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Status and conservation of Desmaninae in Europe

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INTRODUCTION

The Desmaninae are semi-aquatic members of the family Talpidae (Insectivora, Mammalia), comprising only two species: the Pyrenean desman, *Galemys pyrenaicus* and the Russian desman, *Desmana moschata*.

During the Miocene period, the Desmaninae was comprised of many species and covered a wide distribution area (PUISSEGUR, 1935). In the Ancient Pleistocene, *Galemys kormosi* and *Desmana thermalis* lived in freshwater habitats in what is today the British Isles (HARRISSON et al, 1988). Fossils from the same period suggest that the distribution of *Galemys kormosi* included the whole of Europe, from the South of the Iberian Peninsula (Malaga) to Polish and Hungarian territories (RUMKE, 1985).

Decreases in their distribution turned their ancient sympatry into the current allopatry: *Galemys pyrenaicus* is now restricted to the North of the Iberian Peninsula and to the Pyrenean region; *Desmana moschata* inhabits in a large area that includes part of Russia, Byelarus, Ukraine and Kasakhstan.

Both species show various common adaptations to an aquatic way of life:
(1) dense fur - which retains a large quantity of air and provides both thermal isolation and buoyancy;
(2) webbed feet - which help the animals to swim; these species also have fringes of stiff hair on the external side of their tarsus, probably for the same function;
(3) a long tail - laterally flattened in *Desmana* to aid movement in the water, and mainly round in *Galemys* being flattened only at the tip;
(4) the absence of an auricle - which may reduce water resistance.

RICHARD (1985b) also refers to certain characteristics, existing in species of the genus *Talpa* , that could have been present in the common ancestor of the present aquatic and fossorial forms (these are usually called pre-requirements). Among these, a particular respiratory apparatus is notable (RICHARD & MICHEAU, 1975).

Even more than the morphological features referred to above, however, the desmans' appearance is characterised by a long and mobile proboscis. This organ, a center of tactile sense, is especially important in avoiding obstacles, the recognition of habitat and the detection, catching and handling of prey. Numerous vibrissae surrounding the snout are also involved in the desmans' tactile sensorial world.

Although there are no specific studies on the visual acuity of desmans, all relevant data indicate a small perceptive capacity.

Chemoreception seems relatively well developed, is of an olfactory nature (even though it operates in a liquid phase), and takes place in the Jacobson's organ. This olfactory organ, the only one in the inferior Vertebrates, is ussually vestigial in adult mammals, but is well developed in the Talpidae with the entire internal surface covered with olfactory epithelium (RICHARD,1985b). Nevertheless, encephalic olfactory centres are relatively small in aquatic insectivores when compared with terrestrial species of a similar philogeny (BAUCHOT & STEPHEN, 1968).

The Desmaninae produce musk smell from the under-tail glands. In *Desmana moschata* these are particular active in males, less so in females or juveniles. Musk production also varies according to the reproductive period. It is certainly an important means of chemo-communication (SOKOLOV et al, 1977).

Acoustic repertoire has not been accurately described, but several authors refer to its existence, both in *Galemys pyrenaicus* (NIETHAMER, 1970; RICHARD,1986) and in *Desmana moschata* (KHAKHIN & IVANOV, 1990). We must assume that hearing plays an essential role in communication.

These two aquatic insectivorous show significant differences in their ecological requirements. *Galemys pyrenaicus* lives especially in fast moving waters, eating freshwater invertebrates (BERTRAND, 1993; SANTAMARINA, 1993). *Desmana moschata* inhabits the slow-moving streams and adjacent lakes of the big rivers of the Russian lowland, with an omnivorous diet (Gastropoda being the most important prey group).

There are significant differences in size: *Galemys pyrenaicus* rarely exceeds 70 grams (length of head and body approximately 15 cm). *Desmana moschata* is bigger and can reach 625 grams, with an average of 450 grams (head and body up to 22 cm) (BARABASH-NIKIFOROV, 1968).

Desmana moschata occurs in still water habitats in the Volga, Don, Dnieper, and Ural basins, strongly influenced by seasonal changes. In the beginning of Spring, the water level increases and for a few weeks each year a flood lowland exists. At this time, trees and shrubs provide refuges for desmans, where groups of 3 or 4 animals live together. Such meetings seem to be one of the most important steps ensuring mating and pregnancy; according to ZIKOV (1991), desmans do not breed without floods.

Reproductive biology is poorly understood. All studies of the physiology of reproduction in *Galemys pyrenaicus* have been based on dead animals (PEYRE, 1961, 1968a). With *Desmana moschata*, Russian researchers attempted to breed animals in captivity but were unsuccessful (for a review see KHAKHIN & IVANOV, 1990).

The monitoring of populations have only beenconducted for *Desmana moschata*. In the past, this species was hunted in the USSR and its fur has an official trade price. Consequently, authorities used to evaluate the number of animals that existed each year in order to manage trapping. Much biological information may be found in BORODIN (1963).

Galemys pyrenaicus is very small, inhabits particular turbulent sites and has a restricted distribution area; it has consequently been overlooked by many scientists. The first studies were published by TRUTAT (1891) and PUISSEGUR (1935), and today have great historical value. Eco-ethological studies conducted by B. RICHARD for more than 20 years are the basis of all the current knowledge.

Although there are still large gaps in the knowledge of the biology of Desmaninae; the reduction in its historical distribution area, and the disappearance of the species from rivers, streams and lakes where changes in the water quality or quantity, and in the morphological structure of banks and beds have occurred, are quite evident phenomena.

Galemys pyrenaicus and *Desmana moschata* are threatened species listed as Vulnerable in the IUCN Red Data Book (W.C.M.C., 1990) (Table 1), and in all the relevant national Red Data Books (Table 2 and 3). Of the two species only *Galemys pyrenaicus* is included on the Appendix II of the Bern Convention. This species is also included on the Annexe II of the EC Habitats Directive.

Scientific name	Habitat	Distribution	Food sources	I U C N status
Galemys pyrenaicus	Typically turbulent, well oxygenated streams and rivers	Northern part of the Iberian Peninsula and the Pyrenean region **Countries:** Portugal, Spain, Andorra, France	Aquatic invertebrates, specially insect larvae of Tricoptera, Ephemeroptera and Plecoptera, taken underwater	**Vulnerable**
Desmana moschata	Slow-moving streams and lakes with rich marsh and shrubby vegetation	Don, Volga and Ural basins and the Upper Dnieper area; introduced in some parts of Western Siberia **Countries:** Russia, Byelarus, Ukraine, Kasakstan	Aquatic insects (adults and larvae), molluscs and leeches	**Vulnerable**

Table 1 - Summary of the information concerning requirements, distribution and IUCN status of Desmaninae

	Status	Population parameters
PORTUGAL	**Vulnerable**	- in regression; - locally "abundant";
SPAIN	**Rare**	- globally unknown; - variable year to year; - "abundant" in the oceanic influenced zones; - 6.15 ind/Km in the Cantabric mountains and 2.85 ind/km in the Navarro Pyrenees (*);
ANDORRA	**Vulnerable**	- probably, in regression; - fragmented populations in consequence of hydro-electric installations and valleys' s urbanisation (**)
FRANCE	**Vulnerable**	- in partially regression; - fragmented populations in consequence of hydro-electric installations and due to pollution in the lower part of the basins; - unknown densities; - probably more abundant in the west than in the east;

Table 2 - Summary of the information concerning status and population parameters of *Galemys pyrenaicus* present in the National Red Data Books (CABRAL et al (Eds.) 1990; BLANCO, J.C. & GONZALEZ, J. L (Eds.) 1991; BEAUFORT, F. (Eds.); 1983) , (*) NORES (1991), (**) BERTRAND (unpublished) and BERTRAND (1994).

	Status	Population parameters
RUSSIA	**Vulnerable**	- stable; - 40 000 ind.;
BELARUS	**Extinct**	- (not included in the last edition of Red Data Book);
UKRAINE	**Endangered**	- globally unknown; - several pairs;
KAZAKHSTAN	**Vulnerable**	- 2500 - 3000 ind. - area increasing to the south from Russia

Table 3 - Summary of the information concerning status and population parameters of *Desmana moschata* present in the National Red Data Books (DEZHKIN, V.V.; 1983 (Russia); KHAKHIN, G.V., 1984 (U.S.S.R); SITNIK, K.M. et al (Eds.);1980 (Ukraine); BEKENOV, A.B. (1991) (Kazakhstan)

In 1992, scientists and technicians in water management, and members of non-governmental environment protection organisations met in Lisbon ("Meeting on the Pyrenean Desman", 28th Sept -1st Oct 1992), a joint initiative of the S.N.P.R.C.N. (renamed as Instituto da Conservação da Natureza) and the Museu Nacional de História Natural (Museu Bocage). Although *Galemys pyrenaicus* was the central subject, there were presentations and one poster on *Desmana moschata*. Conclusions reflected the participants concern over the main threats and the urgent need to define measures to prevent habitat degradation. Participants resolved to exchange information, to pool research resources, to exchange technical knowledge on field studies and to repeat the meeting as soon as sufficient new data on the species became available. Participants on the "Seminar on the management of small populations of threatened mammals", held in Sofia from 25 to 28 October 1993, felt that Appendix II of the Bern Convention needed to be enlarged. *Desmana moschata* is one of the species that may be included and also requires a recovery plan. *Galemys pyrenaicus* was mentioned as a species whose country's of distribution should evaluate its needs. Such differences in the recommendations reflect not only unequal conservation status but differing levels of knowledge (which is more developed in respect of population dynamics and management in *Desmana* than in *Galemys*) and legislation to prevent habitat destruction (Portugal, Spain and France - countries where *Galemys* occurs - may respect EC Directives concerning water and habitat's conservation).

In this context, the Standding Committee of the Bern Convention approved in its annual meeting of December 1993, the production of a report on the "Status and Conservation of Desmaninae in Europe". The report's main objectives are:

(1) to provide an overview of the conservation problems facing these aquatic species;

(2) to define with updated references (both published and unpublished) the current distribution area and habitats of the species;

(3) to identify the most important causes of decline and the current threats;

(4) to propose effective conservation measures.

Details on the biology of these species are provided when these are needed to explain conservation problems and the proposed solutions. The report reflects different approaches and differing levels of current knowledge between countries.

We hope that this report will help both to clarify some difficult issues and define a global conservation strategy.

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PART I - *Galemys pyrenaicus*

1. Distribution and habitats

1.1. Iberian Peninsula

Methods

Data on the distribution, habitats and conservation status were collected using two methods. Our aims were:

(1) to collate all published data: particular emphasis was put into trapping field studies and the survey of indirect signs; data obtained from enquiries was always referenced.

