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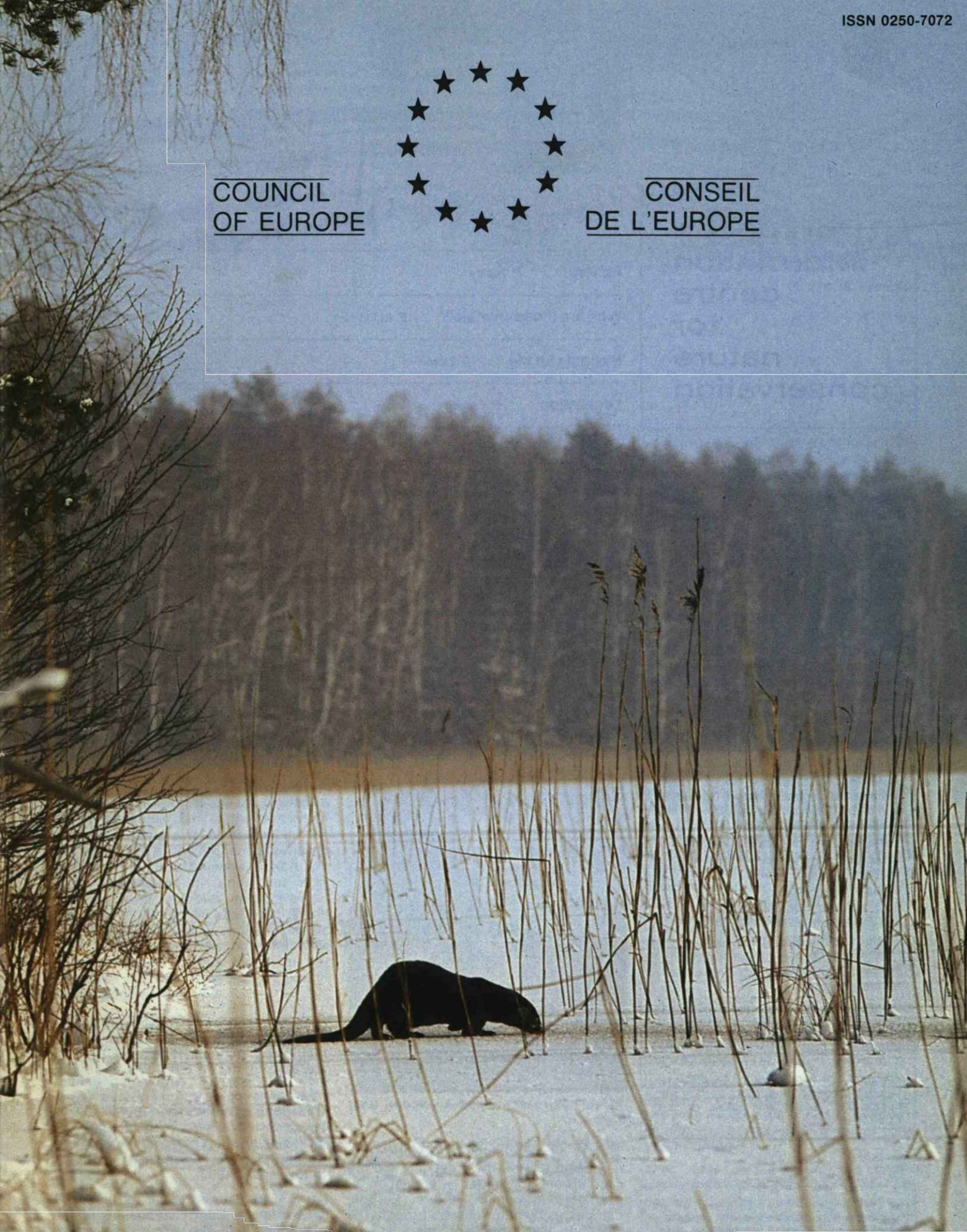

Naturopa

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Captions to colour illustrations p. 16-17 :
1. *Gulo gulo* (Photo C. Nardin-Jacana)
2. *Lynx lynx* (Photo Labat-Jacana)
3. *Ursus arctos* (Photo J.-P. Varin-Jacana)
4. *Canis lupus* (Photo Ziesler-Jacana)

Let us protect this "vermin"

Furry, beautiful, but seldom seen —Europe's small predatory mammals have not always enjoyed a favourable status. As competitors, they were usually swiftly dealt with and only a few naturalists raised a voice in their defence.

This is slowly changing. A world-wide campaign to save the great cats laid the groundwork for better appreciation of predators in general and in Europe, campaigns by nature-lovers brought the wild cats, foxes, badgers, otters, stoats, ermines, weasels, etc. almost to the front pages. As predators they may come into direct conflict with man—young roe-deer, fish, song-birds and eggs are among their prey, and man does not always like this. There is also the problem of rabies, which is a current subject for debate. However, this world is also theirs and they too have the right to live in it.

This issue of *Naturopa* is published on the occasion of the Third International Colloquy on the Otter, which was held in the Palais de l'Europe in Strasbourg in November 1983.

"The Water's Edge" campaign will be highlighted at the Fourth European Ministerial Conference on the Environment, to be held in Athens at the end of April 1984. Thus *Naturopa's* next issue will encourage better appreciation of that vulnerable and rich habitat: where water and land meet. H.H.H.

(Photo W. Lapinski)

Editorial

Poisoned, snared, trapped, clubbed or shot, the small predatory mammals of Europe have a poor time of it.

A common argument used to justify their destruction is that without such control their numbers would rise to such levels as to seriously harm human interest. Yet increasingly naturalists are aware that left alone predator populations are almost self-regulating. Man's hatreds are scarcely relevant and given the scale of environmental change in Europe the pressure upon the predators may have reached eradicating proportions.

Yet persecution continues—often in ways which are almost as obscenely barbaric as those used to end the life of the big cats so that their unmarked furs may adorn the backs of rich ladies.

But our smaller European predators are an essential part of the pattern of our nature. They are themselves a control upon the rodentiae, an alternative, perhaps, to the poisons which we rather recklessly ply upon our ecosystems. Their removal might well be not only a matter for aesthetic regret but of economic disadvantage. And we should realise that whilst our landscape is impoverished in visual quality for our own eyes this means habitat for predators is entirely removed.

The fox is regarded as a threat to poultry yet most European foxes will never have tasted domestic chicken. Poultry is kept increasingly in intensely managed security. Yet the hunt continues perhaps in order to maximise the yield of game. But the vixen shot whilst carrying mice to her cubs no longer contributes unwittingly to making the agricultural economy just a little more robust.

In Britain it was lawful until 1973 to dig out the badger's sett, to haul him out with special tongs and then to torment him for so-called sport. We had abolished dog—and cock—fighting and bear-baiting over a century before. I take some pride in having steered the 1973 Badgers Act through the Commons and I was further relieved when the Wildlife and Countryside Act of 1981 consolidated that measure and provided greater sanction against offence. This was necessary for road traffic alone is a critical influence upon badger survival. Persecution adds surfeit to destruction.

But law alone cannot suffice. In a rural situation each weasel may not be watched, each stoat supervised, a police officer cannot guard every fox's earth. In fact more protection may be afforded by enlightenment than by the schedules of law—important though these are.

Enlightenment is urgently required for without it the decline of many species will be maintained to the point of their national or regional disappearance.

In many Council of Europe states only three or four small predator species are likely to be widely established. Others may have gone or become exceedingly rare as creatures retreat to their wilder fastnesses before the demands of man.

Destruction of habitat, pollution, disturbance and persecution have brought our otter population to a level which means that less than one person in a thousand will ever see at first-hand this attractive animal, a creature which reveals such a beautiful fluidity of movement, a unique "ring upon bright water".

Fortunately some television films have aroused awareness and offer opportunity for observation which would otherwise be an experience denied. But what do we see when there is nothing left to film?

Observation of such creatures requires either good fortune or the exercise of considerable wit for the four-legged hunters have to be furtive to survive. But if man has to use subtlety to observe so he has to destroy. That intelligence should be used for such a purpose seems a contradiction. There we have a rather modern paradox.

There is another.

In many of our countries we have just begun to see greater admiration of the falcon's beauty, have begun to watch with respect the ascent of the eagle or the dash of the hawk. With necessary controls upon agriculture's organochlorides the raptor's egg-shells may have returned to a thickness which assists their prospect of survival. For that we can be a little relieved.

Yet the killer birds serve the same role as the mammalian predators which yet do not enjoy the same improvement in regard.

The swoop from the air may be no more noble than the pounce from an earth-bound stillness. Both deal in the death nature's design requires.

But the most ruthless of nature's murderers is man and the instruments he has now devised allow him to eradicate neighbour species, even those of value and of beauty.

That value and beauty need urgent recognition. Our own sensitivity and perhaps our own eventual comfort suggest that there should be tolerance. A tolerance of other species which share our continent including those killers which are smaller than ourselves.

Peter Hardy, M.P.
Chairman, Council of Europe
Sub-Committee on the Natural Environment

Who are these animals?

Erkki Pulliainen

Martes martes moving house (Photo W. Lapinski).

Nyctereutes procyonoides, a newcomer (Photo W. Lapinski).

Only one of the small predatory mammals belonging to the rich Villafranchium fauna which inhabited Europe before the Ice Age, namely the badger (*Meles meles*), has survived the past 2-3 million years. This species has been enough of a "generalist" in its living demands and habits (e.g. overwintering in dormancy) to tolerate the considerable climatic changes which have taken place here during the period in question.

What, then, are these "small predatory mammals"? Since we do not speak about "medium-sized" carnivores, we can include in this non-systematic group all those carnivores which are not called "great predators", a group which includes the wolf (*Canis lupus*), the bear (*Ursus arctos*), the wolverine (*Gulo gulo*) and the two lynx species (*Lynx lynx* and *L. pardina*). Defined in this way, small carnivores can vary very much in size and weight from a tiny weasel (*Mustela nivalis*) (min. weight 24 g) to a fat badger weighing more than 20 kg.

Variety of species

The ten European mustelid species include one which has been introduced, namely the American mink (*Mustela vison*), which has been able to inhabit more of the northern areas than its European counterpart, the European mink (*M. lutreola*).

The Arctic fox (*Alopex lagopus*) and the two viverrid species, the genet (*Genetta genetta*) and the mongoose (*Herpestes ichneumon*), represent two extremes in the distribution of European small carnivores. The Arctic fox inhabits the alpine summits of the northernmost mountains, the tundra lowlands and some arctic islands, whereas the viverrids occur only in the southwestern corner of the continent. The jackal (*Canis aureus*) and marbled polecat (*Vormela peregusna*) are inhabitants of south-east Europe.

Only three of the European small carnivores inhabit the whole continent or have done so during this century. They are the red fox (*Vulpes vulpes*), the otter (*Lutra lutra*) and the weasel. More species are lacking from its northern parts than from its southern parts, indicating the severity of subarctic and north boreal conditions.

Food specialists and generalists

The smallest mustelids, the weasel and the stoat (*Mustela erminea*), are typical food specialists, actually rodent specialists. Although they are also able to kill young hares and birds, they are so dependent on small rodents for their nutrition that increases in their populations are usually connected with mass occurrences of small rodents. When small rodent populations are low, or such mammals are absent from a particular area, these small carnivores may also be absent. This leads to a pattern of continuous emigration and immigration.

Many of the Arctic fox populations are similarly dependent on small rodent populations, especially lemmings, but they may also utilise ungulate or sea mammal carcasses. Small rodents play an important, but not so decisive, role in the diet of many other small carnivores, although these generalists also consume a variety of compensatory food items.

Red foxes are well known for their catching of voles, but they are able to kill a variety of other animals and may be carrion feeders. This habit certainly helps populations to recover after a rabies epidemic. The rapid covering of rubbish dumps with soil and improved veterinary hygiene have reduced their potential sources of food, however. Pine martens in the taiga forests feed mainly or solely on small rodents when these are abundant, but in their absence will eat berries, mushrooms, other mammals, birds and all kinds of carcasses. The badger is an omnivorous feeder which will eat both vegetable and animal matter during its nightly foraging trips.

The otter and the American and European minks are fish-killers, which may also hunt small mammals and birds on dry land. An American mink once killed a female Capercaillie (*Tetrao urogallus*), weighing approx. 2 kg, in front of one of my field assistants, but this is a rare exception.

Predator-prey relationships

Many of the small carnivore species are useful from the standpoint of human economy in killing small rodents in considerable numbers. Biological control would work extraordinarily well if these predators were able to cause a real crash in their prey populations, but this is not the case. In cyclicly or irregularly fluctuating small rodent populations other factors than predators may accomplish this, but the predators can only deepen the lows in their prey populations.

Predation on small rodent populations by small carnivores together with birds of prey and owls may be so pronounced in certain parts of Europe, however, that the populations do not fluctuate at all. This is the case in southern Sweden, for instance.

Questionable benefit from introductions

The introduction of fur-bearing animals from other continents was commenced in the 1930s. Although congresses of game biologists some thirty or forty years later have spoken about "fauna improvement", perhaps fortunately no notable introductions were achieved.

One goal of such activities was to increase the number of pelts produced for the fur market. The pelt of an American mink is not valued so highly as that of a mink bred in captivity, however, and the number of pelts of wild minks produced each year has remained low.

Meles meles (Photo G. Lacoumette).

The American mink has thrived well in northern Fennoscandia, better than the native European mink or polecat (*Mustela putorius*). Just now the strong American mink population is preventing the recovery of the European mink population in eastern Fennoscandia, but viable populations of the latter still occur in the USSR, France, Romania and Spain. The species spread to France from the east at the end of the eighteenth century and has advanced into Spain during the past 30-35 years.

Expectations were not fulfilled in the case of the introduction of the Asian raccoon dog (*Nyctereutes procyonoides*). The species spread quickly, but appeared to cause considerable damage to fields of oats, maize and melons and also to vineyards. Introduction of the species into the USA has been forbidden, for instance.

Man-predator relationships

A species feeding on small rodents and simultaneously producing a valuable pelt for the fur market should naturally be managed according to the principle of an optimum sustained yield. In many parts of eastern and northern Europe fur-bearing populations are still hunted, and the hunting authorities, at least, tend to take this principle into account in their decisions.

