals that were born in a Swedish zoo and are part of the EEP for this species. These otters are registered in the studbook under numbers #2676 and #2677.

EEP programmes involve the development of husbandry guidelines (containing the most current knowledge on housing, nutrition and breeding the species), initiation and coordination of research (for example on reproduction and diseases), and population management. Population management involves control over population size (demographic management) and avoidance of inbreeding and maintenance of genetic variation (genetic management). This paper will present some techniques that are applied in the genetic management of the zoo population of European otters, using the otter subset in Dutch zoos as an example.

Studbook data

Studbook data, including identification marks, parentages, dates of birth, transfers between zoos and dates of death, on individual animals are computerised in the program Single Species Animal Record Keeping System or SPARKS (Scobie & Flesness 1989). This programme allows the production of various overviews and listings, such as the history of the population or just the living population. The population of European otters in European zoos numbers 455 animals in some 80 institutions (data current as of January 2001).

The add-on programme GENES (Lacy 1994) is used for genetic analyses. GENES computes

various genetic measures such as inbreeding coefficients and mean kinship values for each individual animal, and founder representation in (subsets of) the living population. These data are used to determine which animals should be paired and which animals should be allowed to breed.

Founder representation and mean kinship

Founder representation in a zoo population refers to the proportion of genes from wild-born animals that are present in the living captive (zoo-)born animals. Figure 1 shows the founder representation in the living population of European otters in Dutch zoos as on 1 January 2001. The history of breeding success with this species in zoos is reflected in an unequal founder representation. Only a few zoos amongst those originally holding them were successful in breeding from wild European otters (and later their offspring) and so the genes of these first founders are represented in higher proportions than the genes of other founders, which were added to the population later.

The overview of founder representation is used to determine which animals are important for breeding in order to equalise founder representation, when feasible. It is clear that it will be important to breed with wild-born animals which have either not reproduced or are under-represented in the population. However, it becomes more difficult to select genetically important individuals in populations with complex pedigrees (see for example Princée 1988), especially when such individuals are descendants from multiple founders which are over- and under-represented in the population. Because of this the genetic measure "mean kinship" is used to identify genetically important individuals in the population. Mean kinship refers to the average genetic relatedness of an individual to the other individuals in the population. A mean kinship of 0.00 refers to an individual which is unrelated to all others. Such an individual is either wild-born and has not reproduced or is the single living offspring of a founder (or founders), and being thus genetically important would be a priority for breeding. A mean kinship of 1.00 means that all individuals are genetically identical ("clones"). See Ballou & Lacy (1995) for further details.

Mean kinship values for the 10 genetically most important males and females in the Dutch zoo population are presented in table 1. This table shows that all European otters currently in Dutch zoos are related so it is therefore not possible to establish new breeding pairs within this subset of the European zoo population. This

Table 1. Ranked lists of mean kinship values (MK) for European otters (*Lutra lutra*) in the Dutch zoo population ordered by sex as on 1 January 2001. Stud# = Studbook number; MK= mean kinship value; Known = fraction of the genome which originates from known ancestors.

Rank	Males				Females			
	Stud#	MK	Age (yrs)	Known	Stud#	MK	Age (yrs)	Known
1	1306	0.1208	7	1.00	1334	0.1966	6	1.00
2	2131	0.1502	6	0.50	1284	0.2176	8	0.25
3	2132	0.2499	6	0.38	2133	0.2440	6	0.38
4	2176	0.2638	4	0.75	2335	0.2972	2	0.25
5	2450	0.2846	1	0.44	2336	0.2972	2	0.25
6	2451	0.2846	1	0.44	2579	0.3084	0	0.56
7	2340	0.2846	2	0.44	2580	0.3084	0	0.56
8	1351	0.2862	7	0.5	2175	0.3116	4	0.75
9	2234	0.2972	3	0.25	1152	-	13	0.00
10	2484	0.3084	1	0.56	1240	-	10	0.00

Guidelines for reintroduction of otters in the wild require that animals which are to be introduced should be as closely related genetically with the original native population as possible. *Photograph: Edgar van der Grift.*

means that further exchanges with zoos in other countries, following mean kinship tables for the living population in Europe, are required.

Unknown parents

Some institutions unfortunately had not maintained records of the animals in their collection when the European otter studbook started some 20 years ago. Therefore valuable information on animals in the studbook is not always available (or accurate). It is clear that unknown data for parentages directly affect the results of genetic analyses. The programme GENES can handle "unknown" genes i.e. genes from unknown founders (Lacy 1994). The programme adds pseudo-founders as parents for unknown sires and dams. Founders 6601, 6701, 7002 and 7107 in the founder representation in the Dutch zoo population are pseudo-founders (see figure 1). These pseudo-founders contribute to almost 35% of the genes in this population subset. This large percentage can be explained; these zoos received animals from the few successful breeding institutions in the past.

The unknown origin of genes in the genome of individuals is also reflected in the mean kinship list. For example only 25% of the genome of female 1284 can be traced to known founders (see table 1).

Future management

The genetic situation in the European zoo otter population as a whole does not differ much from that illustrated for the Dutch zoo population subset. Large numbers of animals are of unknown or of partly known origin. Therefore the European otter population is managed in two groups. The "A" group is composed of otters whose origin is

completely known. These animals are allowed to breed. The A-line otters or their offspring can be used for reintroduction programmes, as recommended by the IUCN/SSC guidelines. This group currently comprises 30% of the living European zoo population.

The B-line otters are restricted in breeding and are currently maintained for conservation education display purposes only. The restricted breeding in this group should result in its complete replacement by animals of known genetic origin (i.e. the A-line) within the next 25 years.

References

Ballou, J.D. & R.C. Lacy 1995. Identifying genetically important individuals for management of genetic variation in pedigreed populations. In: J.D. Ballou, M. Gilpin & T.J. Foose (eds.). Population management for survival and recovery. Analytical methods and strategies in small population conservation: 75-111. Columbia University Press, New York, USA.

IUCN 1995. IUCN/SSC Guidelines for reintroductions. Prepared by the IUCN/SSC Reintroduction Specialist Group. The World Conservation Organisation IUCN, Gland Switzerland. Available from the internet, accessed on 19 November 2002. URL: http://www.iucn.org/themes/ssc/pubs/policy/ reinte.htm

Lacy, R.C. 1994. GENES: a computer program for pedigree management and genetic management. Chicago Zoological Society, Brookfield, USA.

Princée, F.P.G. 1988. Genetic variation in the zoo population of the red panda subspecies *Ailurus fulgens fulgens*. Zoo Biology 7: 219-231.

Scobie, P. & N.R. Flesness 1989. Single Population Animal Record Keeping System (SPARKS), software and manual. International Species Information System, Apple Valley, USA.

Samenvatting

Genetisch beheer van Europese otters (*Lutra lutra*) in Europese dierentuinen

De Euraziatische otter (*Lutra lutra*) is een bedreigde diersoort in Europa. Daarom zijn de verenigde Europese dierentuinen een speciaal fokprogramma begonnen waardoor de dierentuinenpopulatie zonder verdere wildvang in stand kan worden gehouden. Bovendien kunnen uit deze populatie op termijn dieren gebruikt worden voor diverse herintroductie-projecten in Europa. Methoden en technieken die worden gebruikt bij het genetisch beheer van dierentuinpopulaties worden in deze bijdrage besproken.

Received 31 December 2001
Accepted 26 July 2002