(2) to update the information with unpublished data on distribution, to detail the current research projects and to gather scientific opinions concerning the threats to, and the status of, the species: a questionnaire was sent to Portuguese and Spanish researchers and technicians (annexe I); this procedure also allowed completion of a DBase on "Bibliographic references about Galemys" (annexe II) and "Desman Conservation people" (annexe III).

1.1.1. Portugal

Collaborators:
- Carlos ALMAÇA (Museu Nacional de História Natural, Lisboa)
- Jorge PALMEIRIM (Fac. de Ciências da Universidade de Lisboa)
- José Manuel NASCIMENTO (Parque Natural do Alvão, Vila Real)
- Carla Marisa QUARESMA (I.C.N. / Fac. de Ciências da Universidade de Lisboa)
- Helena ALVES (Instituto da Água, Lisboa)

In 1987/1988 a questionnaire on the distribution of small aquatic mammals was compiled with the cooperation of local departments and non-governmental organisations. Participants were provided with morphological descriptions and pictures of *Galemys pyrenaicus, Neomys anomalus, Arvicola sapidus* e *Rattus norvegicus,* and were asked questions about the presence and behaviour of these species in the area (QUEIROZ, 1989). Before this study, only historic and occasional references were available (MADUREIRA & RAMALHINHO (1981); PALMEIRIM & HOFFMAN (1983)).

Despite the technical limitations of these enquiries, data were gathered not only on the distribution, habitats and population trends (which need confirmation by field survey) but also on some behavioural parameters such as space utilisation, activity-period, prey-catching and handling, etc.

Results show a concentration of positive responses on the occurrence of *Galemys pyrenaicus* in Bragança, Vila Real, Braga and Viana do Castelo districts, which suggests that these are probably the most suitable areas for this species. In terms of river basins, the species seems more widespread in Minho, Lima, Cávado and in the northern part of the Douro, being rare in the southern part of Douro, in Tagus and Mondego (Fig. 1). It occurs in 4 Protected Areas of the north and the centre of the country: Peneda-Gerês National Park, Alvão Natural Park, Montesinho Natural Park, and Serra da Estrela Natural Park (Fig. 2).

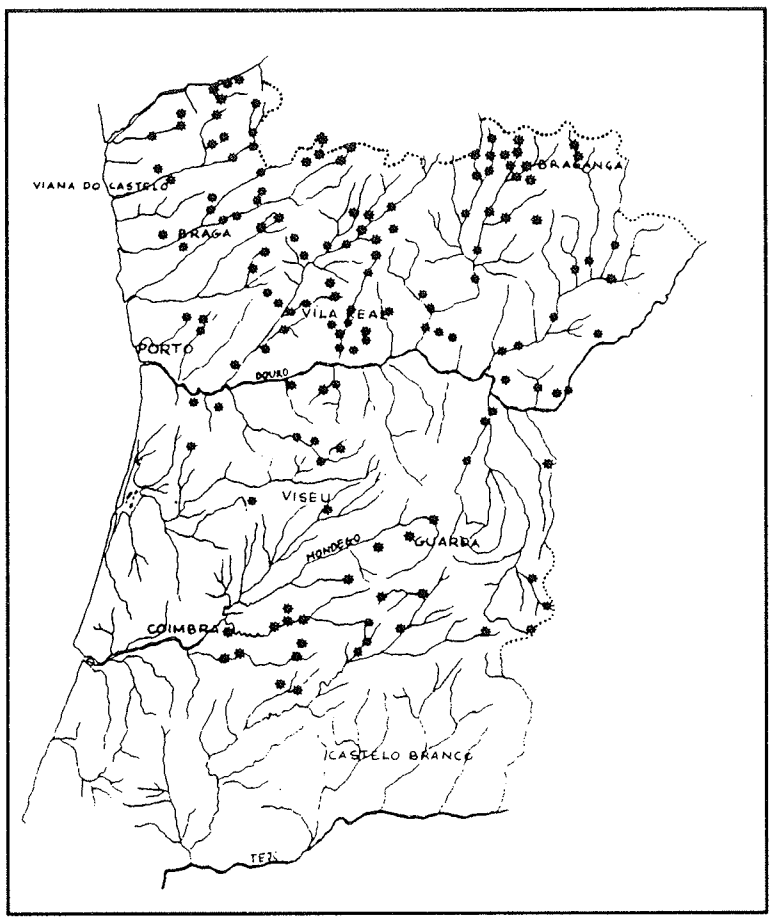


Figure 1 - Occurrences of *Galemys pyrenaicus* - results from an enquiry (QUEIROZ, 1989).

Twenty years ago, the species was also known in the northern edge of the Serra da Malcata Natural Reserve, but current survey (QUEIROZ, unpublished) has yet to confirm its presence. Rivers and streams that cross this area have strong fluctuations in water level and can be partially dry in the summer.

Records of occurrence were also analysed in terms of habitat parameters: altitude, river width and depth and water flow. The most common sites are 1 - 5 meters wide, shallow with a low or medium water flow. Basically, these correspond to the typical habitats described in bibliographic references, but we cannot exclude some middle river reaches with large width, deep water and low water flow, as important habitats occupied by this species.

Records collected through questionnaire survey are now being confirmed through field study and detailed research on distribution is being developed. The study of distribution and habitats of *Galemys pyrenaicus* in Montesinho Natural Park, Serra da Estrela Natural Park and in the north-west region of the country (districts of Porto, Braga and Viana do Castelo) is part of a wider project, named "Conservação da toupeira-de-água", that belongs to a I.C.N. (Instituto da Conservação da Natureza) program of activities, co-financed by LIFE (contract B4-3200/93/771/B2).

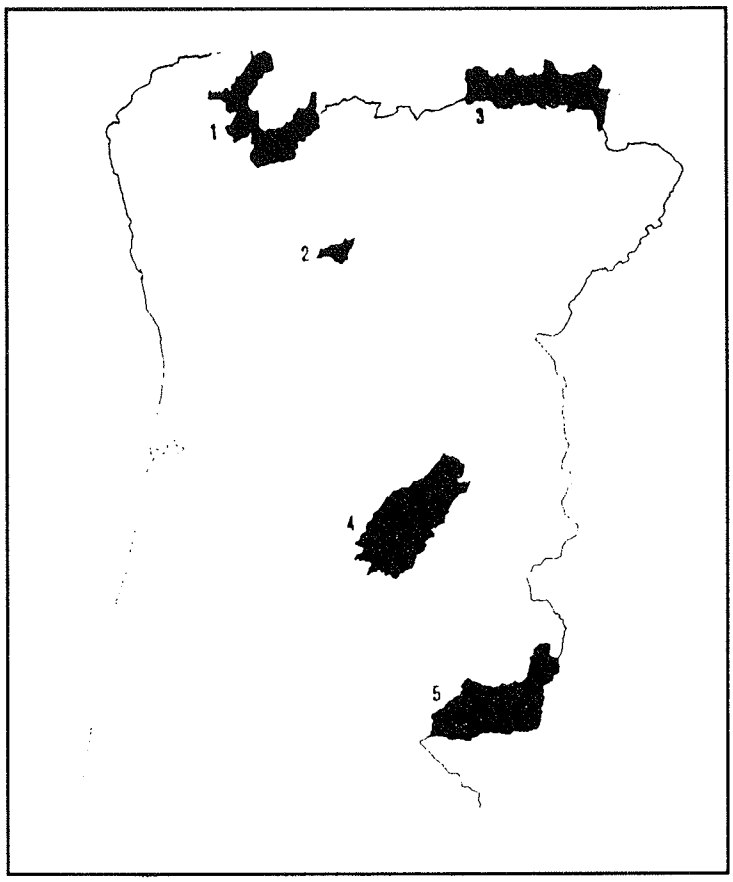


Figure 2 - Some Portuguese Protected Areas
1- Peneda-Gerês National Park
2- Alvão Natural Park
3- Montesinho Natural Park
4- Serra da Estrela Natural Park
5- Malcata Natural Reserve

Peneda-Gerês National Park is one of the most valuable conservation areas of the Iberian Peninsula. Its geographical location in the north-west of Portugal, strongly influenced by the Atlantic climate, explains the high levels of precipitation (more than 1500 m3/m2 / year). As a consequence, a great number of permanent and temporary streams cross these mountains, creating a high diversity of freshwater habitats.

Galemys pyrenaicus' distribution study involved questionnaires, direct observations, and collection of data on indirect signs and captures. (Fig. 3). Studies of morphological and biological descriptors of riparian and aquatic habitats, and of the physical parameters of water quality were also developed in order to characterise the species habitats in this area (QUEIROZ, 1991).

Galemys pyrenaicus lives on (1) shallow waters of high tablelands with a silt river bed, low slope with bright light; (2) small streams with densely forested banks, low deep and fast running water sections alternating with deep, slow running waters; (3) large rivers with unstable and torrential environments with stone blocks on the river bed and a regularly fast flow rate.