Wherever the trapping of fur-bearing animals is practised in the civilised world, the demands for humane trapping have increased. North America, with its trapline system, has been a pioneer in this respect. Last winter a similar debate was conducted in the Finnish Parliament. The indiscriminate killing of mammalian predators is said to be a typical European attitude, having even involved the use of bait poisoned with strychinine, a practice which still continues in some parts of Europe.

Mammalian predators have also been the first to suffer from the biochemical onslaught to which man will ultimately be exposed as well. In areas of intensive cultivation they are strongly subjected to poisoning by insecticides, rodenticides and other biocides. Deliberate destruction of small predatory mammals takes place especially often by secondary poisoning through pollution and the loss of acceptable habitats. The forests of Europe have undergone drastic changes over the last few hundred years. The cutting down of old forests is perhaps the most serious general threat to wildlife in the world, especially concerning those species which depend on mature forests for their habitats.

In the northern taiga forests the pine martens show a preference for spruce and mixed forests and avoid entering areas with no overhead cover. In the Lake District in the British Isles, where there was very drastic deforestation, pine martens have been recorded in rocky areas, but niche shifts of this kind are not possible everywhere where deforestation take place.

In central and southern Europe there is another related species, the beech marten (*Martes foina*) which lives almost exclusively in human dwellings and their immediate surroundings including the margins of woods. It has been suggested that inter-species competition for habitats has pushed it into these circumstances.

The otter is an apt example of an aquatic mammal whose populations have declined in most parts of Europe due to changes and new dangers in its living environment. It has suffered due to water pollution through industrial waste, organochlorine pesticides, heavy metals, etc., but many have also drowned in fish traps. They have been killed illegally by hunters or other people, and also dogs and cars. They have suffered from changes in landscapes through amelioration or elimination of their riparian habitats.

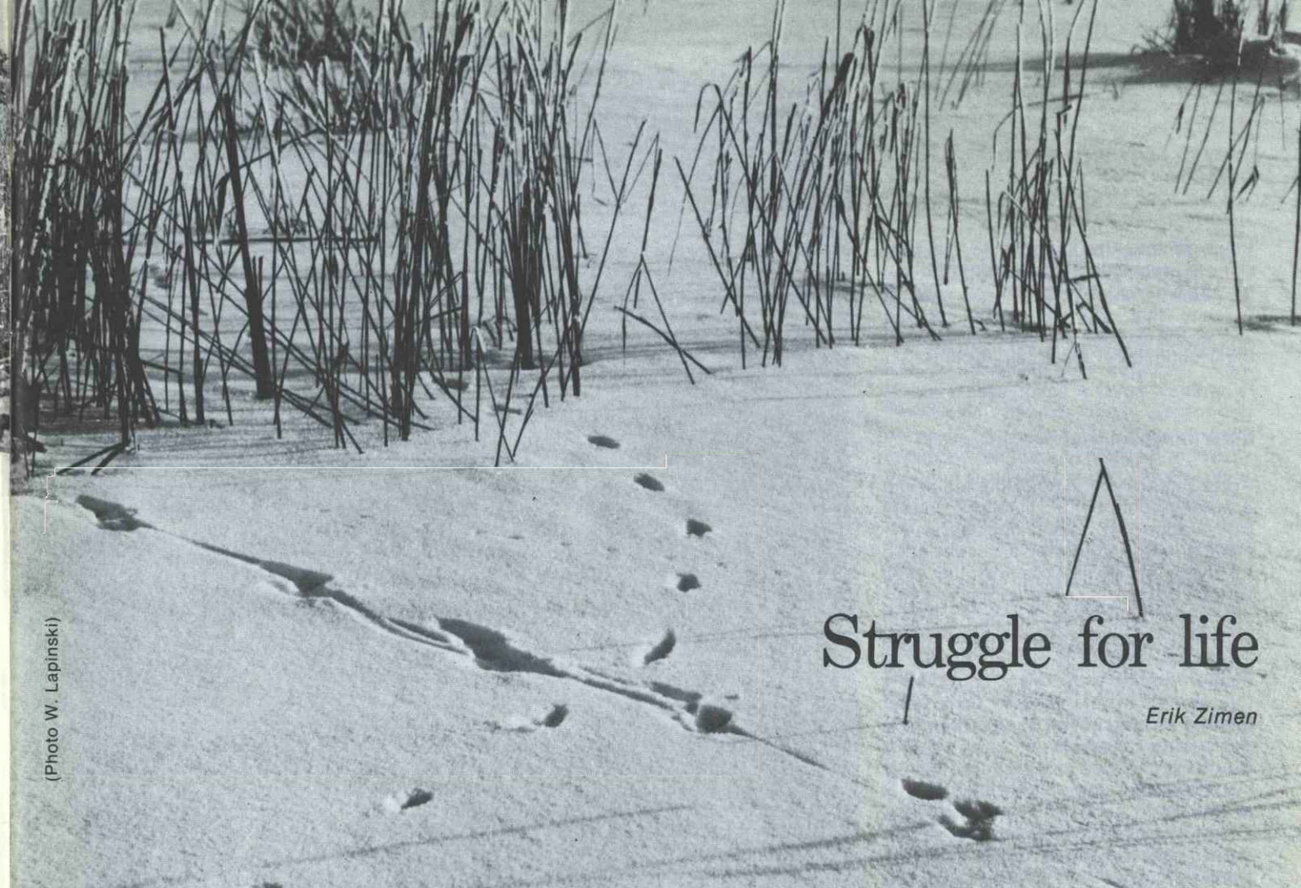
Future perspectives

None of the small predatory mammals dealt with here are included in the IUCN Mammal Red Data Book, but the populations of the wild cat (*Felis catus*), otter, badger and pine marten, at least, are declining generally within Europe. The history of these species parallels that of the birds of prey.

Of the European small predatory mammals the otter, the wild cat, the viverrids and the canids belong to the species list of the CITES Convention. Much has been done, provided that governments can really control the extremely damaging trade in wild animals, and that TRAFFIC succeeds in monitoring international trade in wildlife and wildlife products, but this is not enough.

As the otter example indicated, even though a species is protected by law, its populations may be seriously threatened by the numerous decisive factors involved in the "hard" and "heavy" technology of our civilised world. Much needs to be done, and quickly, to steer these ultimate causes in a "softer" direction.

I sincerely hope that the old saying that "man never learns from his own mistakes" is no longer true. E.P.



(Photo W. Lapinski)

Struggle for life

Erik Zimen

We know a lot about the behaviour, ecology and population of elephants in Africa and also about the situation of tigers in India or of pandas in China. But there is amazing ignorance about certain of Europe's own indigenous animal species. Who is interested for example in the behaviour of the pine-marten, the local occurrence of the stoat or the population trends of the polecat? Ecological field studies of our predators have indeed been made here and there, but the gaps in our knowledge are greater than with any other family of animals. Why is this?

A secretive life

One reason is to be found in the behaviour of the predators themselves. They live very well hidden away, although often in close proximity to human beings. They are mostly active only at night; during the day they retreat into areas of dense vegetation.

Although this ability of predators to use land cultivated and developed by man and in close proximity to human beings largely unnoticed makes it difficult to observe and study them, it is an ability which is essential to their survival.

For they not only use the same space but they often hunt the same prey as human beings. And in accordance with our anthropocentric view of the world, we label this competition "destructive". After a struggle lasting thousands of years, the larger beasts of prey have finally been largely driven away. But we have not been so "successful" with the smaller ones. Admittedly the attitude of hunters is slowly changing today, but there is still a long way to go before sceptical tolerance turns into genuine interest. On the continent at least (matters are different in the British Isles), research into wild animals has traditionally been done by hunters, and this explains why we have a lot of catching-up to do in the ecology of predators.

This ignorance which has thus historically prevailed also has economic consequences. I am thinking, for instance, of the unsuccessful attempts—as part of the campaign against rabies—to reduce the fox population by intensive hunting and gassing. Had we known more about the population dynamics, territorial behaviour and adaptability of foxes earlier, rabies-prevention measures with greater prospects of success would have been chosen from the outset.

The fox (*Vulpes vulpes*) has a special place among Europe's predators. No other species has been so successful in adapting to human behaviour in land developed and cultivated by man, whilst many other species are faced with imminent extinction.

Example of the extermination of the wolf

The wolf provides a perfect example of the development and effect of various causes of the extinction of an animal species. Until the late Middle Ages the wolf was widely distributed throughout Europe. With the almost total clearance of forests in the British Isles, it lost its retreats there. Wolf-hunting became more and more successful; yet it took several centuries of slow decline in ever smaller, isolated pockets of population until the last wolf died in Scotland in the 17th century.

On the continent the wolf held out longer. In Scandinavia large areas of forest remain but here, at the beginning of the 19th century, the wolf's main prey, the elk (*Alces alces*) became almost completely extinct. The wolves then had only domestic animals on which to prey, and even these were securely locked up in winter. Certainly large-scale wolf-hunting also had its effect; but the ultimate cause of the sudden rapid disappearance of the wolf from great areas of northern Europe in the middle of last century was lack of food, and the animal has survived only in small vestigial populations in the northern reindeer region.

The no less intensively hunted wolves of central Europe experienced a similar fate. All attempts to deal with them failed until here too reindeer and roe-deer had practically disappeared. In sparsely populated areas of south-eastern Germany such as the Bavarian Forest or on the northern edge of the Alps, wolves managed to survive for another fifty years or so, but in the middle of last century they disappeared. Individual animals managed to survive much longer, on the other hand, in the densely populated areas of the Rhine, Moselle and the Saar, and also on the southern

fringe of the Alps. Thanks to the mild climate, domestic animals could be put out the pasture throughout the year—a practice that was life-saving for the last of the wolves but often threatened the livelihoods of the small farmers.

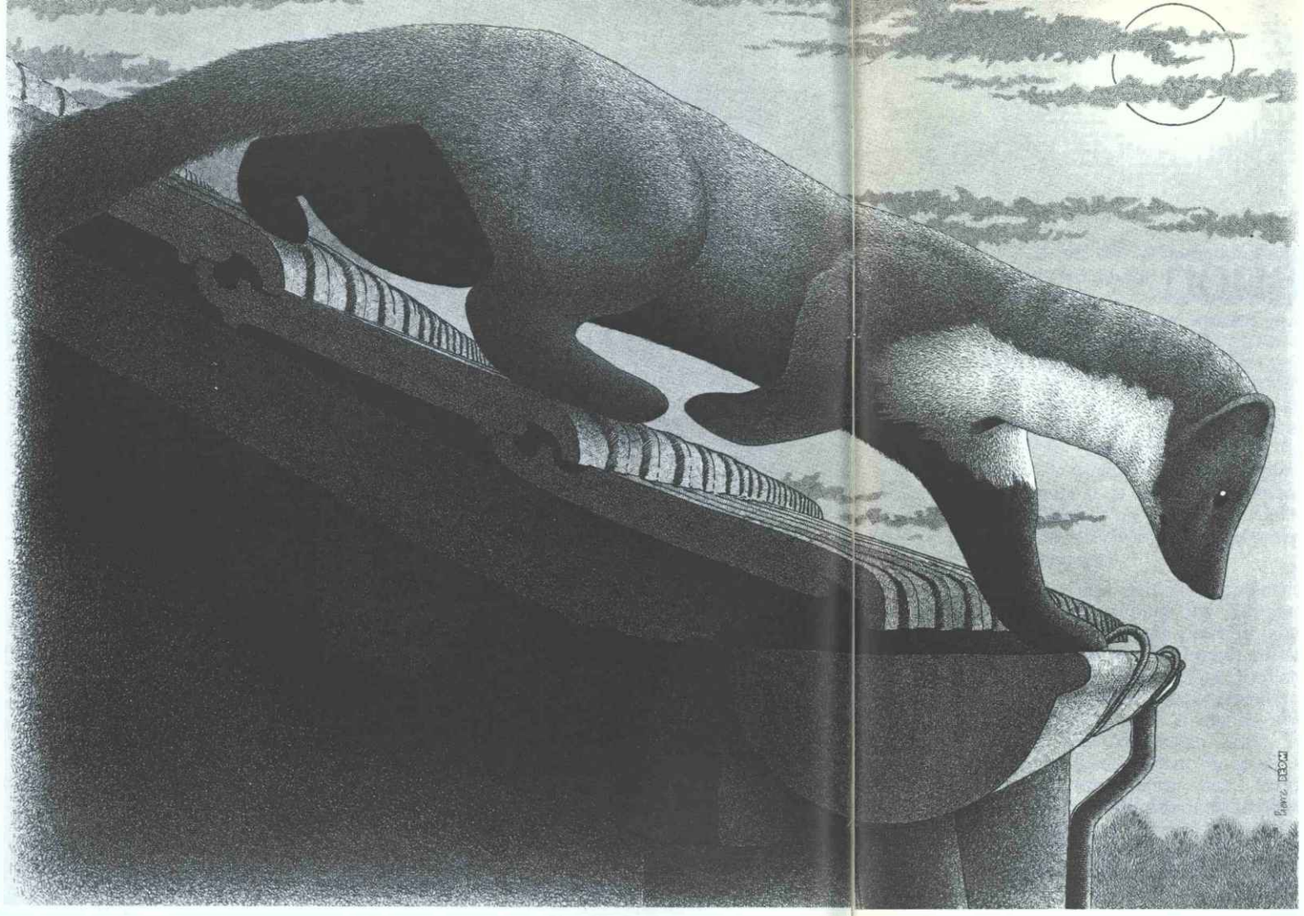
Extermination mechanism

Accordingly there is no single factor but a whole complex of different causes which doom an animal species to extinction in land cultivated and developed by man. As in the case of the wolf, various phases in the struggle for existence can be distinguished. To begin with, the species in question is widely distributed. Adequate rates of reproduction compensate even for mortality due to human intervention. Only when there is a combination of direct hunting, decreasing numbers of prey and/or extensive changes in biotope do falls in the population come about in Phase 2, at first locally and later over a wide area. These usually lead very rapidly—in just a few years—to the breaking up of the population into small, isolated pockets. In these retreats the remaining population can in certain circumstances hold out for some time (Phase 3). But without any exchange between the separated communities, chance factors such as a succession of early summers with cold, damp weather, or temporary food shortages or an epidemic can, in a fourth and final phase, carry off the remaining groups—which will in any case mostly be at the limits of their survival capacity—one after the other until the species is completely wiped out.