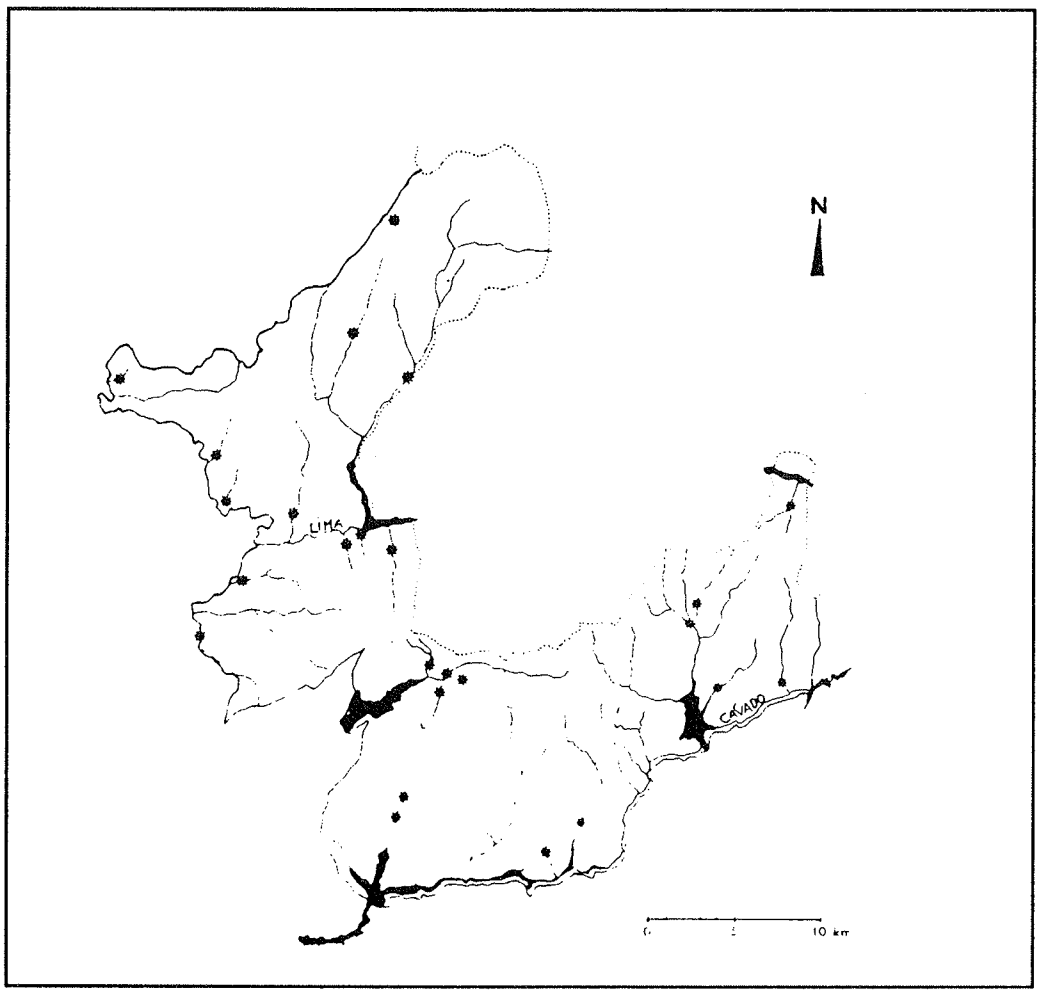


Figure 3 - Occurrences of *Galemys pyrenaicus* in Peneda-Gerês National Park

Changes in the morphology of the watercourses are due to the historic human use of this area for pasture and agriculture, which involved the cutting of riparian vegetation, the construction of stone walls along the river banks and traditional watering systems. The most important current threats to these freshwater habitats are:

- hydro-electric schemes: several dams have been constructed on the Park´s border, two more small hydro plants are to be built inside this area;
- the loss of characteristic oak-groves: deforestation of hillsides is responsible for the low productivity of these mountain streams and the lower invertebrate biomass influences the abundance of all aquatic insectivores like desmans, trout or dippers.

Alvão Natural Park covers 7220 ha of mountain habitats crossed by the river Olo and its small tributaries. High slope, rapids and waterfalls area a characteristic feature of this river. The water quality was evaluated: no eutrophication or toxic products were found; high dissolved oxygen content (near saturation); pH7; low levels of nitrates and orthophosphates (CORTES, 1992).

A preliminary distribution study of *Galemys pyrenaicus* was conducted, using both questionnaires and the survey of indirect signs (QUEIROZ, unpublished) (Fig. 4).

Agriculture and pasture are the only activities of the local human populations.

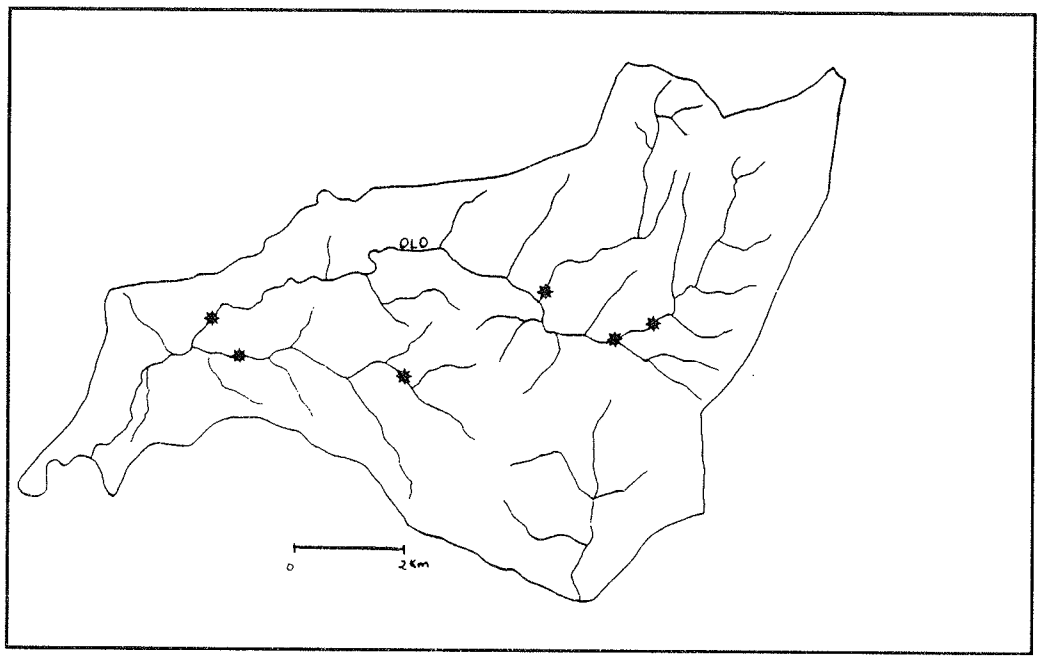


Figure 4 - Occurrences of *Galemys pyrenaicus* in Alvão Natural Park (QUEIROZ, unpublished).

Despite the landscape and geographical interest of this area, the main threat to this river is water deviation for public supply in Vila Real. For this purpose, a dam already exists. Currently proposed is a new project to retain 10% of the total water, near the source (Lamas de Olo).

Montesinho Natural Park is a protected area of the north-east of Portugal that includes the Coroa and Montesinho mountains. This is a very diversified area in terms of flora and fauna.

The first distribution study was conducted in this area by RAMALHINHO & TAVARES (1989), confirming the occurrence of this species in 5 watercourses.

A new research project began last year. The main objectives are to obtain detailed knowledge on the distribution and to characterise the habitats of this species in the area. Twenty-eight new "sites" have been found as a result of a survey of droppings (Fig. 5). Two dead animals were also found.

Tuela and Rabaçal are two important rivers that, originate in Spain but cross all the protected area. For these watercourses, a Spanish hydrological project anticipated the retention of about 92% of the water flow that originating in Spain (1) with the construction of 2 dams, 16 Km (Tuela) and 12 Km (Rabaçal/Pereiro) from the frontier and (2) the transfer of water to another hydroelectric installation in Galicia.

Thirty years ago, the project was approved formally by the Spanish and Portuguese governments. Presently, it is being renegotiated and local populations (from small villages of the department of Zamora - C.A. Castilla-Leon, Spain - and Vinhais - district of Bragança, Portugal) that need the river resources are opposing it.

An environmental impact study exists only for the Spanish territory but calculations made for the Portuguese part of these rivers show that 50% of the normal water flow will be lost. This could be disastrous for the maintenance of healthy populations of *Galemys pyrenaicus* and also have a significant negative impact on fish resources.

Trophic ecology is being studied in Tuela river. A macroinvertebrate quantitative study is also currently underway (QUARESMA, unpublished).

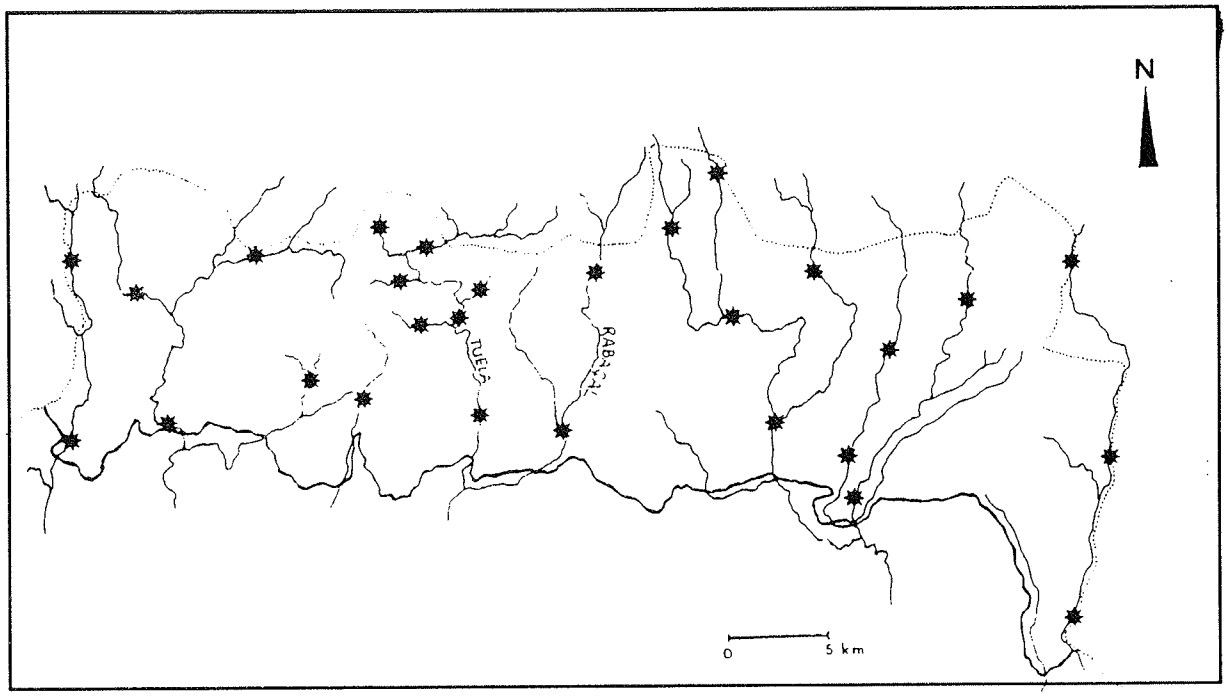


Figure 5 - Occurrences of *Galemys pyrenaicus* in Montesinho Natural Park (QUARESMA, unpublished).

Serra da Estrela Natural Park

Serra da Estrela is the highest mountain in Portugal (1998 m). The uniqueness of its relief and its relatively southern geographic position make this area one of the most interesting research sites for the study of the ecological requirements of this species. It is also the southern limit of the distribution area of *Galemys pyrenaicus* in Portugal.

Very few data on the occurrence of the species in this area exist. ENGELS (1972) caught one specimen in the Alva river (Mondego basin) near Sabugueiro, and repeat observations are currently being made near the source of Zêzere river (Tagus basin) by nature-wardens and biologists that work in the area.

BERTRAND (unpublished) also referred to its occurrence in the Alva river, between Sabugueiro and Vila Cova de Alva.

Using similar methodologies to the other Protected Areas, study of the detailed distribution and habitats of *Galemys pyrenaicus* is already underway. A survey of droppings and other indirect signs has been carried out in 32 sample watercourses of the Mondego and Tagus basins. Small natural ponds have also been assessed.