Species that could maintain themselves

Of the 13 terrestrial carnivores indigenous to central Europe, only five occur over a wide area in adequate numbers: the fox (*Vulpes vulpes*), the beech-marten (*Martes foina*), the pine-marten (*Martes martes*), the weasel (*Mustela nivalis*) and the badger (*Meles meles*).

Let us take the smallest of these first. Like all the members of the marten family, the weasel likes to live in small, strongly structured habitats such as hedgerows, piles of brushwood or stones, fallow land, fields of stinging nettles, old sheds or other mostly man-made biotopes such as were frequently to be found until recently in the proximity of villages. Modern farming and efforts to make villages more beautiful have led to the disappearance of many of these habitats. The weasel, however, seems to be able to make do with such small remains of earlier disorder that its population is not yet endangered.



Martes foina (Drawing Pierre Déom).
The land predators which live in Europe today are classified into 6 families:
- the martens (Mustelidae), 12 species;
- the canines (Canidae), 5 species;
- the felines (Felidae), 2 species;
- the bears (Ursidae), 2 species;
- the viverrines (Viverridae), 2 species; and
- the racoons (Procyonidae), 1 species.
The distribution of 8 of 24 species only just touches Europe; in southern Spain, for instance, the African mongoose (Herpestes ichneumon), in Greece and southern Yugoslavia the jackal (Canis aureus), and the marbled polecat (Vormela peregusna), or in the far north the polar bear (Ursus maritimus) and the Arctic fox (Alopex lagopus).
A further 3 species were brought to Europe to be farmed for their furs and then became wild: racoons (Procyon lotor), racoon dog (Nyctereutes procyonoides) and the American mink (Mustela vison). In central Europe there are accordingly only 13 indigenous species of terrestrial carnivores (Carnivora), and even of these there are 5 which have become extinct over a wide area: the wolf (Canis lupus), the bear (Ursus arctos), the lynx (Lynx lynx), the otter (Lutra lutra) and the European mink (Lutreola lutreola).

The beech-marten too takes advantage of human building activity in the countryside. Although fitted for living in rocky terrain, it has found a substitute biotope in villages, and so far as may be judged from our rough estimates of the population, this greatly appeals to it. Latterly it has probably also benefited from a decrease in hunting. Modern farms do not have chickens running around and there are hardly any hunters left who are still masters of the time-consuming art of trapping.

The pine-marten simply has not had to adapt particularly. Its biotope—woodland—has so far changed least of all the habitats in land cultivated and developed by man. So far! The prospect of dying forests in the next few years bodes ill for many of those who inhabit them.

The last of the successful ones is the badger. Admittedly, only some years ago, it was well into the phase of rapid population decline. The 1960s and early 1970s were a time when gassing of earths took place annually in order to decimate the fox population: but it was the badgers, more closely tied to their setts, which suffered—not from the poison gas, according to the veterinary surgeons, but from the rabies itself, carried by the foxes.

Our observation in Saarland do not confirm this view. As everywhere else, the badger population at the beginning of the 1970s was very small after the first rabies epidemic and years of gassing earths. The badger was accordingly protected from hunting all the year round. At the end of the 1970s, rabies broke out again with devastating results for the fox population. The gassing of earths, however, was abandoned. Nor would it be much use, because 8 out of 10 of all our occupied earths this spring were being used by badgers. The fox has become rare, albeit undoubtedly only temporarily. The badger, however, despite the rabies, has made a magnificent recovery, although we occasionally found badgers which had died from the epidemic. But the badger was now spared what was clearly the main cause of the first decline in its population —poison gas.

Threatened species

Let us turn now to the threatened species. We know little about the stoat (*Mustela erminea*). There is much to suggest, however, that in many places it is becoming rarer. It is probably at the beginning of Phase 2. The polecat (*M. putorius*) has already gone through this phase of dramatic falls in population. Like so many other species, it found villages and their surroundings congenial to live in, particularly where humid biotopes were still to be found. On the one hand hunted for stealing chickens, but on the other tolerated, like the stoat and cats, as being good at keeping mice down, it was to be found in nearly every farm. But like the stork, dormouse, rat, barn owl or frog, it has been hard-hit by draining, asphalting, straightening, walling up and tidying in and around villages, and it is now accordingly in the phase of slow decline. For the time being it will no doubt be able to survive in a few isolated oases which progress has passed by.

It looks as though the otter (*Lutra lutra*) will soon have come to the end of that phase; its extinction is imminent. Unlike almost any other predator, the otter is tied to a specific biotope—streams, rivers and lakes. And in central Europe this habitat has been altered, polluted or destroyed by man as no other has. The second species to have been wiped out in central Europe by the destruction of biotopes—the mink—is also characteristically tied to a watery habitat.

By comparison with the foregoing, the position of species which are being eliminated by being directly hunted by man is less serious. No doubt wolves and bears will not be found hunting in central Europe again in the near future. But the lynx, which has settled again in central Switzerland, is rapidly spreading over the western Alps and has already become re-established in large areas of the Swiss and French Jura.

Even the wildcat (*Felis silvestris*), which was once seriously threatened, has apparently recovered in recent years and is again penetrating into areas it had previously deserted. Hunters' increasing tolerance of competing predators also appears to be having a beneficial effect in reducing the number of accidental shootings due to confusing wildcats with stray domestic cats.

These examples, like that of the badger or the successful reintroduction of the sable (*Martes zibellina*) in Russia, show that by directly hunting individual species man can wipe them out over large areas but that if hunting stops, the animal populations recover within a short time. Loss of a biotope, however, is irrevocable.

Adaptation faculty

But animals can also adapt to new living conditions, and happily there are many such ecologically flexible species among the predators. The daily new challenges of hunting have turned them into past masters of adaptation; and they are accordingly probably less threatened as a whole than many other groups of animals.

A prerequisite of any process of adaptation is variability and selection. Variability presupposes a large number of individuals. Species must accordingly be protected before the phase of rapid falling populations begins. All too often, though, protection measures are taken only when the species is already on the red list. And then the first concern is to eliminate every conceivable mortality factor; the selection necessary for adaptation cannot be allowed to occur. The animal becomes a beneficiary of the affluent society—dependent on human beings and no longer able to maintain its existence by its own endeavours. That too is a form of extinction.

Consequently, in the long term, we shall only be able to maintain the surviving wealth of species in Europe's landscapes that have been cultivated and developed by man if we refrain from progressively making optimum use of this land. We must maintain on our continent a dense network of varied natural and man-made biotopes. This implies large-scale internationally co-ordinated local restrictions on human use of land.

E.Z.

Mustela putorius (Photo Dr. K. Robin).

Legislation

Peter Dollinger

Formerly small predatory animals were simply considered pests. They enjoyed no legal protection, and indeed the killing of them was encouraged by the state. For instance, the Swiss Game Act of 1925, which was in force up to 1965 in cantons with a system of hunting preserves, in no way restricted the pursuit of furred predators, while the Fisheries Act of 1888 stated: "Extermination of the otter, the common heron and other animals particularly harmful to fisheries is to be encouraged to the utmost". To this end the Confederation subsidised the bounty paid out by the cantons by up to 50 %, until the European otter was almost wiped out. It was then placed under protection (1962).

National conservation measures

Nowadays most of the European countries have a more discriminating approach. At least those species that avoid a man-made environment, and whose very existence is threatened, are now almost everywhere totally or at least extensively protected. In most countries even the more frequent species which, because of their adaptability are not endangered, enjoy partial protection. Feral cats, 71,000 of which were killed in 1982 in Hungary alone, and immigrants such as the racoon, racoon dog and American mink are, however, considered undesirable and are not protected at all, or at the best minimally.

Table 1 shows the status of protection for individual small predatory species in various countries. The data on countries in the European Communities were taken from the publication by Nowak (1981); other data were made available by the game or nature protection authorities in the relevant states *. The following degrees of protection are distinguished:

T = total protection.
F = far-reaching protection; animals may be captured or killed only to a very limited extent and only by special licence.
P1 = partial protection; hunting and capture are permitted only during a certain season, under certain conditions or in certain parts of the country. During the breeding and rearing season the animals are under total protection.
P2 = partial protection; as P1 above, but without full protection during the breeding and rearing season.
U = unprotected; killing and capture of animals is permissible, at least by a recognised method, throughout the year in the whole country or large parts of it.

In countries with a federal structure hunting usually comes under the jurisdiction of the individual federal states. Thus in Austria and Czechoslovakia the federal states have different regulations. On the other hand, in Switzerland, the federal structure of the country notwithstanding, minimal protection of individual animal species is laid down by the Confederation; the cantons merely have the possibility of adopting stricter measures than those provided under federal law. For example, the European polecat is today totally protected in 11 out of 26 cantons.

The game laws of individual countries vary considerably, not only in respect of species protected and the hunting season; there are also substantial differences regarding permissible and prohibited methods. While in Hungary, for instance, only poison bait is prohibited, Czechoslovakia, its neighbour, also prohibits iron traps of any kind, gins and anaesthetics, but permits the use of poison gas to reduce the fox population in areas infected with rabies. Austria leaves it to its federal states to determine what methods of trapping and killing are not permissible. The Federal Republic of Germany and Switzerland, on the other hand, have federal bans on spring guns, poison bait, nooses, steel traps and various other means. Liechtenstein has similar regulations to Switzerland. Sweden and Switzerland too have restrictions similar to those of the central European countries, although in northern Finland the use of strychnine is still permitted.

The Berne Convention

On 19 September 1979 the Council of Europe Convention on the Conservation of European Wildlife and Natural Habitats was concluded in Berne. The Convention requires the Contracting States to take appropriate measures to protect certain species, which it names in Appendices I-III, and their habitats.

* I wish to express my warm thanks for the support of the following:
A: Ulrike Goldschmid (Vienna); CH: Hansjürg Blankenhorn (Berne); CSR: Milada Leiská and Jaroslav Hromas (Prague); SSR: Anton Lucinkiewicz, Liptovský Mikúláš; FL: Felix Nascher (Vaduz); H: Ervin Szenes (Budapest); N: Peter Schei (Oslo); S: Sven Johansson (Jönköping) and Ulf Weinberg (Solna); SF: Esko Jaakkola (Helsinki).

Mustela putorius, an ever rarer appearance (Photo W. Lapinski).

Appendix II of the Convention lists strictly protected fauna species. These include the Arctic fox, otter and European mink. Where these species are concerned the Contracting States have to prohibit all forms of deliberate capture, keeping and deliberate killing, deliberate destruction of breeding or resting sites and deliberate disturbance of the animals. Possession of and internal trade in animals, dead or alive, including goods such as stuffed animals or furs, are also to be prohibited if this will add to the effectiveness of the other protective measures.

Appendix III lists partially protected fauna species, including the badger, ermine, weasel, European polecat, pine marten, beech marten, European genet and wildcat. The Contracting Parties undertake to regulate the exploitation of these species in such a way as not to endanger the population level. In particular closed seasons or other ways of regulating exploitation (e.g. fixed quotas) are to be prescribed, and where appropriate there must be temporary or local bans on exploitation and, if necessary, restrictions on possession and internal trade.

In the case of the species named in Appendix III all indiscriminate means of capture and killing are to be prohibited, as well as all methods likely to cause the local disappearance or serious disturbance of the populations of any of those species. Prohibited means and methods of killing, capture and other forms of exploitation are given in Appendix IV of the Convention.

So far the Berne Convention is being applied by 12 states (Denmark, excepting Greenland and the Faroe Islands, Greece, the United Kingdom, Ireland, Italy, Liechtenstein, Luxembourg, the Netherlands, Austria, Portugal, Sweden, Switzerland) and the EEC. In order to conform to the Convention several states will have to make changes, quite considerable ones in some cases, to their national legislation.

Table 1. — Protection of small predators in various countries.

Country	A *	B	CH	CSSR ** CSR	CSSR ** SSR	D	DK	F	FL	GB	GR	H	I	IRL	L	N	NL	S	SF
Alopex lagopus																T ***		T	F
Nyctereutes procyonoides	P1 (1) U (1)			U		U	U	U				U						U	U
Vulpes vulpes	P1 (1) U (7)	U/P2	P1	U	U	U	P2	U	P1	U	U	U	P1	U	U	P2	U	P1	U
Procyon lotor	P2 (1) U (1)		P2			U		U	P1			U			U		U		
Lutra lutra	T (6) U (1)	F	T	T	F	T	T	T	T	F	U	F	T	F	T	F	T	T	F
Martes foina	P1 (3) P2 (3) P1/U (1)	F	P1	P1/2	P1	P1	P1	P2	P1		U	P1	T		P1		T		
Martes martes	U (1)	F	P1	P1/2	P1	P1	T	P2	P1	U		F	T	T	P1	P1	T	P1	P1
Meles meles	P1 (3) P2 (4) U (1)	F	P1	P1/2	P1	P1	P1	U	P1	F	U	F	T	T	T	P1	T	P1	U
Mustela erminea	P2 (2) U (5)	U/P2	P1	F/P2	F/P2	P1	P1	P2	P1	U		F	T	T	P1	P1	U	F	P1
Mustela eversmanni												F							
Mustela lutreola	T (1)				F			T				T						T	F
Mustela nivalis	T (1) P2 (1) U (5)	U	P1	F	F/P2	P1	T	P2	T	U	U	P2	P1		P1	T	U	T	F
Mustela putorius	P2 (1) U (6)	U	P1	U	U	P1	P1	P2	T	P1		U	T		P1	T	P1	P1	U
Mustela vison												U				P2		U	U
Vormela peregusna											U								
Genetta genetta								T											
Felis catus (wild)		U	P2									U							U
Felis silvestris	T (3) U (3)	F	T	F	P1/2	T		T	T	U	U	F	T		T				

* Numbers in brackets: number of federal states for which data are available.
** P1/2 and F1/2: killing and capture in pheasant preserves allowed at any time (CSR = Bohemia Moravia; SSR = Slovakia).
*** On Spitzbergen (Svalbard): P1.