Non-protected areas

A study of the distribution and habitats of desman in the north-west of Portugal (districts of Porto, Braga and Viana do Castelo) started recently at the Augusto Nobre Zoological Institute (University of Porto) . This is one of the most densely populated areas in the country, where major changes in the natural environment have been seen in recent years. Many rivers and streams are classified as *polluted* (40 S.S. 80 mg/l; 30 O2 diss 50 % sat; 8 CBO5 20 mg/l; 2 NH4 5 mg/l) or *medium polluted* (S.S. 80 mg/l; 50 O2 diss 70

% sat; 5 CBO5 8 mg/l; 1 NH4 2 mg/l) by (JANEIRO, 1987). However, the occurrence of *Galemys pyrenaicus* is known in the area (FONTOURA, 1990). Probably, populations are fragmented, due to the existence of some extremely unsuitable sections of the river, some of which is in danger of disappearing altogether.

Surveys of droppings and other indirect signs, the study of macroinvertebrates' communities and physical and chemical parameters are currently being conducted in 15 stations of Lima, Cávado and Neiva basin.

In 1995 and 1996, studies on the distribution and habitats of this species will continue (1) in the north-west of Portugal - basins of Minho, Âncora and in the sub-basin of Paiva river and (2) in the north-east of Portugal - districts of Vila Real and Bragança, northern part of the Douro basin.

In 1997, field distribution studies will continue in the rest of the country.

1.1.2. Spain

Collaborators:
Carlos Nores (Fac. de Ciências Biológicas; Univ. Oviedo)
Pablo Aguirre-Mendi (Centro de Estudos Riojanos, Logrono)

Distribution data comes from published and unpublished data, from the results of a questionaire, and from field studies that were detailed in a report presented to the ICONA (Instituto Nacional para la Conservacion de la Naturaleza) by NORES (1992).

Between 1991 and 1992 a survey to evaluate the distribution and conservation status of *Galemys pyrenaicus* in Spain was carried out.

In the southern part of the Cantabric cornice (Asturias and Leon region) 6 rivers were surveyed for droppings. Only in del Puerto river did this prove positive\. In other 3 rivers (Torrestio, Luna and Omañas) the occurrence of *Galemys pyrenaicus* was confirmed by other methods.

Animals were caught in 2 rivers of the Asturias region (Piguena river - Somiedo Natural Park, Muriellos river - Muriellos Biological Reserve) and Urrobi river (Hunting Reserve Quinto Real).

A questionnaire was distributed in 32 provinces of the potential distribution area (Autonomic communities: Galicia, Asturias, Cantabria, Vasca, Castilla-Leon, La Rioja, Castilla - La Mancha, Madrid, Extremadura, Navarra, Aragon and Catalunha) via regional and provincial governments to gamekeepers and fishermen. It covered four aquatic small mammals (*Neomys* spp, *Galemys pyrenaicus, Arvicola sapidus* and *Rattus norvegicus*) to try to avoid mis-identification. From a total of 593 answers, 117 were positive to *Galemys pyrenaicus.*

Other records, provided by bibliography and unpublished opportunistic sightings, trapping, electric fishing and specimen collections were collated and analysed. In the Cantabric cornice, Galicia and Northern Douro more than 20% of questionnaires gave positive answers to *Galemys* ; in the entire Ebro basin (including Spanish Pyrénées) positive answers were more than 10%, in the southern Douro and Northern Tajo desmans were present in less than 10% of the questionnaires.

More details are presented concerning territory units (Table 1).

Studies conducted by AGUIRRE-MENDI & ZALDÍVAR-EZQUERRO (1991) define the distribution of *Galemys pyrenaicus* in the C.A. La Rioja. Direct observations, trapping and indirect signs contribute to these data (Fig. 6).

Records from HERNANDEZ (1988) regard the Torio river (Douro basin-Leon). Results derive from 7 direct observations between 1984 and 1988 (Fig. 7).

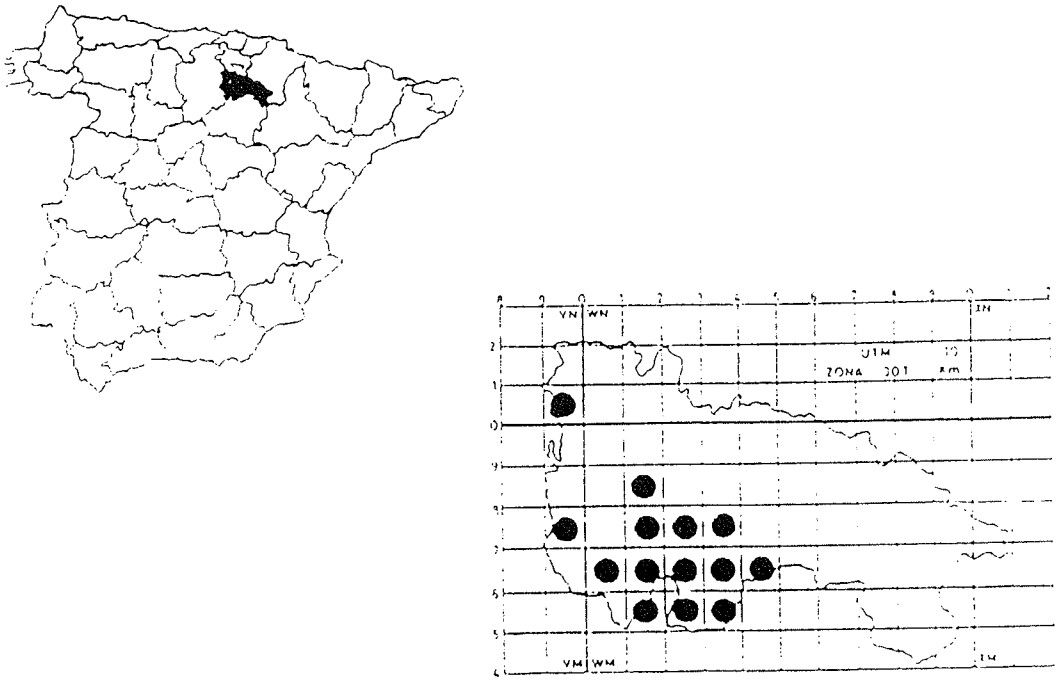


Figure 6 - Distribution of *Galemys pyrenaicus* in La Rioja (AGUIRRE-MENDI & ZALDÍVAR-EZQUERRO, 1991)

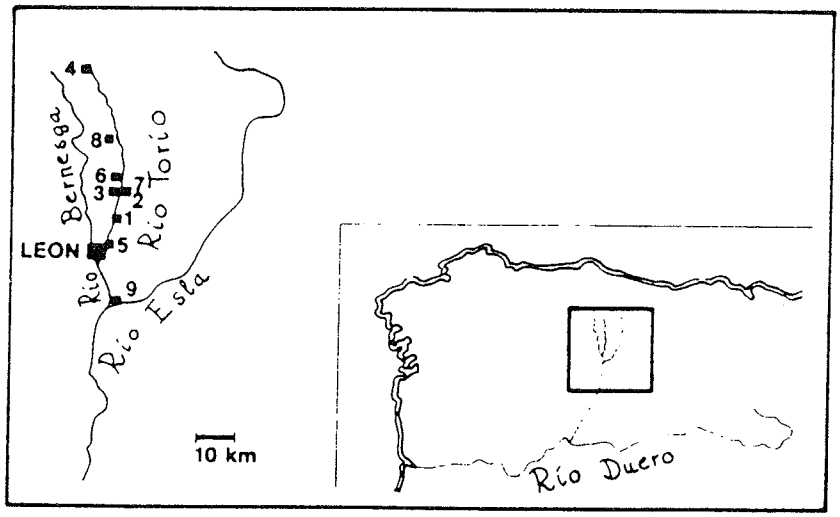


Figure 7 - Location of the recordings of *Galemys pyrenaicus* in the Torio River (HERNANDEZ, 1988)

	% positive desman		Altitude
Galicia	34.2	**Widespread in all area;** Watercourses with good water quality and regular regime, typically Atlantic features.	0-1000
Cantabric cornise	38.9	**Continue distribution from the western part of Asturias to las Encartaciones (Vizcaya);** Absent in regulated rivers, low water quality and small coastal watersheds (Porcía, Esva-Canero, del Bedon)	100-1400
Northern Douro	27.7	**No answers from Zamora or Burgos region and only 1 positive to *Galemys* in 17 answers.** Good water quality in the major part of the watercourses;	650-1500
Southern Douro	5.3	**In the northern part of Central System, since Segovia to the Portuguese frontier, common in Guadarrama mountains, probably absent in Gata and Peña de Francia mountains;** High densities of *Mustela vison*; low water quantity during summer.	700-1800
Northern Tagus	4.5	**Continue distribution since el Alagón to the upon part of Gabriel y Galán until Ayllón massive, interruption between Gredos and Portugal.** Probably, very fragmented populations. Presence of *Mustela vison* and low water quality	850-1700
Southern Ebro	23.6	**More common in la Rioja than in Zaragoza province and no answers from Tervel, the more southern record in Spain - Pedra river (Cimballa).** Low water quantity during summer excepted in Karstic regions.	200-1500
Northern Ebro	17.3	**Continue distribution with the French population (Spanish Pyrénées and high stretches of Cantabric rivers);** Some watercourses are typically oceanic and others have pirenean features. Many dams were constructed in the prepirenean region; low water quality in Pamplona and Huesca.	200-2000
Ter-Llobregat	5.1	**Only in the upon part of these watersheds. In the east part of the Pirenean region rivers have Mediterranean features - limit of the distribution area,** populations with a high risk of extinction	no information

Table 1 - Results from an enquiry: distribution and habitats of *Galemys pyrenaicus* in Spain (from data published by NORES,1992)

The geographic distribution of desman in the western Pyrénées was described by CASTIEN & GOSALBEZ (1992). A total of 45 new sites was reported (Fig. 9).

Galemys pyrenaicus can be found in several types of watercourses. The first important suitable characteristic is related to the regularity of the water regime. In Atlantic rivers, the flow is fairly constant. In the Mediterranean rivers, notable differences exist between low summer water levels and spates in Spring and Autumn.

The distributional limits coincide with areas where temporary streams are common. In the context of the equilibrium extinction-colonisation in the biogeographic theory of islands, the possibility of recolonisation is small when a local extinction occurs.