The Washington Convention

The demand for certain animal products, such as furs, leather and ivory, can have extremely negative effects on the wild animal population unless adequate protective measures and controls are available. As it is relatively easy to evade existing national regulations in international trade, the Washington Convention on International Trade in Endangered Species of Wild Fauna and Flora was concluded on 3 March 1973. The aim of the Convention is to prevent transfrontier commercial trade in animals and plants, alive or dead, or in any readily recognisable parts or products of animals and plants of endangered species and to bring such trade in potentially endangered species under supervision. The Convention contains precise, directly applicable provisions governing the conditions under which import and export are permissible and the information which permits and certificates must contain.

Species listed in Appendix I of the Convention are to be considered as endangered; those in Appendices II or III as potentially endangered.

Of the small predators in Europe only the otter is strictly protected. It was included in Appendix I in 1976 at the request of Switzerland, after it had been observed that considerable numbers of live otters and otter skins from an Eastern European country were being offered for sale.

Appendix II includes wildcats and jungle cats among protected species. However trade is allowed in both species with a permit. In 1979, 65 wildcat pelts were exported from Albania and 1,975 from Bulgaria; approximately 50 exports of live specimens were reported worldwide. In 1979 too the export of 1,080 and the re-export of 16,200 jungle cat pelts was recorded. The great majority of the pelts came however from the part of the jungle cat range lying outside Europe.

Other small predatory animals in Europe are not protected by the Convention.

At present the Washington Convention on endangered species covers 81 states. The European states among these are Denmark, the Federal Republic of Germany, the German Democratic Republic, Finland, France, Liechtenstein, the United Kingdom, Italy, Monaco, Norway, Austria, Portugal, Sweden, Switzerland, the Soviet Union and Cyprus.

Conclusions

Small predatory animals are not merely vital to the balance of nature; it is also a worthwhile experience for anyone to meet them in field or wood. Moreover, as suppliers of pelts they represent an economic dimension which should not be underestimated. The laws of all countries should therefore aim at preserving at least the small cousins of the larger beasts of prey which have disappeared from many parts of our continent.

Not all the game and nature protection laws existing today meet this requirement. Adjustments are urgently needed in many areas. Non-selective means of killing and capture should be prohibited as quickly as possible. Fumigation of fox-earths as a means of combating rabies has a devastating effect on the badger population and should be replaced by intensified hunting or by peroral injection of foxes. Acutely endangered species such as the European otter should be placed under total protection, and species which are declining in numbers, as the polecat is in many areas, under extensive protection. All other native species need to be managed in such a way as to ensure healthy and viable populations. Generally speaking no bounty should be offered for capture or shooting; rather should proven damage be made good, as is done in the case of damage to crops by hoofed game. And, last but not least, care should be taken to preserve the largest possible appropriate habitats.

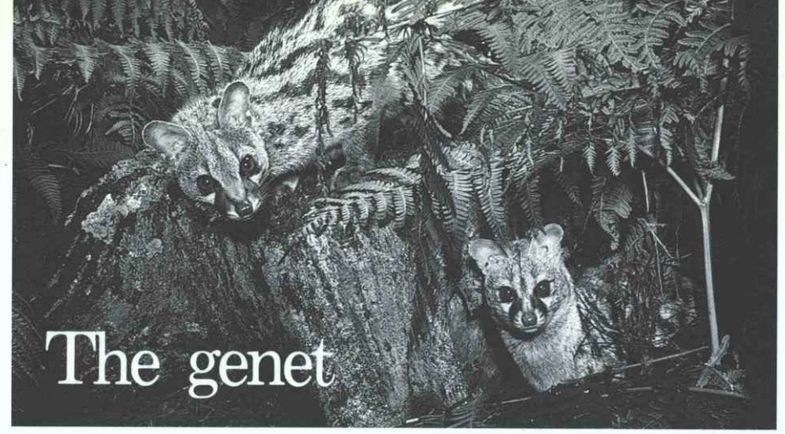
The Berne Convention of the Council of Europe is a considerable step towards achievement of this aim, and it is to be hoped that it will be put into effect by the European states as soon as possible.

P.D.

Table 2. — Hunting seasons.

Country	CH [a]	CSSR	FL	H	N	S	SF
Alopex lagopus					01.11-15.03 [e]	●	●
Nyctereutes procyonoides		01.01-31.12				01.01-31.12	01.01-31.12
Vulpes vulpes	15.06-28.02	01.01-31.12	[d]	01.01-31.12	15.07-30.04	01.08-15.03	01.01-31.12
Procyon lotor	01.01-31.12		[d]				
Martes foina	01.08-15.02	01.11-31.01 [b]	[d]				
Martes martes	01.08-15.02	01.11-31.01 [b]	01.12-31.01		01.11-15.03	01.09-28.02	01.09-31.03
Meles meles	15.06-15.01	01.08-30.12 [b]	01.09-31.12		21.08-31.03	01.08-15.02	01.01-31.12
Mustela erminea	01.08-15.02	● [b]	[d]		21.08-31.03	01.09-28.02	01.12-31.03
Mustela nivalis	01.08-15.02	● [b,c]	●		●	●	●
Mustela putorius	01.08-15.02	01.01-31.12	●	01.01-31.12	●	01.09-28.02	01.01-31.12
Mustela vison					15.07-30.04	01.01-31.12	01.01-31.12
Felis catus	01.01-31.12			01.01-31.12			01.01-31.12
Felis silvestris	●	01.12-28.02 [b,c]	●				

[a] Applies to cantons with hunting ground tenancies; in cantons with permit hunting and shooting, maximum for all species 1 September-15 February, except for the badger where the maximum is 1 September-15 January.
[b] At any time in pheasant preserves.
[c] Applies to Slovakia only.
[d] At any time except the reproductive season.
[e] Applies to Spitzbergen (Svalbard) only.
● No limit.



The genet

(Photo Varin-Jacana)

Miguel Delibes

There are two carnivores of African origin living in the south west of Europe not found elsewhere on the continent. They are the genet (*Genetta genetta*) and mongoose (*Herpestes ichneumon*), belonging to the Viverridae family. Both species are recent arrivals having probably succeeded in reaching Europe with the help of man.

A "European" animal

A number of ancient chronicles recount that genets were introduced into the Iberian peninsula and France by the Arabs, who used their skins in saddlery. According to these reports, Charles Martel obtained at the battle of Poitiers very substantial spoils in the form of genet skins, which prompted him to found the Order of the Genet, to which in due course Pippin the Short and Charlemagne belonged. Historians are nevertheless somewhat sceptical about this theory. It was not customary in the eighth century, they say, to take spoils in battle, and the Order of the Genet does not appear in the codes in which mediaeval orders were listed. Certain archaeologists and palaeontologists, on the other hand, have found what they consider to be remains of genets in prehistoric deposits, but it has inevitably turned out that either they were not authentic genets or, if they were, that they appeared out of context on the surface, so that they were extremely difficult to date correctly. We do not know precisely, for that reason, when or how genets "crossed" the straits of Gibraltar.

In any event, today the genet is a fully-fledged European carnivore, occupying the whole of the Iberian peninsula, France as far as the Loire and the Rhône, and the islands of Mallorca, Ibiza and Cabrera (Baleares). Sightings of isolated individuals in the north of France, Germany, Switzerland and northern Italy suggest that the species is currently extending its area of distribution, although in some cases those observed had certainly escaped from captivity.

Genets weigh between one-and-a-half and two kilos, their fur is light grey with dark spots, and their tails are resplendent with between sixteen and twenty alternate light and dark rings. Like cats, they have retractable claws (although in the genet they do not disappear completely when retracted) and their pupils, in relatively large eyes, are vertical. This means that their appearance recalls that of a small feline, and it is customary for this resemblance to apply to other aspects. Genets in fact utter an abrupt cry when they are displeased, defend themselves by scratching and biting, and clearly find rodents irresistible, pursuing them mercilessly.

Useful but hunted...

In the last few years research has been carried out into the feeding habits of the genet in different parts of the Iberian peninsula, the Baleares and France. Using the bodies of snared animals sent to taxidermists and furriers, researchers have contrived to analyse hundreds of specimens of gastro-intestinal contents and thousands of specimens of excrement. Findings converged in almost all cases. Genets are omnivorous and indiscriminate predators, but the basis of their diet is small rodents, especially field-mice (*Apodemus sylvaticus*). Small and medium-sized birds, certain eggs, lizards (particularly in the Baleares), amphibians, insects, occasionally small fish, scorpions, centipedes, fruit (particularly figs), also appear in their diets. Generally speaking, then, it is an animal serving a useful purpose, each individual being capable of consuming in a single year between one and two thousand rodents. In spite of this, as with other carnivores it has a bad name and is accused, on very inadequate grounds, of damaging the cynegetic capital (red partridges, rabbits, etc.). This means that many specimens are killed and poisoned in game preserves.

Another direct threat to genets comes from the destruction of its habitats, although here too the species proves extremely adaptable, being able to settle in wooded or rocky places or heathland. The greatest numbers, however, are found in the Mediterranean forests of holm oaks and cork oaks in south west and central western parts of Iberia, and in the temperate woods of oaks and chestnuts of the north west. Many of these forest areas have been transformed, with the original stands being replaced by exotic species, such as the *Eucalyptus*, producing a general impoverishment of the fauna and almost always the disappearance of the genet.

In the last 15 years, moreover, the price fetched by genet pelts has risen, and this, coupled with unemployment and the economic crisis, has prompted some people to supplement their incomes by capturing genets, foxes, and martens in particular.

The situation is not desperate

It would be wrong, however, to imagine from this that the situation of the genet in Europe is desperate, or even critical. It is one of the commoner small carnivores in the western half of the Iberian peninsula, and in the rest of the area in which it is found it is not a rarity. It can produce its young in any month of the year (but generally does so in the spring, with at most one second but smaller litter in the autumn), and each time two or three baby genets are born; one special feature is that a female which loses its young can again reproduce immediately. As a rule the other European carnivores do not have this capacity, which enables the genet to improve its chances of survival, especially since its slow growth (it takes the genet almost twelve months to grow to its full size) and failure to achieve reproductive maturity until the second year of its life otherwise hamper its chance of survival.

Genets are not totally protected by the law in the Iberian peninsula, but being regarded as game species (in Spain) they can only be captured (in theory) between October and February. If this restriction is observed, if there is a ban on the use of poison and the number that can be captured is controlled, it is reasonable to hope that this fine nocturnal hunter, possessing agility and rapidity, which is alleged (perhaps wrongly) to have performed the role of the domestic cat in ancient times in eliminating mice from human habitations, will never disappear from our fields.

M.D.

The otter, symbol of our threatened fauna

Sheila Mcdonald and Nicole Duplaix

The otter, one of the mammals most threatened with extinction in Europe (Photo W. Lapinski).

Otters are related to stoats, martens and badgers but differ from them in being adapted to an amphibious way of life. The European otter (*Lutra lutra*) is 100-120 cm in length, the males, larger than the females, weighing around 10 kg. The fur is thick and waterproof, dark brown on the back and lighter on the under-parts. The feet are webbed and the tail is broad and slightly flattened. The ears are small and these, together with the nostrils, can be closed when the animal dives. A profusion of vibrissae are found on the muzzle helping the otter to detect prey in murky waters.

Otters live on rivers, lakes and marshes and, in Scotland, Ireland and Norway, on rocky sea coasts. They feed largely on fish. Otters on Welsh rivers may tackle adult salmon (*Salmo salar*) while on the coastal marshes of eastern England they prey on small sticklebacks (*Gasterosteus aculeatus*). Slower-moving fish, such as cyprinids, are easier to catch and otters have a clear preference for eels (*Anguilla anguilla*). The diet is supplemented with amphibians, crustaceans and the occasional small mammal or bird. In southern Europe water snakes are eaten. On the west coast of Scotland otters can be seen searching the sea-weed for intertidal fish and crabs and many a cub has a bloody nose after its first encounter with *Carcinus*.

It is thought that the European otter can breed at any time of year although workers in Sweden and Scotland suggest that there may be a peak of births in late winter and spring. One to three cubs are born and may stay with the female for up to one year. The reproductive rate is thus rather slow.

Home ranges

Otters live within home ranges. Pioneering work in this field was done in Sweden in the 1960s. By means of tracking otters in snow it was concluded that a male patrolled about 15 km of waterway and that one or two females occupied smaller areas within this range. In a recent radio-tracking programme on a Scottish river an adult male was found to use 40 km of river while the ranges of females averaged about half this length. The age and social status of an individual will affect the size and position of its range. Range size will also vary according to available resources including the potential of the habitat for resting sites and the quality of the food supply. On Norwegian fjords the availability of fresh water during severe winter conditions may affect the distribution of ranges. Where den sites and food are abundant, as on the Scottish coast, an otter may occupy only about 5 km.

Otters mark their ranges with their faeces (called, in English, spraints) or with anal secretions. Since they lead rather solitary lives the spraints serve as a form of chemical communication. Spraints are easy to recognise, especially when fresh, since they have a pleasant sweet-musky smell and usually contain fish bones and scales. Frequently spraints are deposited at conspicuous places such as large boulders in the water, on fallen trees or at stream confluences. The same sites may be used year after year and the nutrients from the spraints can result in patches of lush, darker grass. Spraints are the commonest field signs of the animal's presence but the 5-toed print can be seen in mud or snow. Sometimes otters scratch up little mounds of sand or vegetation and scent mark them. The significance of this behaviour is not understood.

In most places the otter is nocturnal and is very seldom seen. When field surveys are carried out to determine distribution it would be a waste of time to look for the animals themselves—only the telltale signs reveal their presence. In the past, circulated questionnaires were usually used as the basis of regional surveys but it is now becoming accepted that such results may be quite misleading. Hunters and fishermen tend to assess an animal's status to suit their own interests and, where a species is supposedly protected, local people can be wary of giving information. Surveys conducted in the field will not detect every otter range but results generally provide a more reliable picture of distribution. Published statements of actual numbers of otters in a region or country must be treated with caution since the carrying-capacity of small areas may differ widely.