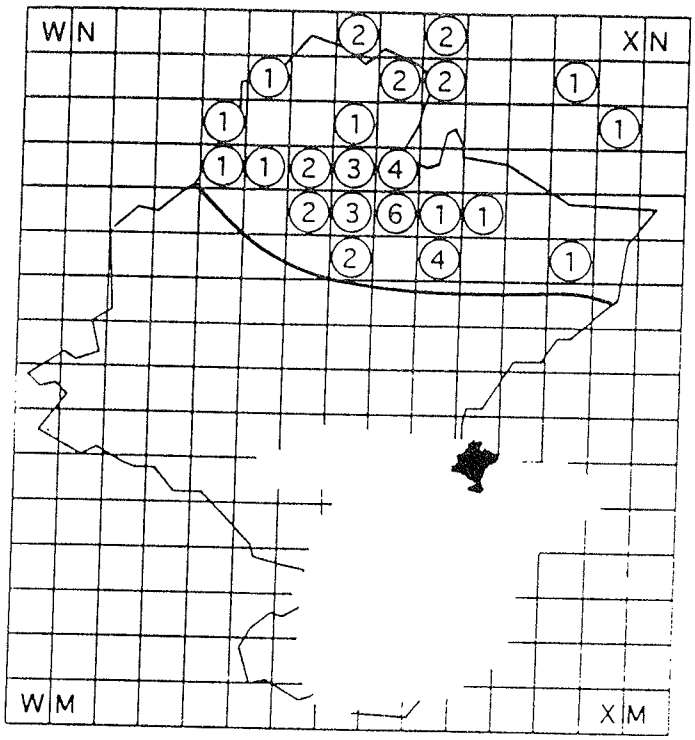


Figure 8 - Distribution of *Galemys pyrenaicus* in the Western Pyrénées. The number of localities for squares is shown into the circles. The thick line shows the southern potential limit of the species ' occupation (CASTIEN & GOSALBEZ, 1992). Data from the French Pyrénées included only of bibliographic references.

According to NORES (1992), there is no positive correlation with altitude: with the frequency of desmans in each altitudinal class not significantly different for the available stretches. However, it seems that this species selects inclines between 10 m/Km and 30 m/Km. Within the range of 30 to 130 m/Km the values of expected and observed frequencies are similar. Consequently, the occurrence of desmans in relation to water speed is higher than it is expected for values above 0.2 m/s. Although these two parameters are related, the latter depends also on local phenomena, such as the amount of water.

Behavioural evidence on the patterns of prey detection, and on the movements near the bottom (QUEIROZ & ALMADA, 1993) suggest that the animal incurs a high energetic cost associated with these activities, and may prefer waters where large prey are available (i.e. Tricoptera). These prey need cold waters, high levels of oxygen and absence of pollution. The *ritron* is thus considered, for all these characteristics, the most suitable habitat for *Galemys pyrenaicus*.

In the western Pyrénées the species occurs at the source of rivers spreading to the transition zone between the salmonid and ciprinid sectors (CASTIEN & GOSALBEZ 1992). The majority of observations (65%) are from mountain streams less than 5 meters wide. Ninety six percent correspond to typical habitats: clean water, inclines above 7 % in the most cases and 15 % in some, shallow water in which rapids alternate with small pools and stony bottoms with pebbles of different diameters that have no significant macroscopic vegetation.

1.1.3. Andorra

No study specific to desmans has been conducted in Andorra. The distribution presented in Figure 9 is based only on a non-systematic search of droppings carried out in 1994 (BERTRAND, unpublished) and from enquiries made between the seventies and 1993 by naturalists.

The points on Fig. 9 represent survey but it seems plausible that desmans may occur throughout the whole watercourse.

No information is available on population parameters.

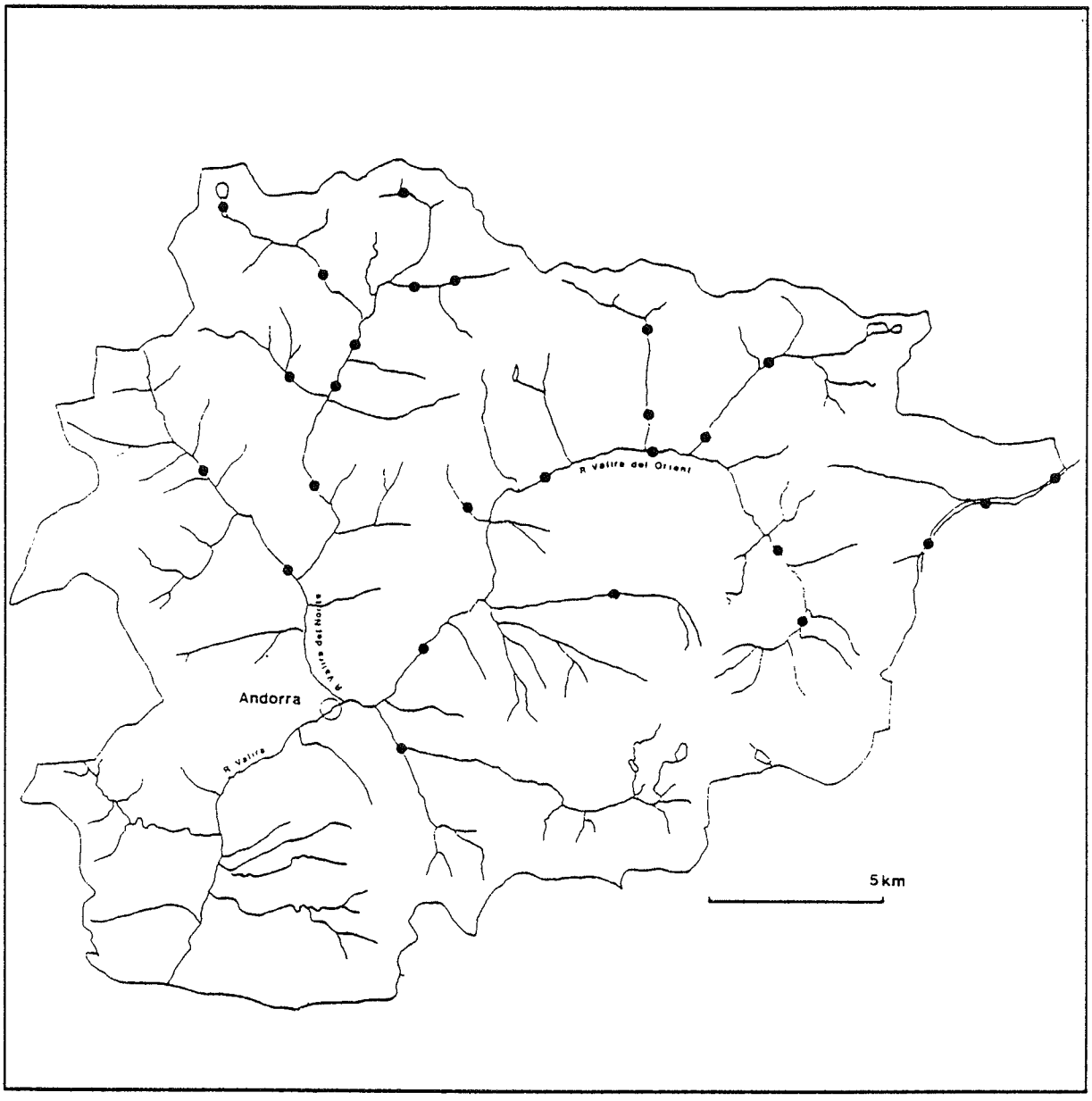


Figure 9 - Occurrences of *Galemys pyrenaicus* in Andorra (BERTRAND, unpublished)

In conclusion,

(1) It is possible to present a distribution map with distinct areas in terms of "habitats and populations status", that summarises published information and empirical data from the field survey (Fig.10).

Improving this map should be one of the main goals of future co-operative projects. This will be especially crucial in trans-frontier areas with shared watersheds.

(2) Although concise information on previous distribution is lacking, a reduction in distributions, especially in the eastern and southern limits in the Iberian Peninsula is probable. An example of this, is the Malcata Natural Reserve (Southern Douro and Northern Tagus, Portugal), side by side with Gata Mountains (Spain) and the southern limit of Estrela Natural Park (northern Tagus and Mondego basin).

(3) Zones of oceanic influence rivers are the most conducive habitats to healthy populations of *Galemys pyrenaicus*, for instance the Minho region (districts of Braga and Viana do Castelo, Portugal), Galicia and the Cantabric regions (Spain). Some other areas may also have suitable habitats. Suggested examples are Montesinho Natural Park, Sabor river and Nogueira mountains (districts of Bragança, Portugal), these two last sites are classified in the list of CORINE biotopes, and in the upper and middle parts of Najerilla and Cidacos river (Soria and La Rioja, Spain)

(4) Fast running waters, with low temperature and a high concentration of dissolved oxygen is the most characteristic habitat of *Galemys pyrenaicus*. However, the species is present in other types of habitats, such as the middle reaches of rivers and some moderately polluted watercourses.

(5) Projects on distribution and habitats should be developed to give a more integrated knowledge on the ecological requirements of this species.

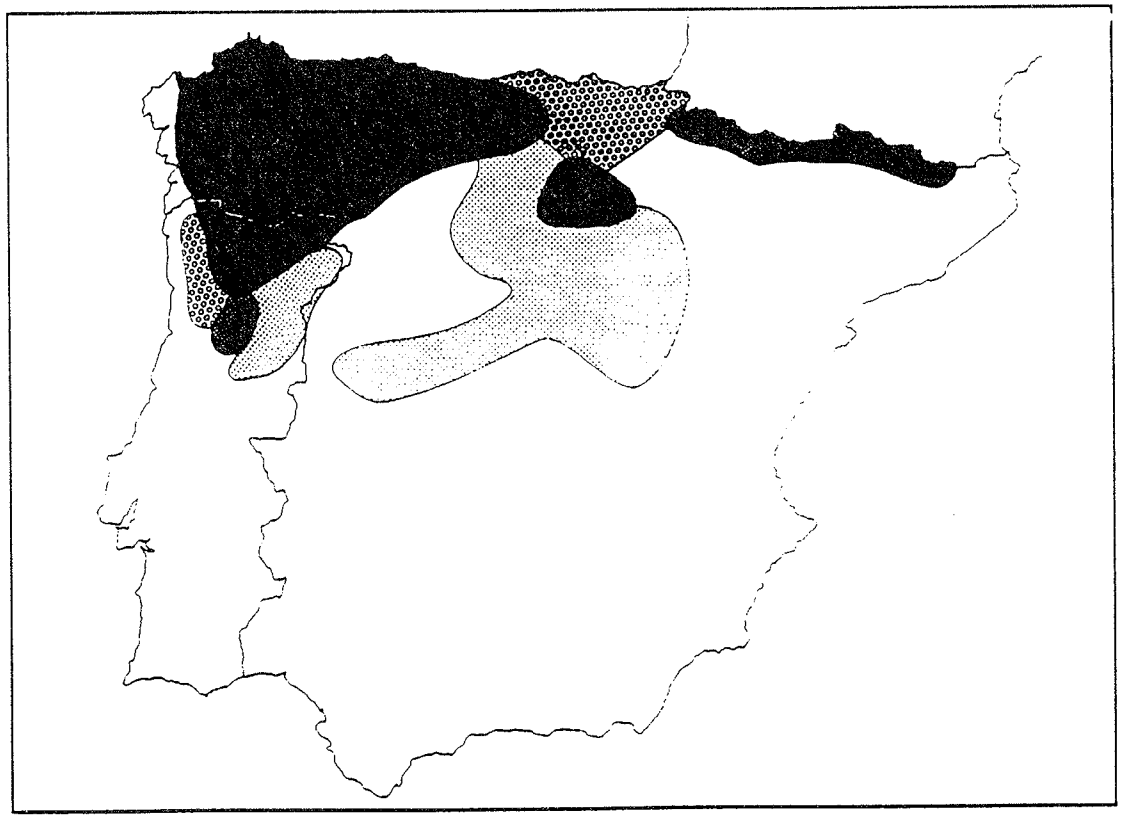


Figure 10 - *Galemys pyrenaicus* in the Iberian Peninsula: distribution map with distinctive areas in terms of "habitats and populations status" (NORES & QUEIROZ, inedit)

- Abundant and widespread
- Scarce
- Located only at some limited points. Pollution is the main threat.
- Located only in the more suitable watercourses. Fragmented populations especially due to the construction of hydro-electric installations.

1.2. France

The desman's distribution in the French Pyrénées has become relatively well known since 1985 when we started, with the financial suport of the French Environment Office ("Direction pour la protection de la nature" later renamed as "Direction de la nature e du paysage", S.R.E.T.I.E) and of the "Parc National des Pyrénées", a series of studies with the following goals:

- The production of detailed distribution maps;
- Description of trends in distribution area over the last century;
- Description of the limiting factors to, and degeneration of, the species' habitat.

Methods

Data were obtained from:

- Naturalists, hydrobiologists and fishermen.
- Trapping surveys.
- Surveys on the presence of indirect signs, and on droppings in particular, since the latter are an efficient way of surveying large sections of the water stream (BERTRAND, 1994).

The data are presented in Figure 11, which shows a 0.1 x 0.1 squares. Production of this map was based on approximately 600 survey sites, including the distribution area and the northern border, in order to accurately represent it's limits.

The desman is presently known to exist in 228 units and more than 600 sites, distributed along the Pyrénées' hydrographic area.

We conducted a detailed analysis, at the level of each large river and it's respective basin. We outlined, for each of these rivers and basins, the distributional area, with the lower distributional border determined only on the basis of our data and the upper limit only when it seemed to be connected with the presence of water streams or lakes.

Distribution by hydrographic basins

The Nivelle's basin

The desman's presence in this small basin became known in the seventies, when many individuals were captured in the course of electric fishing (RICHARD, 1976). We record the presence of this species in various sites; the lowest reach being located downstream from St-Pé-sur-Nivelle, at an altitude of 15m.

In the Basque Country, other small river basins (Bidassoa's, Urumea's, etc.) were surveyed but we were unable to confirm the presence of the desman (about Bidassoa, [c.f.] Spanish part).

The Adour's basin

The Adour's basin drains most of the Pyrenean areas within the areas of the Atlantic-Pyrénées and the High-Pyrénées.

The desman can be found in most of this river's tributaries; for each of these tributaries we defined the lower limits of distribution, as presently known (altitude of the lowest site is shown in parenthesis):

- La Nive, Itxassou(40m);

- La Bidouze, upperreaches of St-Palais (50m);
- Le Saison, Riverhaute (100m);
- Le Gave d'Oloron, Dogne (140m);
- Le Gave de Pau, Ignon (250m);
- L'Echez, Barry (350m);
- L'Adour, Salles sur Adour (360m);
- L'Arros, Ricaud (280m)

On the low basin of the l'Adour, DUBALEN (1894, 1895) reported the presence of the desman, in the region of Saint-Sever en Chalosse (Southern to the Landes' section).

We carried out a thorough survey of the different sections of this river, particularly of the Chalosse region, but we were unable to find signs of the desman. Furthermore, enquiries in areas near to the river on the presence of the desman were similarity negative.

Other data included in "l'Atlas des Mammifères de France" (SFEPM, 1984) refer to the low course of the Adour in Saint Sever (Landes) and to Peyreroade (Atlantic-Pyrénées), to the Plateau de Sannemezan (high Pyrénées and high Garonne) and to the low vale of Tech (East Pyrénées).

In all these areas, our research failed to confirm presence, but as a result of questionnaires, surveys and observations, we gathered, through direct or indirect reports, information on 16 dead or living animals.

All those that could be dated with sufficient precision (13) were collected during the floods produced by the melting of snow (in April and May).

Although we were unable to determine complete details on the conditions in which the above observations took place, we believe that the presence of the desman in these reaches is accidental and that the observations relate to animals that were carried into these areas by floods. In fact, these water-courses show different environmental conditions to those that characterize regularly populated sections.

The Garonne's basin

The desmans' presence through the Garonnes's course is regular until it meets the Neste tributary; at this point, the course becames too large and deep to allow efficient survey.

Information from where Pique and Ger (downstream from Saint-Gaudens) flow into the Garonne, suggests that the desman is also present there. Indirect positive data from the Montejeau region (canals and streams) are available, but cannot be confirmed by survey.

Left-bank tributaries

- La Neste, the entire basin, all the way down until entering the Garonne is populated by *Galemys pyrenaicus*;

- La Pique, the entire basin, all the way down until entering the Garonne is populated by *Galemys pyrenaicus*.

RICHARD (1976) reports observing desmans in the water-courses of the Lannemezan plateau, on the basin of the river Baise. We have not conducted systematic survey of all

the rivers in this region. However, the regular presence of the desman over water-courses such as the Baise, the Gers or the Louge appeares unlikely, since their characteristics seem very different to those of the pyrenean water-courses. Also, in many cases they show serious evidence of degradation.

In October 1993 we were informed of the capture of a desman by electric fishing at the Louge, to the north of Saint-Gaudens. We were able to survey that section in December 1993 and confirmed the presence of the species upstream from this reach.

The desman's presence on these waters poses the problem of it's 'nativeness' or that of it's recent colonization through the Neste's canal. In both cases it would be advisable to survey more carefully water-courses of the same kind in the Lannemezan plateau, as well as those fed by the canal (Save, Baise, etc).

Right-bank tributaries

- Le Ger, over the entire basin until it flows into the Garonne.

- Le Salat, all the way upstream from Saint-Girons.

Downstream the desman can be found in all right-bank watercourses before reaching the basin of the Arbas's stream at the point where it flows into the Salat, in Mane. However, we were unable to obtain data on the river-bank tributaries, where RICHARD had unsuccessfully set traps (personnal communication). On the course of the Salat itself, very little data were gathered downstream in the Lacourt region (5Km upstream from Saint-Girons).

- L'Arize, all the basin to the lower-reaches of Mas d'Azil.

- La Lèze and Le Volp: this two small water-courses have sloped basins reduced in Ariège and in Haute-Garonne. No sign of presence or any information were obtained regarding the existence of desmans in their waters.

- L'Ariège: the desman can be found all over the basin upstream from Foix. On the Hers, a right-bank tributary of the Ariège, the desman's presence has only been recorded on the high basins of the river, upstream from Bélesta and it's two main tributaries, the Douctouyre and the Touyre, close to Nalzen and Montferrier, respectively. These three "populations" have a restricted distribution and seem to be isolated from those of the Ariège's and Aude's limitrophe basins. Sections of these water-courses partially dried out in 1989 and 1990.

Aude's basin

The distribution area of the desman on the Aude's basin continues from Quillan to all these two rivers' tributaries.

Moving upstream, no data has been collected, with the exception of the Orbieu, which flows into Aude very much upstream from Carcassone. In this water-course the presence of the desman has been recorded over the entire high basin upstream from Lanet (350m). Very recent information, still unverified, concerns a tributary of Aude, the Salses' stream, located upstream from Quillan.

Agly's basin

The whole basin upstream from Ansignan, including the Desix's lower basin is populated by *Galemys pyrenaicus*.

Têt's basin

The entire river-course and the basin upstream from Villefranche de Conflent; downstream, two left-bank tributaries, the Castellane and the Caillan are likewise populated by *Galemys pyrenaicus*.

Tech's basin

The entire bassin upstream of Arles-sur-Tech.

Ebro's basin

Two tributaries or sub-tributaries of Ebro, the Ségre and the Rio Iraty drain the French Pyrénées.The desman can be found in both these two basins.

Distribution on a slope basin: the example of high Salat (Ariège) (Fig.12)

The global survey of the Pyrénées made possible the production of a summary map, but not the precise details on the colonization patterns of the water-courses. In the case of the high basin of the Salat, an accurate study has been conducted with the purpose of claryfing this pattern. This study is based on survey of droppings, which has proved to be an efficient method of obtaining accurate information on the desman's presence (BERTRAND, 1994).

At this scale of detail, the discontinuity of the desman's distribution area, as stressed by RICHARD & BERTRAND (1987), appeared clearly. This discontinuity is both spatial, and temporal.

Comparison of data on the distribution of the desman the location of the the basin's hydro-electric schemes, shows that, in most cases, downstream from these arrangements the desman population is either absent or fragmented.

Conversely, the undisturbed or little disturbed reaches show a continuous distribution of the desman.

In the Saint-Girons' section, both in the course of the Salat and in the lower reaches of Lez, the desman remains absent. In this section several industries, milkfactories and, most of all, paperfactories, and hydroelectric factories as well, pollute or strongly disturb the water flow.

The consequences of this fragmentation of the distribution area are unknown and should be studied in detail, since this is probably the most disturbing factor in terms of the species' future.

Characterization of the desman's distribution area on the french slope of the Pyrénées.

By the end of our study we realised that the global distribution of the desman in the north slope of the Pyrénées was much more important than previous data suggest.

Throughout the entire north slope of the Pyrénées, we recorded no discontinuities in the distribution area.

However, the constraints of the sort of cartography adopted for a species such as the desman, which inhabits linear environments, should be stressed. The limits' appear in a clear-cut manner, since we adopt a linear representation of the desman's distribution in the water courses, in most of which there is a spatial and/or temporal discontinuity and a fragmentation of the distribution area.

The interpretation of this fragmentation should be cautious, since regardless of all precautions taken, the origin of a significant part of the observed variability can be found in the natural and/or artificial environmental variability. Although it is impossible, to quantify the biases induced by this phenomena, it is clear that the population's spatial and temporal variability is a reality that stems from the deep changes to which a portion of the north pyrenean water-courses has been submitted.

Observations on the extreme specialization of the desman's diet have also contributed to the elaboration of this hypothesis (BERTRAND, 1993; 1994).