Declines in numbers

Until recently most of the information on the distribution and status of *Lutra lutra* derived from northern Europe and overall the situation seems bleak. The otter is rare and still declining in England, West Germany, the Netherlands and Denmark. In Norway good populations are still to be found on the northern coasts but the species is far less common in the south. The Swedes claim alarming declines in otter numbers. Field surveys in northern Europe have revealed only two countries where otters are still abundant—Scotland (and there, most animals are found in the Highlands, on the north and west coasts and on the Islands) and Ireland. Indeed Ireland now holds the healthiest of the known otter populations with animals making use of every type of waterway. During 1980 a total of 2,373 sites was surveyed and otter signs were found at 92 %. In contrast, in England only 6 % of 2,941 sites produced signs.

In southern Europe a series of field surveys has been carried out since 1980. Italian fears were confirmed and the otter is now highly endangered in that country. In France populations have become fragmented and declines have occurred in Spain and Yugoslavia. Only in Portugal and Greece has evidence been found of healthy and widespread populations.

Pesticides and other pollutants

A combination of factors has caused the alarming declines in otter numbers and not all the factors are yet understood. Investigations in Britain suggested that the initial sharp declines occurred in the late 1950s and early 1960s with the widespread application of organochlorine pesticides. Dieldrin was pin-pointed as the major culprit because at the time of the otter population crash it was being extensively used in agriculture as a cereal seed dressing and in sheep dips. Persistent pesticides build up in the food chain so that top predators like otters can receive heavy doses. Even if the chemicals do not prove lethal, reproduction is affected and populations can be drastically reduced. During the period when organochlorine pesticides were being used in Britain they were equally popular in many European countries with advanced agricultural systems like Germany and the Netherlands. It may be significant that in Portugal, where otters still thrive, the agricultural output is one of the lowest in Europe while in Greece agricultural advancement has been relatively recent.

The organochlorine pesticides have now been phased out of agriculture and in Britain today analyses of fish tissues have suggested that these chemicals are no longer present at high enough levels to affect otters. Nevertheless, these compounds are used illegally and there are occasional spillages into rivers. Earlier this year a large quantity of dieldrin polluted a river in south-west England killing many fish but it is, as yet, too early to assess effects on local otters.

In Sweden recent analyses of dead otters revealed high levels of PCBs (polychlorinated biphenyls), chemicals which are used in industrial processes and which have now been found world-wide in the bodies of animals. There has been little work on other persistent pollutants. In Britain a recent analysis of fish tissues has suggested that concentrations of mercury, cadmium and lead may be sufficiently high to adversely affect otters although analyses of otter tissues have

(Photo W. Lapinski)

The predators

Large or small,
they are indispensable

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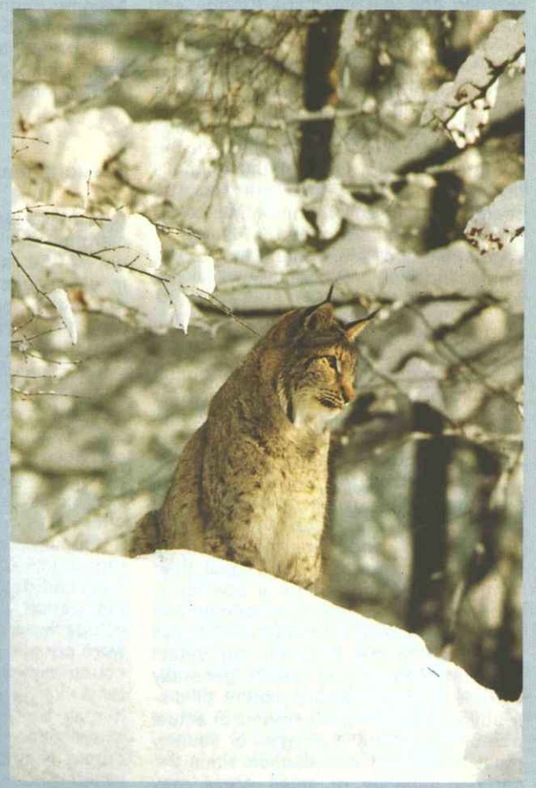

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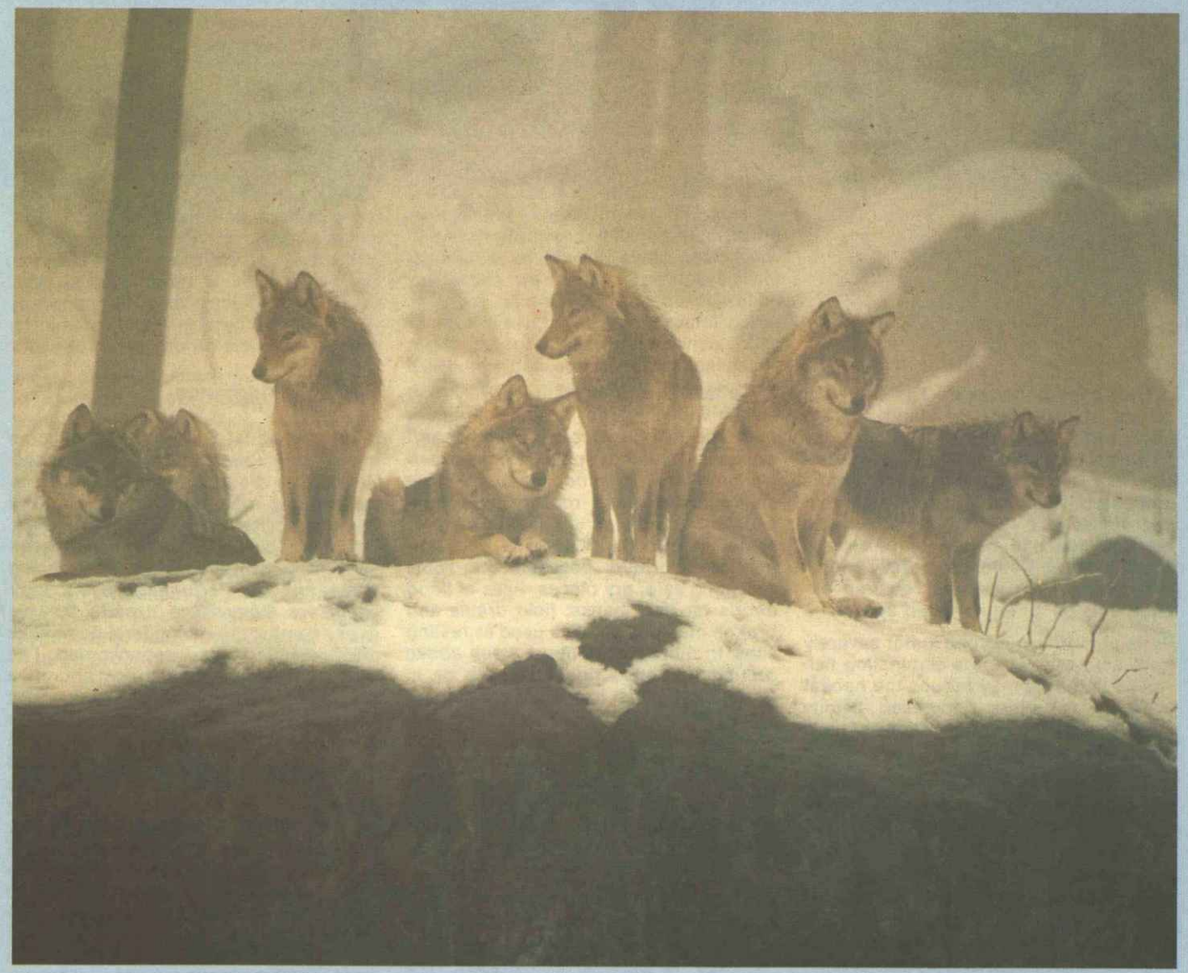

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(Photo W. Lapinski)

not yet been undertaken. The sublethal effects of persistent pollutants, particularly when several occur together, may be more important than direct mortalities but the mechanisms are poorly understood. Cumulative chemicals at low doses are known to affect the reproduction and behaviour of several species but it would be morally reprehensible to carry out the required experiments on an endangered species.

Parts of northern Europe suffer severely from acid rain which is eliminating fish stocks and thus may reduce the habitat available to otters. Increased acidity may increase the concentrations of toxic metals in waters.

Coastal otters in both Scandinavia and Scotland are vulnerable to oil pollution. In 1978 at least 13 otters died after an oil spill in the Shetlands.

Clearly many forms of water pollution are affecting otter survival and while some countries are making efforts to clean-up rivers gross pollution, both organic and industrial, is still a common feature of many European rivers. Anti-pollution laws are often flouted.

Habitat destruction

The otter, like so many other species, is also threatened by habitat destruction. The animal requires safe sleeping places and the females in particular need very secure dens. Many forms of shelter can be used by otters. On the coasts of Norway and Scotland dens are found among rock falls or in caves, and in peat banks dens can be extensive and resemble badger setts. Broken rock is also used on river banks and such dens can be found on Spanish and Portuguese rivers.

In Britain the animals frequently find shelter within the root systems of mature bankside trees, especially oak, ash and sycamore (*Quercus* spp., *Fraxinus excelsior* and *Acer pseudoplatanus*). These species have open root systems susceptible to erosion by fast-flowing or spate waters. Deep caverns and tunnels are formed between the roots providing safe, dry places. Piles of flood debris on river banks, field drains and broken masonry are also used as resting sites. In quiet places otters sleep above ground in dense riparian scrub or in *Phragmites* beds. In the flat agricultural plains of northern Greece otters are common in the irrigation ditches and can find shelter in the dense growths of *Rubus* on the banks. In Yugoslavia wide margins of impenetrable *Salix* scrub provide cover while the same species of otter in North Africa finds seclusion in dense *Nerium oleander*.

Bankside habitat is everywhere under threat. In Britain trees and scrub are removed by the authorities responsible for flood prevention. In southern Italy many river banks are practically devoid of vegetation due to regular cutting and because of intensive gravel extraction. The bulldozers and heavy lorries leave behind wide, bare shingle beds and waters thick with sediment. Light is impeded and fish suffocate. Throughout Europe wetlands are drained to provide additional farmland. Widespread deforestation in southern Europe has affected water flow and fish stocks. Scouring torrents are typical in winter while in the summer river beds are dry.

It can be seen that the otter has proved highly vulnerable to both pollution and habitat destruction. It is, therefore, a good indicator of the ecological health of the wetland environment.

Human disturbance

As their habitat is lost otters become more vulnerable to human disturbance. So long as they have security and can vanish at a moment's notice, they will tolerate a certain level of human activity. On the Scottish coast otters can be seen swimming in harbours amongst fishing boats and on Portuguese rivers their signs are everywhere despite the big gypsy camps, the roving feral dog packs and the ubiquitous washerwomen. The otters' nocturnal habits in most countries are probably a reaction to long years of persecution. The species is now legally protected in most of Europe although enforcement of the law is often neglected or an impossible task. Little can be done at present to control trigger-happy hunters especially in Italy and France. While otters are still shot because of fears that they compete with fishermen many more are accidentally drowned in fish traps. In a recent study on the Norwegian coast 80 % of known deaths resulted from drowning. In Poland a third of 192 dead otters had been drowned in fish traps. A positive conservation measure should involve adapting fish traps to prevent otters from entering.

Conservation measures

Conservation measures for the otter are now well established in many countries including France, West Germany, Belgium, the Netherlands and Britain. Such countries are attempting to prevent further attrition of already fragmented populations, populations which, in places, are still declining. The ultimate viability of remnant populations is doubtful and it is clear that we understand too few the causes for decline. There are, however, certain positive measures which can be taken. It is essential that remaining otter habitats be conserved, a formidable task in the face of agricultural advancement with subsidised incentives. However, studies in Spain, Greece, Portugal and Britain all show clearly that otter distribution is closely related to the existence of suitable habitat. In Britain conservationists are now involved in constant negotiations with water resource managers to try to minimise destruction of riparian habitats. Private landowners are approached to establish otter havens. These are areas known to be regularly used by the animals where disturbance is minimised and bankside habitat is retained or even improved by planting trees and scrub. The preservation of existing den sites is considered to be of prime importance. Artificial resting sites made of piles of logs are created and ponds close to rivers can be stocked with fish.

Most conservation effort is being made in northern Europe where many otter populations are dwindling. In the south, in countries like Greece and Portugal where healthy, widespread populations still remain, public interest in the species is negligible. There are few field biologists trained to recognise otter signs or to monitor their populations. The general public has little commitment to, or even an awareness of, wildlife conservation. Yet it is conservation of healthy populations which makes most sense. A large programme of public education is a prerequisite for conservation in southern Europe but Portugal is not even represented in the World Wildlife Fund. In Italy the Gruppo Lontra Italia was formed in 1982 and already the resultant publicity has led to sudden widespread interest and concern for the otter amongst scientists and the general public.

Re-introduction of species

Another approach to otter conservation involves re-introduction of the species. There are regions throughout Europe where the animal is now absent but where it might, once again, thrive. In the Camargue the last otter was recorded in the 1950s and yet this wetland wilderness appears ideal. In northern Italy too, pockets of suitable habitat still remain. Clearly before any re-introduction programmes could be initiated, assessments would have to be made of fish populations and fish tissues would have to be analysed for pesticides and metals. Increased control of hunting and fishing within release areas would have to be implemented. Despite these difficulties it seems that for such sites re-introduction is the only solution.

Unfortunately, there is little experience in this field. An attempt to re-establish otters in Switzerland in 1975 was unsuccessful. In Britain and West Germany otters are being bred in captivity and in July 1983 three of these animals were released in eastern England to initiate a long-term re-introduction programme. Because the European otter is notoriously difficult to breed it may well be more effective to translocate animals from countries such as Ireland with healthy, natural populations. It has been argued by purists that this could result in the mixing of different stocks or even of races, while some may question the morality of interfering with healthy populations. However, otters are almost everywhere under threat. If some of Europe's protected wetlands, such as the Camargue in France, could again support otters, we should surely not vacillate but take action. Inter-state co-operation in the USA has led to sucessful translocations of *Lutra canadensis*. Co-operation between conservationists on a European scale could be equally effective.