An overview of the general characteristics of the desman's distribution area in the French Pyrénées, should take particular account of the factors directly or indirectly affecting the water-courses' hydrology.

We considered two mesoclimatic parameters, the annual distribution of rainfall and altitudinal distribution.

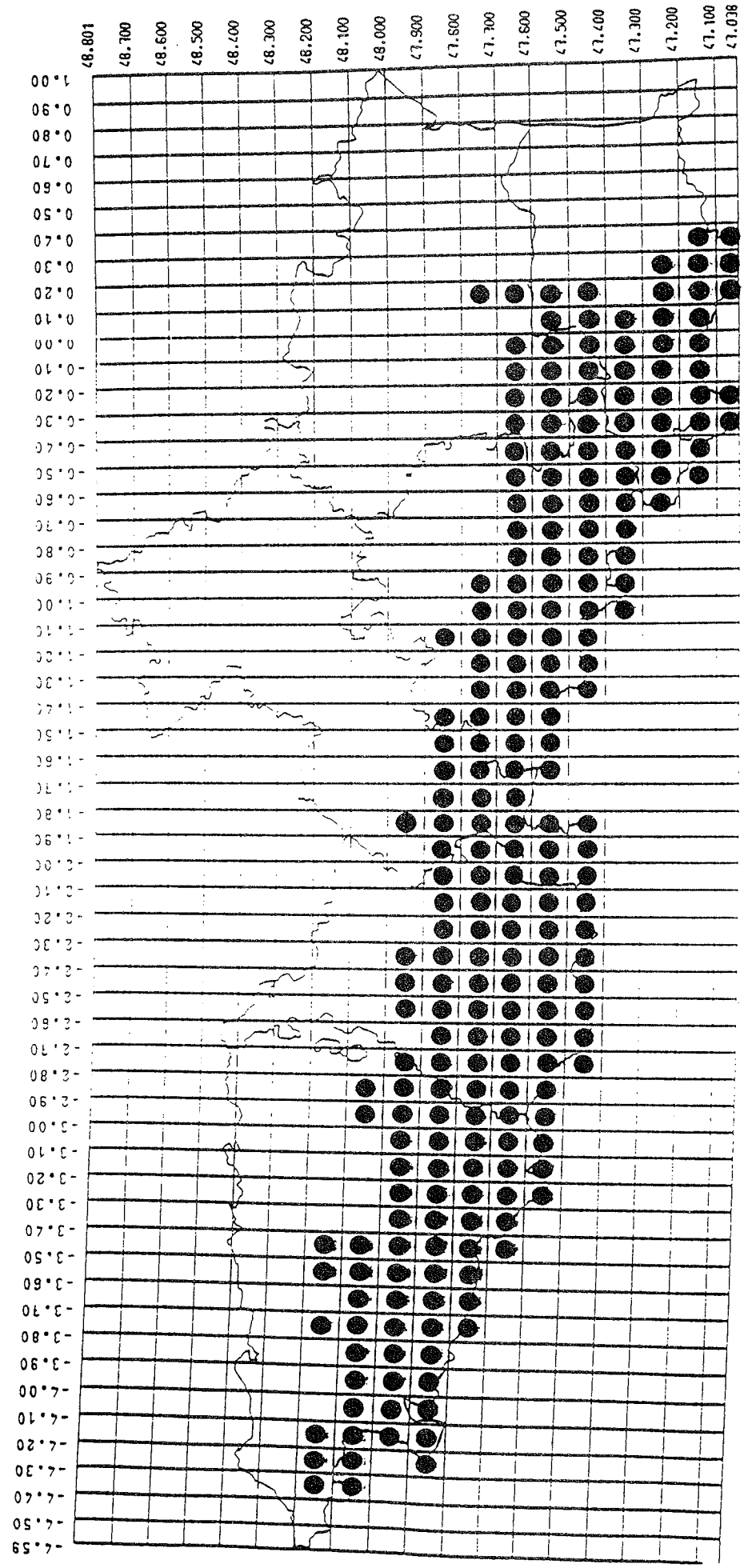


Figure 11: Pyrenean desman's distribution in France (mail of 0.1 x 0.1 grade)

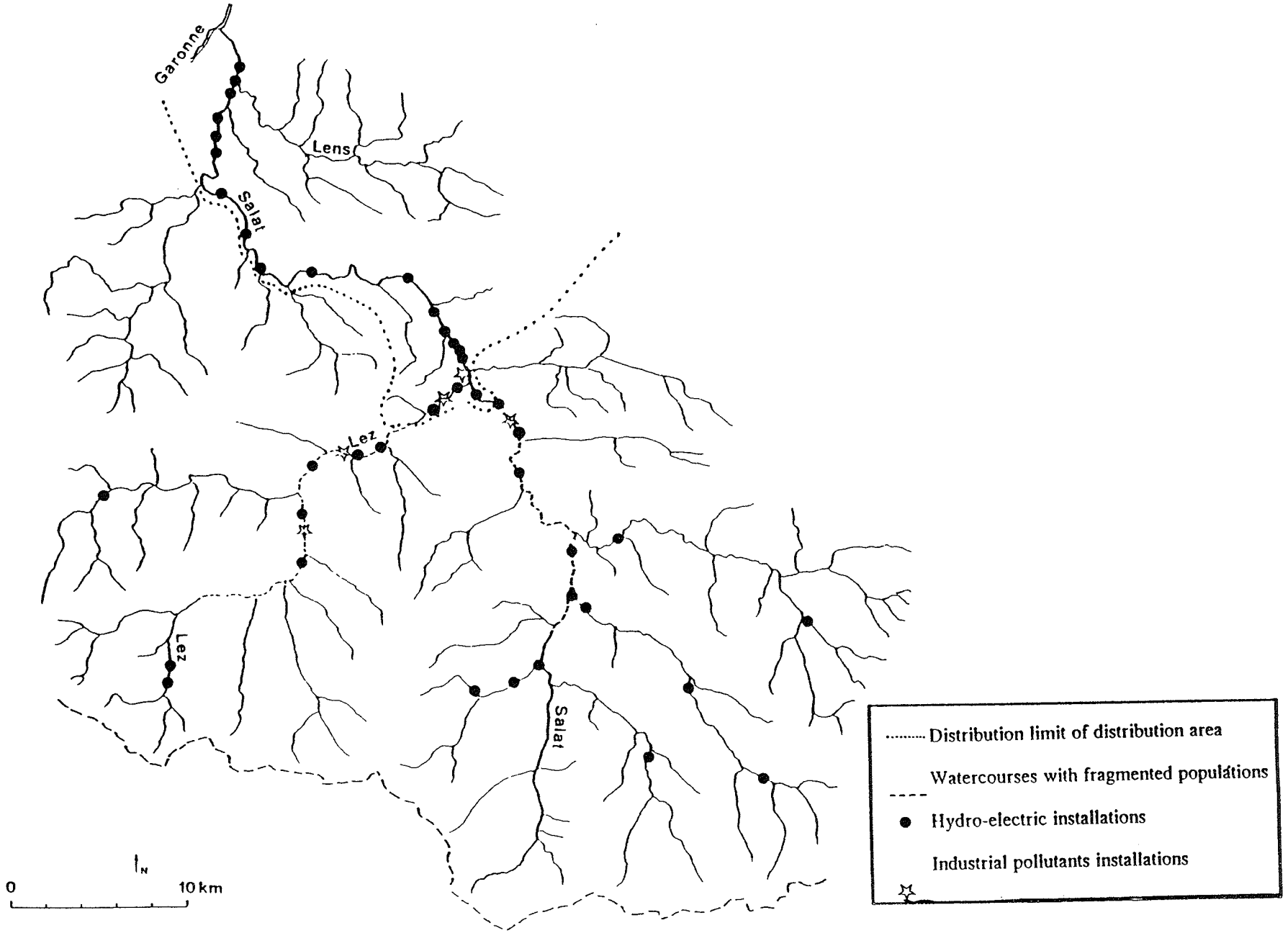


Figure 12: Desman's distribution on the high basin of the Salat and hydro-electric systems.

Altudinal distribution of the desman's location sites

Whereas the upper border of the desman's distribution is associated with the presence of water-courses or lakes, the lower limit of this distribution is harder to define, due mostly to the difficulties in spotting this species in the large sections of the water-courses. With the available information we can, nevertheless, outline the northern border.

West Pyrénées (Atlantic-Pyrénées and High-Pyrénées)

In this section, more than 60% of the known sites are located between 15 m (Nivelle's basin) and 750m N.G.F.; 20% of the sites are located above 250m. All the sites located above 100 m are in the Basque Country or at Béarn. To the East, the lower limit rises abruptly to above 250 m.

Central Pyrénées (Ariège and Haute-Garonne)

In this section none of the sites where the desman is known to live are above 300 m. In Ariège, the lowest sites are Prat-Bonrepaux, near the Salat, Le Mas d'Azil near the Arize, Foix-Labarre near the Ariège and Aguillon near the Hers; in Haute-Garonne these sites are Mane, near the Salat, Pointis-Inard, near the Ger. There is still some uncertainty on the Garonne's course itself and, as we have pointed out, on the tributaries located north to the Lannemezan's plateau.

East Pyrénées (Aude and East-Pyrénées)

In this section, the frequency of sites located above 500 m is lower than 10% and they are all near the Orbieu's basin on the Ridges north slope.

Rainfall related border

Altitude alone seems insufficient to characterize the desman's distribution area. Conversely, most of it's presence sites (96%) are included in the pyrenean area where the annual rainfall exceeds 1000 mm.