S.Mcd. and N.D.

Vulpes vulpes (Photo G. Lacoumette)

A special case

David W. Mcdonald

To the ancient Greeks the red fox was the epitome of versatility. Mediaeval Europeans embodied in the fox qualities of guile, wit, devilment and revolution—impressions passed from generation to generation in the lines of *Le Roman de Renart* and other epic poems. Europeans have been writing about red foxes for some two thousand years—long enough, you might think, to draw some reasonable conclusions. Indeed, many countrymen will readily offer a very emphatic conclusion—the only good fox is a dead one! It comes as something of a surprise to find that, despite such longstanding interest and strong opinions, little is known of foxes, and that those glimpses we do have of the fox's private life paint a very different picture to that of the villain of our fairy-tales.

A wide geographical range

The red fox is an extraordinary animal. It has the widest geographical range of any member of the family Canidae—the dog-like carnivora. This one species prospers throughout the northern hemisphere from Arctic tundra to Arabian desert, from mountain to marshland, and from forest to city centre. The red fox is found in North Africa, throughout Asia to Japan and throughout North America. They were deliberately introduced into Australia in the mid 19th century and have spread over most of that continent. The species' range embraces extremes of temperature from −40 °C to +40 °C—the ancient Greeks were right about its versatility.

The red fox is largely nocturnal and part of its knack for survival stems from its secretiveness. That same trait had thwarted biologists until the invention of radio-tracking—a technique which enables even the most wary animal to be followed from a distance and undisturbed. The animal to be studied is equipped with a miniature radio transmitter, often fitted to a collar so that the radio hangs below the neck like a brandy cask on a St. Bernard dog. The biologist with a radio receiver a kilometre or more away detects the "bleeps" emitted by the transmitter and by triangulation with a directionally sensitive antenna can pinpoint his subject's location. Together with my colleagues in the so-called "Foxlot" in Oxford University's Department of Zoology, I have spent a decade tracking foxes, with a principal aim of understanding their great adaptability. The most clearcut difference in behaviour to emerge among foxes radio tracked in different habitats is in their movements. On mixed farmland in Oxfordshire each resident adult fox might travel a home range of 200-300 hectares. Not far away, in the city suburbs where farmland and scattered residential areas meet, the average home range was much smaller at about 40 hectares. In fact, some foxes there lived in little more than 10 hectares —an area they could run across in a matter of seconds! In contrast, foxes tracked in the Pennine hills of the north of England travelled ranges of 1,000 hectares or more.

A varied diet

The quest to explain this wide variation in movements led to a study of fox diet. We scoured the countryside searching for fox faeces. Luckily, red foxes use their faeces as scent marks and often position them aloft prominent sites, making them easier to find. We collected, dried and teased apart thousands of samples, to find undigested traces of prey and fragments of bone, hair, beetle legs, feathers and fruit pips. The analysis revealed quite different diets from one study area to the next (and sometimes even from one home range to the next). In general, the foxes seemed to be behaving opportunistically, making the most of whatever food was available. So, in the northern hills rabbits were the principal prey, followed by grouse and small rodents. On farmland the diet was varied, including small birds, rodents, farmyard carrion, lots of fruit in season, together with abundant beetles and earthworms. In suburbs the picture was different again and earthworms were amongst the most important prey! This might seem an improbable prey for foxes, but under carefully maintained lawns there are huge populations of these worms—the question was how do the foxes get at them?

Using night vision infra-red equipment I stalked the fields by night, following the radio-tagged foxes and trying to ambush them in order to see how they hunted. Soon it became clear how they were catching earthworms. In the shadowy picture of the infra-red binoculars, foxes could be seen slowly criss-crossing pastures and lawns. More than once a minute the fox would pause, listen intently whilst staring at the ground, then plunge his snout into the grass. An accelerating upward movement of the fox's head would then draw the worm taught and then, forced from its burrow, the victim would curl helplessly around its captor's muzzle. But foxes could only hunt for earthworms in this way on certain nights—when the air was moist and the breeze still—because only then did the worms emerge from their burrows and become available for capture. On other occasions these suburban foxes scavenged bones and scraps from garden bird-tables or gorged themselves on apples or blackberries.

So, the wide variation in home range sizes seemed to be partly explained by local variation in the abundance of food available to the foxes. The interface between farmland and suburbs turned out to be especially rich in food and the home ranges were small, whereas food was more scarce in the uplands and ranges large. However, radio tracking revealed not only the sizes of home ranges, but also their pattern and this held some interesting surprises. Despite the wealth of rural lore which maintained that foxes are solitary, antisocial creatures, we found that their ranges can be arranged into groups. Up to six adults (including only one male) may share the same group territory, overlapping widely in their movements, but overlapping very little with comparable neighbouring groups. In the suburban study area there were an average of 4-5 adult foxes in each group and it seemed that they were family groups, probably a mother and successive generations of daughters. The foxes gave the impression of being solitary, because they travelled and often sought shelter alone. However, they met up fleetingly during their nightly travels and doubtless kept in touch through scent marking and vocalisations.

A complex social life

Further study of these red fox family groups indicated that amongst the females there was a dominance hierarchy and that sometimes this had considerable bearing on their breeding behaviour. Despite the fact that all red fox vixens are reproductively adult at ten months old, some of the socially subordinate vixens in the family groups did not breed. Indeed, they took on an active part in the rearing of their dominant relative's cubs. The helpers played with and groomed the cubs and even took food to them. Furthermore, cases have been reported in the wild where when a breeding female was killed a new breeder adopted and reared her cubs! Fox social life is certainly more complex than we thought.

Although interesting for its own sake, one might ask if the new understanding of fox behaviour really matters. The answer is that it does matter, because of its relevance to various "fox problems" and because new knowledge is clearly eroding some entrenched views on fox management. Fox problems, real or imagined, include depredations on game, poultry, lambs, trapping for fur, hunting and shooting for sport and far and away the most significant, rabies.

D.W.Mcd.

Rabies

All mammals are susceptible to the rabies virus, but foxes are particularly so. In Europe the red fox is the most important vector and victim of the disease. Once infected by a bite wound the fox incubates the disease for about three weeks before itself becoming infective. At that stage virus starts proliferating in the rabid fox's salivary glands and shed into its saliva. Within a few days the fox is dead. In 1982 some 15,000 red foxes were reported rabid in Europe, but the reported cases may be only a small fraction of those actually dying from the disease. Happily, human deaths from rabies are very rare in the developed countries, but the disease remains a heavy financial burden, a threat to people and stock, and a serious blemish on the relationship between men and wildlife. Throughout most of Europe traditional methods, that is killing foxes, have failed to eradicate or even contain the disease. The foxes' adaptability and resilience has thwarted the control efforts, which anyway did not take into account the great variation in fox numbers and behaviour between habitats, nor the effect on the rate of contact (and thus infection) among foxes in societies disrupted by the killing schemes. Recently, however, a new idea, being tested in Switzerland, shows great promise. The idea is to feed wild foxes with an oral vaccine against rabies, in this way reducing the population of susceptible animals to below the threshold at which the disease can persist. There is thus hope that rabies may one day be overcome.

The Arctic fox

Páll Hersteinsson

Can you imagine a Europe without the red fox? Well, neither can I, but the Neanderthal man probably did. During his reign in Europe the small mammal predator with whom he was most familiar was the Arctic fox (*Alopex lagopus*), and any self-respecting Neanderthal man certainly would have worn a piece of clothing made from Arctic fox skin. And imagine all those Neanderthal babies clutching a security "blanket" made from the softest fur available, Arctic fox skin.

But all good things come to an end, and so did the Ice Age. Modern men and red foxes invaded and took over Europe. What became of the Neanderthal man is anybody's guess, but Arctic foxes still persist in the far north. They have not changed much during this time, and are still adapted to a cold and inhospitable environment, where they carved out a niche for themselves long ago, hunting small mammals and birds, as well as scavenging from reindeer carcasses left by larger predators, such as wolves and wolverines.

For centuries, an uneasy truce has existed between the two closely related fox species, with the smaller (3-5 kg) Arctic fox inhabiting the treeless arctic and alpine tundras of northern Europe, where it could persist due to its low metabolic demands, and the larger (5-8 kg) and stronger red fox, with its higher metabolic needs, monopolising the rest of Europe.

Survival and "reign" in Iceland

During the relatively rapid change from Ice Age to the milder climate that we take for granted, the ice bridge which, for at least a part of each year, had connected Greenland and Scandinavia via Iceland, broke up. The Arctic fox, which had become somewhat of a specialist in catching sea-birds and scavenging from polar bear kills among the ice-floes, was left stranded in Iceland. In spite of the undoubted barrenness of the island at the time, and the absence of any other terrestrial mammals, such as rodents to feed on, and the lack of left-overs from large predator feasts, the Arctic fox survived this difficult period, as Iceland gradually emerged from underneath a giant ice-cap. The survival of the Arctic fox there is undoubtedly due to the presence of various sea-birds along the coasts, such as guillemots and eiders, in addition to the occasional seal and whale carcass washed ashore.

As time went by, vegetation covered the barren wastes of Iceland, and 9,000 years after the end of the Ice Age, between 25 and 40 % of the country was covered in birch and willow shrubs. The island was teaming with bird-life, including numerous migrants, such as waders and passerines, as well as ducks. The most important species to the Arctic fox, however, and probably one of the first to settle in the country following the climatic change, must have been the rock ptarmigan (*Lagopus mutus*), due to its presence there throughout the year. There is little doubt that only because of this tough little tetraonid was the Arctic fox able to inhabit the interior of Iceland at all seasons. At that time, this volcanic island near the top of the world must have seemed like an Arctic fox paradise: no red foxes to compete with, no Man to be hunted by, and birds-a-plenty. The Arctic fox was lord of the land.

Then suddenly there was a change. Man the Inventor, in the form of Viking seafarers, had built seaworthy ships, and Man the Agriculturalist moved to Iceland 1,100 years ago.

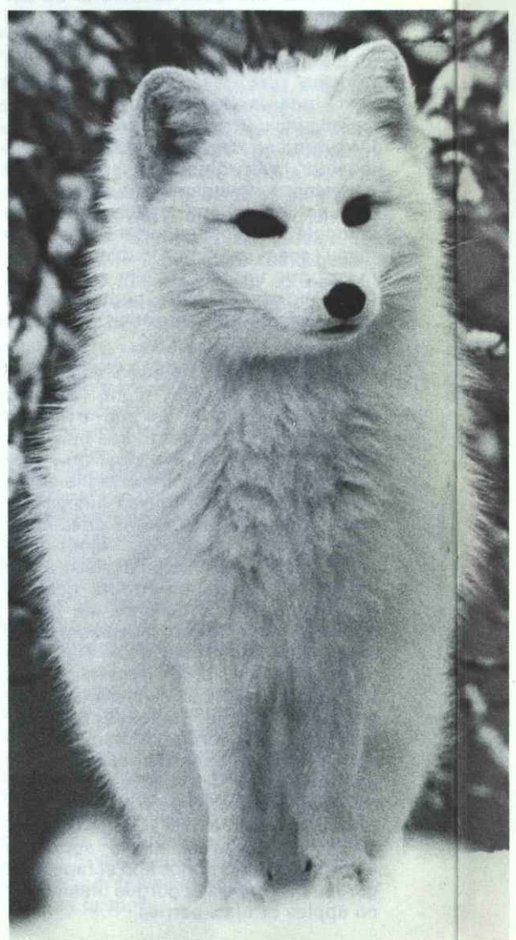
Extermination

The Arctic fox was king of the country no more. His status was quickly reduced to that of a useful furbearer, whose skin became legal tender along with lamb skins and other wares. This state of affairs did not last very long either, as at some stage during the first 300 years of human settlement in Iceland it had acquired pest status by law. Then, in A.D. 1295, a law was passed which made it every farmer's duty to kill one adult or two juvenile foxes each year or else pay a tax which would then be used to pay foxhunters to do the job. The law remained virtually unchanged for the next six centuries. In fact, the present-day law still refers to the extermination of the species, and instead of only individual farmers paying for the hunting effort, the state now foots two-thirds of the bill for the fox-hunters' wages and bounties.

At the same time the species is completely protected in Fennoscandia, the Russians have been trying for half a century to find ways of increasing the Arctic fox population in the USSR, and in other countries they can only be hunted by licensed trappers during a limited trapping season.

So why is the attitude so different in Iceland? Ever since Man and his domestic stock began denuding Iceland 1,100 years ago, lamb carcasses have been turning up at breeding dens. It is impossible to tell now what proportion of these lambs were actually killed by the foxes and how many were scavenged. We can only be sure that both happened. Arctic foxes have always been efficient scavengers, but they evolved in the absence of sheep or any other herbivore of that size. Arctic foxes have a narrow snout and weak bite, completely different from wolves and most dogs. They are therefore extremely inefficient sheep-killers.

(Photo Dr. K. Robin)



Arctic fox and livestock

In bygone days, sheep were allowed to graze a great deal in winter, and if spring came early, the livestock was put out to pasture up in the mountains even before the lambing. But Icelandic weather is very unpredictable. There can be sudden blizzards, even in spring, and the sheep would soon become too exhausted to fight the snow, wind and sleet, and become completely bogged down. At such times the fox was able to attack and kill them, or even eat them alive—a horrible sight for those who happened upon it. If the weather deteriorated around the time of lambing, the newborn lambs often died in large numbers. These were scavenged by the foxes, who were promptly accused of killing them.

Only in exceptional cases did foxes attack completely healthy lambs or adult animals. When they did, they usually went for the sheep's muzzle, often mauling it so severely that the animal bled to death or was unable to feed, which also meant it was doomed. The hatred toward the foxes therefore went far beyond the financial loss caused, which was still regarded as substantial.

It is generally agreed that damage caused by Arctic foxes nowadays is unimportant, but opinions differ as to the principal reason for this. Farming practices have improved dramatically in recent decades; winter grazing belongs to the past, and most lambing takes place indoors under human supervision. Causes of mortality at that stage are therefore known rather than being automatically blamed on the fox. Similarly, lambs are not exposed to the mountains and moorlands until they are 2-3 weeks old and large enough to intimidate the much smaller foxes.

Persecution of the foxes continues, however, as most farmers feel that if the fox population were allowed to increase to carrying capacity, damage would soon reach unacceptable levels.

The conditions of existence are difficult

In the 20-year period 1958-78, the fox catch was reduced by over 70 % in spite of a relative increase in hunting intensity due to the advent of telescopic rifles and snow-scooters. It is of interest that it was probably the attitude of the fox-hunters themselves which reversed this decline. Most of them do not want to see the complete extermination of the species, as not only do they enjoy the hunting, but it is also a substantial source of income to them. Consequently, many of them did leave a few known breeding earths alone, to replenish the population, and fox numbers have been showing signs of a slight recovery during the last five years.

In the meantime the foxes go about their daily business of trying to stay alive and reproduce in a habitat much poorer than 1,100 years ago. Those living by the coast still feed on seabirds, seal carcasses and various invertebrates, such as mussels and kelp-fly larvae, while those living in the interior catch ptarmigan in winter and migrant birds, such as waders and geese, in summer.

Consequently, there are some differences in the evolutionary pressures on foxes in coastal and inland habitats. Thus the "blue" morph, which remains dark throughout the year, is in a majority in coastal regions, as camouflage against the background of the littoral zone, which rarely freezes and is the main source of food, is more important than camouflage against the snow. The latter, however, is more important in the interior regions of Iceland, and the "white" morph (white in winter, grey and brown in summer) is more common there.

Breeding biology

Some 10,000 years of virtual isolation from other Arctic fox populations should have given the Icelandic fox population ample time to adapt to local conditions. Scientists have hardly begun to address themselves to this question, but already a major difference has been discovered between the breeding biology of Icelandic foxes and other Arctic fox populations.

The ptarmigan, which is the mainstay of the winter diet of the inland foxes in Iceland, experiences 10-year population cycles, and the foxes' food availability in winter varies accordingly. The migrant bird species, however, which form the major part of the foxes' food during summer, do not experience such cycles, and prey availability is consequently extremely stable from summer to summer. The foxes have adapted to this by producing litters, the size of which varies remarkably little with the availability of ptarmigan, since it is in fact the prey availability in summer which determines the maximum litter size which can be reared. This litter size is close to 4.0, which is very small compared to the mean litter sizes found in lemming areas (e.g. North America and Scandinavia) in years of lemming population peaks (9-12 cubs per litter). In the latter areas, the vixens' fertility seems to respond to lemming availability in winter, as this is generally a good indicator of the food in the following rearing season.

It is clear that in the respect of their breeding biology, Icelandic Arctic foxes differ from their conspecifics where they have been studied elsewhere. This difference is likely to be of a genetic nature. Other, less obvious, but equally important differences may be discovered soon, if only Man the Conservationist will be allowed to have a little say in the management of the Arctic fox population in Iceland in the future. P.H.

PREDATOR - PREY

Mustela erminea (Photo Dr. K. Robin).

Sam Erlinge

Predator-prey interactions can be studied from the view-point of an individual predator and its prey animal by observing the predator's hunting behaviour and the fugitive reactions of its prey, or the study could focus on the populations of predators and prey by examining the numerical effects of the interactions.

The small mustelids, the weasel (*Mustela nivalis*) and the stoat (*M. erminea*), are small-sized carnivores; in some regions a female weasel weighs less than 50 grams and her body size is not larger than a finger. Here, some aspects of these small mustelids' interactions with their prey will be considered.

Examples of two predators: the weasel and the stoat

They are morphologically and behaviourally adapted to feed on small rodents. The mustelids' long and thin bodies with short legs permit them to enter narrow burrows in pursuit of rodents in their tunnels. Female weasels and stoats have to collect large amounts of food when rearing the young so they must be well designed to be efficient optimal-sized small rodent predators. The body size of small mustelids greatly varies over each species' geographical range, and it has been suggested that female sizes are adjusted to the sizes of their predominant prey and to the width of the preys' burrows. Male weasels and stoats are much larger than the female, weighing almost twice as much. Males probably are larger as a result of sexual selection; large males are selected as they are dominant and so will obtain a relatively higher number of matings (the mating system of the small mustelids is a promiscuous one without any long-lasting pair bonds). A male's larger size prevents him from entering smaller burrows that are accessible to a female and this causes some sexual differences in foraging behaviour.

Hunting techniques

A foraging mustelid spends most of its time searching for prey by means of hearing, sight and smell. A mustelid having traced a prey by listening sometimes finds the entrance of a burrow too narrow to pass through and so the predator tries to force the rodent to leave the refuge by intense scratching at the opening and by vigorous stamping with the back legs. In cases where the mustelid can enter the burrow system, the prey is pursued and killed in the burrow or sometimes the prey is forced to leave the refuge and caught just outside. The quarry is usually carried to a secluded place close to the nest but often the mustelid starts searching for another prey before having a meal. Caching is a characteristic part of the small mustelids' foraging behaviour and provides a continuous supply of food that is needed to fuel their high metabolic rate for temperature regulation and their energy-expensive hunting behaviour. Each day a weasel has to eat food comparable to one-third of its body weight and normally it has a meal every three hours. Access to cached food is therefore important especially since not every hunt is successful. A small rodent quarry provides food for two or three meals.

In theory, an animal is assumed to maximise its net energetic profit when foraging, i.e., the animal tries to have the greatest possible difference between the cost and the benefit of its hunting. In doing so, it has to make several decisions about which kind of prey to hunt for, and where to hunt. In a study in southern Sweden, two species of voles (the field vole, *Microtus agrestis*, and the water vole, *Arvicola terrestris*) were the preferred prey of female stoats throughout the year. In spring and summer however, when vole densities were low, other prey were also included in the diet. The larger male stoats, on the other hand, showed a preference for the bigger vole (the water vole), and males changed their feeding habits during the year, having as additional prey young rabbits in spring-summer and field voles in autumn-winter.

Microtine rodents generally occur in high densities in habitats such as wet meadows, abandoned fields, and clear-cut areas. Such habitats are favourite hunting grounds for weasels and stoats. Hunting occurs in short periods interrupted by rests throughout day and night, and a period of hunting often lasts for about half an hour. Total hunting time during a 24-hour period usually amounts to 4-5 hours. During that time a stoat has to catch on average two or three small rodents having the size of a field vole, which means that a stoat spends on average two hours hunting per catch.

Mustela nivalis only needs a passage of 2.3 cm (as shown) to hunt rodents (Drawing P. Déom).

Defence mechanisms of the prey

The prey attempts to avoid being taken by the predator in different ways. Large and aggressive rodents, such as the brown rat, often are able to defend themselves successfully. In feeding experiments, unexperienced stoats were even chased by the rat after an attack by a stoat. Smaller and less aggressive prey try to escape by taking refuge, by running away or climbing up in trees or by becoming immobile for a period of time, "freezing behaviour". Each species has a repertoire of fugitive reactions which they make use of in different situations and the frequency of their use varies between the species. In tests, wood mice (*Apodemus flavicollis*) often escaped by running and climbing up a tree generally followed by freezing behaviour, whereas field voles usually took refuge in tunnels. Freezing behaviour also was shown by voles in tests with the weasel as the predator but not in tests with the stoat. Thus, the voles seemed to react differently to the two predators. As could be expected, prey reactions that were successful in evading the predators, e.g., running away followed by freezing in wood mice, were also frequently used by the species.

Unpalatability can be a defence mechanism. Relative to their abundances, shrews (*Sorex* sp.) are eaten by the small mustelids to a low extent. This is probably due to distasteful properties. In feeding tests where killed shrews and various species of small rodents were offered weasels and stoats, the shrews were rejected. The mustelids also showed little interest in shrews when hunting. Unpalatability as a defence mechanism could have arisen through kin selection. If a predator, from sampling one or a few of a brood, learns to avoid other members of that group, then a gene for distastefulness can increase in frequency.

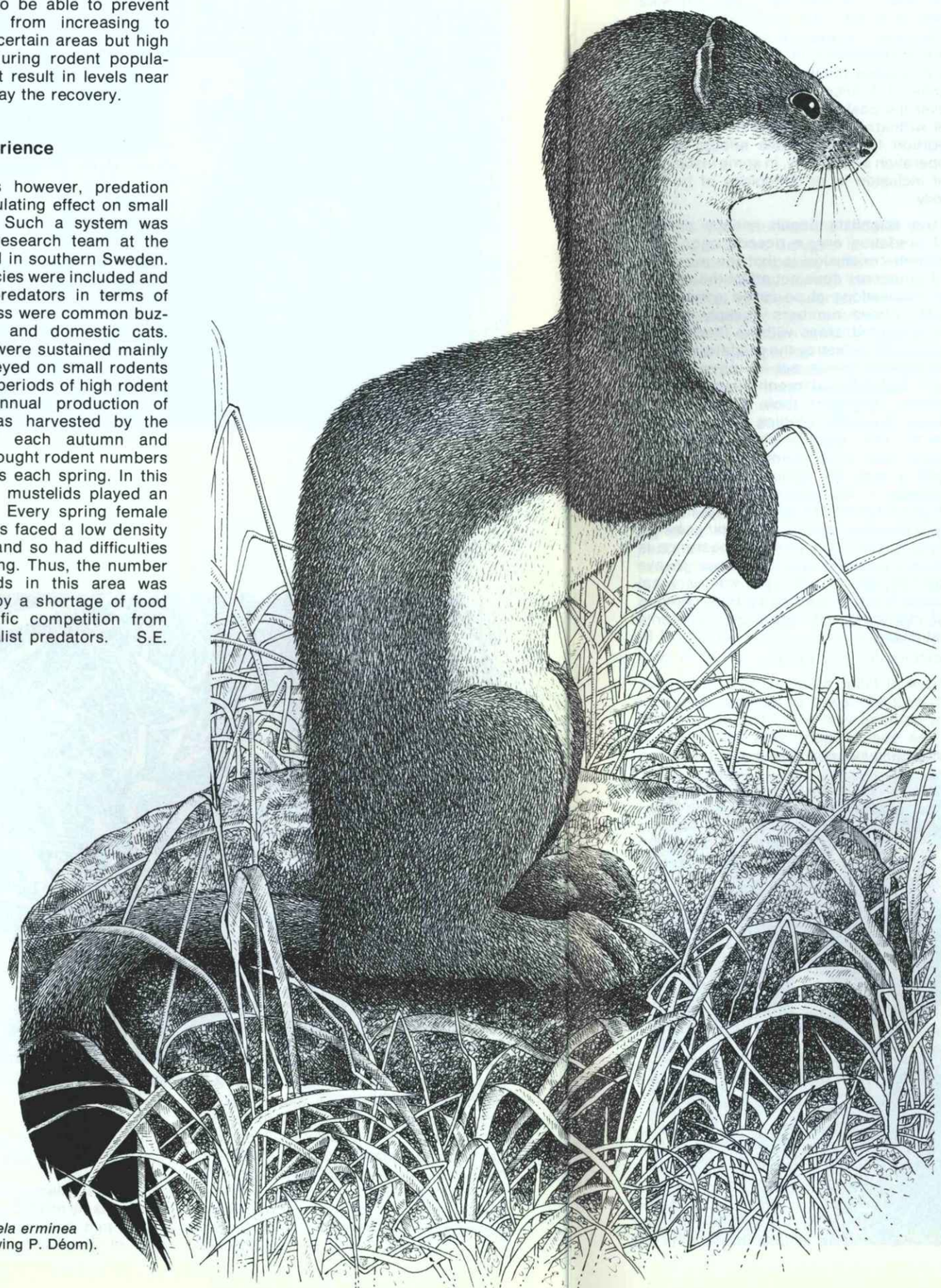
Interactions between predator and prey populations

Predator-prey interactions have numerical consequences on population sizes. The density of prey influences the feeding rate and the number of predators, and predation could have a negative influence on prey numbers and might even limit or regulate prey densities. One generally considers two kinds of influences exerted by the predators that can change prey densities, i.e., an individual predator can increase its consumption rate as a response to increased prey density (a functional response), and predator numbers can change due to variable prey densities (a numerical response). Together the functional and the numerical responses determine the extent of predation.

Individual weasels and stoats react to high rodent densities by increasing the predation rate which sometimes results in their killing many more prey than they can consume. Caches containing up to twenty small rodents have been observed. Also, the small mustelids have a high reproductive potential and can therefore rapidly transform an increased number of voles into more predators. For instance, litter size in stoats having one litter per year can be up to thirteen. Weasels can produce two litters per year and young of the first litter can be sexually mature and reproduce the same season. However, compared to their prey (small rodents) the reproductive capacity even of a weasel is low, and the predator's response also means some time-delay. In the laboratory, a system containing one predator and one prey population has been found to fluctuate in a cyclic way. Similarly, in north-temperate and arctic areas many small rodent populations show fairly regular changes in numbers with the small mustelids fluctuating in synchrony with three or four years between peaks. Thus, small rodent numbers have a decisive influence on the number of mustelids. The effect of the mustelids on the rodents' dynamics, however, is less clear. Neither the mustelids nor any other predators seem to be able to prevent vole populations from increasing to high densities in certain areas but high predation rates during rodent population decline might result in levels near extinction and delay the recovery.

A Swedish experience

In other systems however, predation could have a regulating effect on small rodent numbers. Such a system was examined by a research team at the University of Lund in southern Sweden. Ten predator-species were included and the dominating predators in terms of eaten prey biomass were common buzzards, red foxes and domestic cats. These predators were sustained mainly by rabbits but preyed on small rodents especially during periods of high rodent densities. The annual production of small rodents was harvested by the predators during each autumn and winter and this brought rodent numbers down to low levels each spring. In this system, the small mustelids played an unimportant part. Every spring female weasels and stoats faced a low density of small rodents and so had difficulties to rear many young. Thus, the number of small mustelids in this area was probably limited by a shortage of food due to interspecific competition from mainly the generalist predators. S.E.



Mustela erminea
(Drawing P. Déom).

Trapped, gassed, poisoned...

Pierre Pfeffer

Man's relationship with small and medium-sized carnivorous mammals has never been the same as his relationship with other animals. Whereas most living creatures, except those which can be of service to him and hence arouse in him a desire to subjugate them, leave him indifferent, his attitude towards small and medium-sized carnivores has constantly been dominated by passion. Naked and defenceless, he feared them, despite their modest size, and envied their amazing skill in capturing the prey that he too coveted. When he became an increasingly efficient hunter and subsequently a stock breeder, he regarded them as challengers and rivals and his possessive instinct inspired in him a fierce hatred.

Universal hatred

This hatred is universal and found throughout our oral and written tradition. Anything conjuring up the appearance or behaviour of a carnivore is pejorative: to be weasel-faced, to look like a ferret, to smell like a polecat, to be as wily as a fox, etc. Even scientists feel obliged to satisfy public opinion by using such phrases. Brehm, the great 19th-century zoologist, for instance, expressed his obvious, but at that time unavowable, admiration for the beauty and grace of the ferret and the marten thus: "they are admirably proportioned for a life of brigandage and rapine"!

Throughout history, and particularly over the last two centuries of technological triumphs, man has had a sense of mission, that mission being to control nature and rectify what he considered to be its shortcomings. He paraded as an arbiter, applying to the animal kingdom his universal distinction between good and evil, between the good and the bad, and even went so far as to incorporate in statute the concept of useful animals and vermin. Carnivores were naturally included among the latter and justice in all its rigour had to be meted out to them: "there is nothing to stop you, you are entitled to pass sentence of death, without right of appeal, at any time by any conceivable means". These are the very words used in a very serious encyclopaedia edited in the inter-war years by a French forestry commission warden and judge of appeal, who knows what the law says!

"Death at any time and by any conceivable means": when dealing with "vermin" the ethics and laws of hunting are no more applicable than international conventions and humanitarian rules are when soldiers are fighting maquisards or guerrillas rather than a regular army. Whereas all so-called game animals are left in peace during the breeding season, whereas it is considered very unseemly to shoot a hare in its form or a pheasant on the ground ("that's not hunting, it's murder... you've got to give the animals a chance", say the hunting fraternity), for carnivores it is a case of the end justifying the means, and the means are not lacking! In spring as in autumn, by day or by night, inside or outside their burrow, hole, earth or set, they can be shot, gassed, poisoned and trapped by a multitude of methods to which veritable encyclopaedias have been devoted and which give a quite astonishing idea of the ingenuity of their inventors. Some crush the animal, others mangle limbs and leave the animal to agonise for hours if not days. Other types strangle the victim, suspend it by one paw, stab it with sharp spikes or tear its jaws apart!

No quarter...

The Christian concepts of suffering and pity do not apply to "vermin" and, until only a few years ago, the famous Manufrance catalogue still featured and most armourers still stocked the dreadful "corkscrew", a long, pointed, coiled shaft which was screwed into the bodies of foxes and badgers to pull them out of their earths and sets! To salve their consciences and justify all these horrors, hunters have completely twisted the concept of "vermin" to suit their interests. As for mankind's best interests, the most elementary common sense would want weasels and stoats, which specialise in killing voles and field mice, included among the useful animals, while hares and deer might at times be more accurately classed as vermin.

For hunters, however, the reverse applies and, despite the fact that they constitute only between a hundredth and a thirtieth of the population of the different European countries, the law does their bidding! "Less vermin, more game" has been the motto of the vast majority of hunters since the beginning of the century and is the alluring sub-title of a

Manuel du piégeur (trapper's handbook) published between the wars under the auspices of the eminent Saint-Hubert Club de France. "Ceaseless trapping and destroying are thus the first and foremost requirement... the very foundation of all cynegetic improvements", and it should be remembered that "maintaining (!) vermin on a shoot is tantamount to feeding a team of poachers"!

At the present time a few hunters who are both objective and astute observers of nature are nonetheless trying to combat this collective hysteria. One of them courageously admits that he has "no hesitation in claiming that the damage caused by predatory animals has always been grossly exaggerated... naturally established game can perfectly well co-exist with such animals... At the beginning of the war... no one bothered to kill mustelids and predators, and yet game was abundant". The same writer later gives a lucid analysis of attempts to brainwash public opinion: "Because rewards are very high... and because a good trapper can make an enormous profit on the sale of pelts..., it is in the gamekeeper's vital interest that his employer be made to understand that carnivores are responsible for the disappearance of large quantities of game". The soundness of this analysis was borne out clearly in 1979 when the sale of Mustelidae pelts was banned in France under the Nature Conservation Act: so many gamekeepers stopped laying traps, because they saw that there was little to be gained from it, that the hunting federations became alarmed and immediately asked that right to sell such pelts be restored!

Rewards

The sinister rewards system, which dates back to the days of wolf-hunting, is in fact the greatest single cause of the destruction of carnivorous mammals and birds of prey in Europe. The French forestry commission warden mentioned earlier says so in no uncertain terms: "These rewards are essential; they act as an incentive to gamekeepers and trappers... It would even have been preferable to pay high rewards and relatively low wages... no matter how high the price per head that had to be paid". Such ideas have a certain piquancy when uttered by one of the leading managers of our natural environment!

It was not until ecology emerged in the aftermath of 1968 that these splendid certainties and particularly these outdated methods came to be challenged by a sizeable section of the population and notably by young people. This attitude is in many cases affective too and derives both from a revolt against earlier generations and their prejudices and from a rejection of hunting and particularly hunters, an unconscious identification with the "unloved" victims, i.e. the predators, and a slightly Rousseauist, idyllic view of nature and its famous balance, a balance which had at all costs to be respected or restored, if it had had the misfortune to be destroyed.

Hunters and ecologists

The leading lights of the hunting world were at first thrown into disarray by the ecologists' virulent and often talented, if not always scientifically exact, campaigns but they quickly recovered their poise, adopted their detractors' strategy and even their ecological vocabulary and proceeded to use them for their own ends. They no longer talk of vermin but of predators or problem animals (!), no longer destroying but of "regulating", and consider themselves too to be invested with the duty of restoring those mythical biological balances.

At the present stage we can therefore say that each of the two sections of the public concerned with these problems is standing its ground, as impassioned as ever, despite the fact that each claims more or less valid scientific support for its stance. The existence of these two opposing camps is starkly revealed in all European countries that have reintroduced the lynx. Whereas the acclimatation of the wild sheep, the sika deer and even the coypu and muskrat has never caused the slightest dispute, the acclimatation of this humble feline has divided public opinion and—in the case of France alone—has given rise over the past five years to an avalanche of writings and speeches out of all proportion to the possible effects of the operation and worthy, in some instances, of inclusion in an anthology of human folly.

True scientists began serious studies of predation only a decade ago. Their interim conclusion is that the presence of carnivores does not affect the density of populations of so-called game species, whose numbers multiply rapidly in protected areas without there being any need to destroy the predators which, through a whole set of physiological and behavioural mechanisms, themselves "regulate" their numbers perfectly. Scientific studies of the diet of small and medium-sized carnivores show that it is made up principally and sometimes almost exclusively of rodents which severely damage crops. True scientists are amazed that the fate of species which are, if anything, beneficial to man and whose appearance is always graceful and behaviour always curious should still rest with a vocal minority rather than with a body capable of managing our natural environments rationally.

P.P.

Trapping of weasels (Photo J.-C. Chantelat).

Can they adapt?

Roland M. Libois

The many studies and reports dealing with the dangers to which our fauna is exposed often mention possible remedies for the current predicament of various species threatened with rarefaction or extinction. The remedies very often include legal protection for the species and its corollary, the protection of habitats. It would clearly be pointless to introduce legislation to protect species without making an effort at the same time to preserve their environment. Unfortunately, however, as a result of constant human pressure the habitats around us all too often evolve in a way which is altogether detrimental to the biological communities inhabiting them. Although nature reserves and parks effectively fulfil their role of preserving habitats, it is important to avoid the pitfall of believing that whatever lies outside such protection can be transformed or degraded without giving rise to problems in the short, medium or long term, for the survival of wildlife.

How do small carnivores react to what sometimes amount to brutal changes in their environment? Are they doomed to vanish or can they adapt to new constraints? In fact, there is no single or simple answer. Every species has its own requirements, which will to a large extent determine its response to change. Any attempt to foresee what will happen must rely on detailed knowledge of the ecology of individual species, especially as regards their feeding habits and the parameters which govern their choice of habitat. Although these factors are generally connected, we shall consider them separately for the sake of convenience.

Food requirements

Roughly speaking, small carnivores found in our regions can be classified into two types: stenophagous (narrow feeding range) and euryphagous (broad feeding range). The two will be differently affected by changes in food resources. The former will be unable to adapt to new food sources, while the latter will put them to immediate use, as the following examples show.

The otter is essentially a piscivorous animal, and the dramatic decline of the species throughout western Europe was probably initially brought about by the merciless campaign waged against it by hunters, trappers, fishermen and fish breeders around the turn of the century. In Belgium, 2,048 otters were killed between July 1889 and December 1895. Yet, despite this intensive campaign waged from 1889 to 1965 with official support (in the form of rewards), the otter managed until about 1960 to maintain small groups of individuals scattered around the country. Ever since, however, the situation has steadily worsened, in parallel with the serious deterioration in the quality of all our watercourses for fish breeding purposes. This may be attributed mainly to different forms of pollution (industrial waste, organic pollution) and to frequent works, such as the straightening of watercourses, reprofiling of banks, scraping of river beds, etc. The few otters that survive are found only in the occasional rivers and ponds where there is sufficient fish. The food factor is decisive for the survival of this species and will have to be taken into account in any attempts to improve rivers or rescue the species.

At the other extreme, we find, for instance, the red fox and the stone marten. These animals can eat practically any type of food. Despite his predilection for rabbits, the fox managed to survive the extermination of one of its favourite preys by myxomatosis. In the Belgian Ardennes, for instance, where rabbits have practically disappeared, the fox survives quite happily by eating larger quantities of small rodents. Elsewhere, it will resort to rubbish bins, if necessary well into urban areas, such as the suburbs of Paris, London and Liège. The stone marten also has a very broad feeding range and will move easily from one type of prey to another according to availability. With a diet of eggs or fruit and occasional visits to chicken runs or rubbish bins, the stone marten displays great flexibility in its feeding habits and easily adapts to any new situation.

Apodemus agrarius - a favourite prey (Photo W. Lapinski).

Choice of habitat

Here too it is possible to divide small carnivores into species with very strict requirements, which are only to be found in very specific environments, and species with broad requirements, which will colonise practically any type of habitat provided that some of their fundamental requirements are met.

The pine marten probably belongs to the former. It is morphologically very similar to the stone marten and its diet is also extremely varied (fruit, birds, squirrels, small rodents, etc.), but its presence is strictly linked to large areas of woodland. It appears to have a marked preference for mature deciduous or mixed forests. According to a number of studies made in the USSR, the population density of the pine marten tends to fall after mature forests have been felled and replaced by young trees. Such practices as the intensive cultivation of spruce, short rotation periods and the establishment of regeneration areas on wooded land in the middle of forests (as in Belgium) are therefore bound to have a harmful effect on the species.

The stone marten, on the other hand, will colonise the most varied types of environment, so long as it finds the right kind of shelter, that is, one with good thermal insulation. It is to be found on the edge of forests, occasionally deeper in the woods, but mostly in rural areas, where it lives very close to humans, in ruins, old barns, piles of logs, attics, straw hangars, etc. It has even been sighted in some towns, where it often has no trouble finding shelter (in attics and abandoned houses) and food (rats, mice, pigeons, etc.).

The badger lies somewhere between these two extremes as far as its choice of habitat is concerned. Although it is less particular than the pine marten, it does not have the extraordinary flexibility of the stone marten, and while it accepts a broad range of environments, it depends for its burrow on certain basic requirements:

— soil which is easy to dig and well drained or crevices in rocks;
— a supply of litter nearby, such as fern or hay;
— ground nearby yielding a plentiful supply of earthworms (the badger's main prey), such as humid meadows, leafy woodlands, etc.);
— good plant cover (forest) or at least effective cover for its burrow, such as thick hedges, tall heather or the edge of forests.

Generally speaking, species with a narrow range of both habitat and diet are the most vulnerable to any degradation of their environment, so that in European terms these are the species which are most threatened. Besides the otter, they mainly include the European mink and, to a lesser extent, the wildcat. Species with a broad diet and restricted habitat, such as the pine marten or the genet, are also very sensitive. Species with a narrow diet but a broad habitat are particularly dependent on variations in their food resources. For instance, the diet of the stoat and weasel consists mainly of voles, the numbers of which tend to vary considerably from one year to another. Lastly, the species which are the most accommodating in terms of both diet and habitat (such as the red fox and the stone marten) are so flexible that they are likely to take advantage of any change in their environment, or at least adapt to it without too much difficulty. It is also quite likely that they will benefit from the elimination of other more fragile species competing with them for some of their resources.

The deterioration of environments and the trend towards greater uniformity will therefore have the effect not so much of eliminating small predators but of profoundly upsetting the structure of their populations. The more demanding species will be eliminated either gradually or suddenly, as the case may be, and will be replaced by species which are at home anywhere and whose numbers may even increase. The final outcome will be a greater degree of uniformity in the biocenosis of carnivores. If such is the case, there are likely to be more problems of "co-existence", such as have occurred already with starlings and pigeons in towns.

In conclusion, it may be said that, while it is highly important to set aside certain strictly protected and if necessary managed areas to ensure the survival of a few seriously threatened species, it must be remembered that these special areas will never amount to more than a tiny proportion of the land area as a whole. It is therefore just as important to manage rural and forest areas in a way which is compatible with the survival of rich, diversified and balanced biocenoses. Better knowledge of the ecological requirements of species making up the communities is essential before precise rules of management can be established, but there is one fundamental principle, that it is advisable to aim for the greatest variety of landscape possible so that rural areas should consist of small plots, hedges, copses and wooded embankments, rather than vast, treeless stretches of countryside, while forests should contain mixed populations of trees rather than large plantations of the same age and type. R.M.L.

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Felis sylvestris (Photo G. Lacoumette).

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