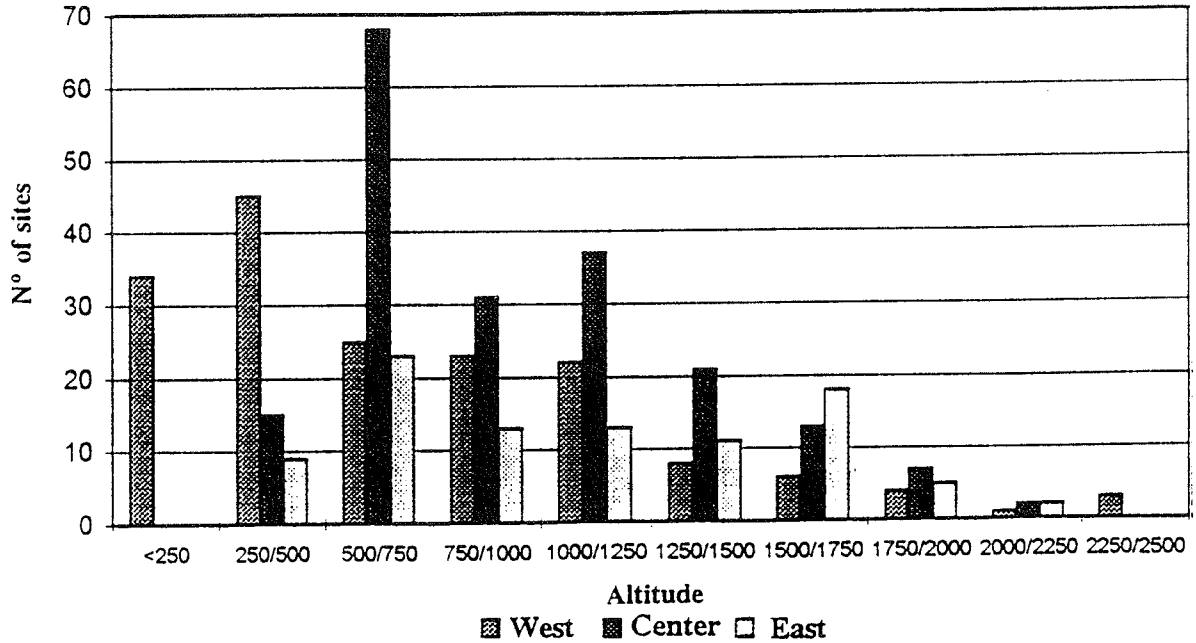


Figure 13: Altitudinal distribution of the desman's presence sites at the French Pyrenees.

The case of the low basin of the Salat in Ariège is particularly significant. In fact, the desman is present upstream from Saint-Girons in all left-bank water-courses that originate in the heavily showered massif (<1500mm) of Lestelas. On the right-bank, it is absent of all the tributaries that originate on the west butresses of the Plantaurel's massif, where rainfall is below 900mm.

Similarly, the western Plantaurel's massif is drained by three main rivers: the Volp, the Arize and the Léze. The Volp and the Léze originate in the Plantaurel and the entire sloped basin of these two water-courses receives an average of less than 900mm of annual rainfall. The desman has never been observed there. On the contrary, in the Arize, which drains the whole north slope of the Arget-Arize massif, which in turn has an average rainfall of <1000mm per year, the desman can be found at least as far as Mas d'Azil.

On the west side of the Pyrénées, the desman can be found at about 15m above sea level. In this region, the value 1000mm is much increased up north, as far as the Landes.

On the East, the desman's distribution area lowest altitudinal limit is exceptionally above the 500m.The only exception is the Orbieu. But everywhere upstream from the basin drained by this water-course, the rainfall largely exceeds 1000mm.

Annual rainfall distribution's related border

Besides the relative importance of the total rainfall, it also seems that the temporal pattern of rainfall throughout the year plays an important role. In fact, the full amount of populated basins present two periods of maximum rainfall. The first, from the autumn through to the begining of winter, the second in May. These two periods involve floods, with the second being particularly due to the basins receiving water from the melting snow. The hydrologic system of the water-courses is of the hibernal type or pluvial-hibernal.

The habitats

Water-courses

All kinds of watercourses, including man-made ones (mill-streams, canals) are populated, but, with no accurate data on population parameters(densities in particular), one cannot define with precision the ecological optimum for this species. We did not observe a significant difference between the strongly-sloped sections and the slightly-sloped sections as, for example, NORES (1993) did in Spain.

Finally, all the populated water-courses show very similar hydrologic characteristics. The most peripheral habitats, especially the high altitude lakes, deserve special attention.

Altitude lakes

The desman has often been observed in high altitude lakes and it is currently known to live up to 2500m.

A particularly notable case occurs in the lakes of Ayous in the high vale of Ossau. This group of lakes is peculiar in that it is not connected with the hydrographic reserve upstream by surface drains, but rather by underground ones. The desman's presence in these lakes is particularly well documented due to the high human activity (guards, naturalists, tourists, etc.) of this part of the 'Parc National des Pyrénées Occidentales'.

This "population" requires detailed study. In fact, the lakes are deeply frozen during for almost six months per year and it would be particularly interesting to know the biology and ecology of these animals.

The presence of the species in the lakes of the Néouvielle massif is equally well documented. M.E. ANGELIER (personal communication) observed it in the Ours lake in the turf of the Ermite springs and in several streams that feed or drain the lakes.

Underground rivers

The presence of desmans in the underground rivers was reported for the first time by COMBES & SALVAYRE (1964) at the West-Pyrénées. We regularly recorded it's presence in the underground river of Aliou (Cazavet, Ariège) and particularly in the smaller underground rivers of Ariège (Queir de Massat, Neuf Fonds d'Aulus), as well as in Haute-Garonne (Juzet d'Izaut, Saint-Paul, etc.). This particular biotope should be studied further.

Conclusion

The desman's distribution area in the French Pyrénées has been studied at two distinct scales.

Firstly, at the level of the entire Pyrénées, there is the impression of a continuous and homogeneous distribution. Conversely, at the basin level, as that of the Salat, but also that of the high valley of the Ossau (BERTRAND, 1987), spatial and temporal discontinuity can clearly, be perceived.

More than the altitude, the hydrologic characteristics of the populated water-courses seem fundamental to the species.

Whereas disturbance caused by man in the water flow seems to play an important role in the fragmentation of the desman's distribution area, it is also important to point out that other sources of disturbance are acting locally, such as industrial and domestic pollution, which help to aggravate the problem at the local level.

Although we have insufficient data, it does not seem that the desman's distribution area has substantially been reduced through this century. The only section where the species has not been recently found is at the Adour's low basin, mainly at the Chalosse located south from the Landes' department.

However, the regular presence of the species in this section's water-courses is discussed and it is possible that previous data came from animals carried by spring floods. We recorded for the first time their presence in a sub-basin of Aude, Orbieau and there is some recent data from the Lannemezan's plateau and the basin of the Salses' stream and tributaries, requiring further study.

2. Causes of decline and current threats

Widespread in the Tertiary, the genus *Galemys* had an important reduction in its distribution area during the Pleistocene period. Hypotheses to explain this decline are normally related to changes in the global climate (the end of the Ice Age, for example) but RUMKE (1985) believes that it is more plausible to relate it to **competition** with species of the genus *Neomys*, which radiated at that time.

The reduction in desmans' distribution since the beginning of the historic period is attributed to **predation pressure**. The first reference is to the arrival of the beech marten (*Martes foina*) in Europe, which occurred only a few thousand years ago (RICHARD, 1976). There is, however, no evidence of a current predation impact by the beech marten on *Galemys*.

More recently, the American mink (*Mustela vison)* has been accidentally introduced to the Iberian Peninsula (for an updated distribution see RUIZ-OLMO, 1991). According to current knowledge, this event might not have the drastic effect that some have predicted (PODUSCHKA & RICHARD, 1986). No remains of desman were found in the droppings of minks in studies on its trophic ecology (VIDAL & DELIBES, 1987). However, its known behaviour indicates underwater foraging and it is a generalist predator, choosing the most readily available prey. It hunts many kinds of prey, including aquatic, semi-aquatic and terrestrial animals (review in EAGLE & WHITMAN, 1987). Rodents especially Arvicolidae, are often the most important food items. The relatively low number of insectivores taken may be explained by their bad taste (KORPIMAKI & NORRDALH, 1985). In the former-USSR, where American minks are abundant and widespread, it certainly kills *Desmana moschata* individuals, even if it does not eat them. Thus, it is wise to keep open the hypothesis that the mink might have a negative impact in desman populations.

Otters (*Lutra lutra)* seem to be the natural predators of desmans. A dietary study of the otter in the upper reaches of the Ebro river basin (Spain) noted desman's remains in 1,4% of the samples (CALLEGO & DELIBES, 1987). In Galicia (Spain), other studies show that desmans constitute 5,2% of the prey and represent 6,1% of the consumed biomass (CALLEGO et al, 1979; CALLEGO, 1984 and ADRIAN et al, 1988). Other occasional predators of desmans are *Esox lucius, Ardea cinerea, Nycticorax nicticorax, Ciconia ciconia, Strix aluco, Tyto alba, Buteo buteo, Mustela erminea* and *Felis catus* (for a review see BERTRAND, 1993).

Some specific **life history patterns** contribute to the maintenance of populations at naturally low densities. The study of the teeth abrasion levels suggest that *Galemys* can live up to 3 years (RICHARD, 1976). Reproductivity is relatively modest, with 3 to 4 young in each litter. Although PEYRE (1961) referred to the possibility of 3 pregnancies, there is no evidence of more than one litter per year. PEYRE (1968) also noticed an endocrine dysfunction in 72% of multiparous females of the pyrenean population, which could be an important limiting factor to its reproductive success.

Some **behaviour patterns** similarly affect the species. RICHARD (1985), RICHARD & VALLETTE VIALLARD (1969), STONE (1985, 1987a and 1987b) and STONE & GORMAN (1985) provided data on desman' home-range, social organisation and activity. Authors used both capture-mark-recapture tecniques and radio-tracking, with similar results. Probably, desman populations include territorial "residents"and "transient" individuals. Resident males and females inhabit the same sector, although they rest in different nests. Females occupy a smaller home-range than males (respectively +/- 300 m and +/- 430 m, *in media* - STONE, 1987). Males' activities are more concentrated at the border of the territory, whereas females are more often observed in the central part. A low level of overlap between pairs seems to maintain naturally low density populations.

Although small and secretive, *Galemys pyrenaicus* is a relatively well known species of the local human populations. In fact, several regional vernacular names are attributed to this species (Table 2). Game fishers and farmers are generally the people who better know its way of life.

Traditional watering, that is deviating water to small furrows, often carried these animals in to fields. The impact of this use on desman populations is unknown but it might have been reduced. Even without studies on the homing-behaviour of this species, we assume that some animals could return to their original stream, either out of water (which would expose them to an increased risk of predation) or in water against the current.

	Vernacular names
PORTUGAL	**Toupeira-de-água** Rato almiscarado a) Rato almiscareiro b) Rato papialvo b) Ratazana do bico comprido b) Almíscaras c) Almiscareiras c)
SPAIN	**Desmán** Almesquera (cat.) d) Rato almisqueiro (gal.) d) Murtuluze pirrinarra (basq.) d) Topo-de-rio e) Almizclera (cast.) f) Mizclera (cast.) f) Rata almisclaza (cast.) f) Aguana (gal.) f) Aguaneira (gal.) f) Aguadana (gal.) f) Rata d´auga (gal.) f) Rato d' almiscle (gal) f)
FRANCE	**Desman des Pyrénées** Rat trompette g) Rat à trompe g) Rat à museau de cochon h)

Table 2 - Summary of the information concerning vernacular names: a) CABRAL et al (Eds.) (1990) ; b) QUEIROZ (1989); c) QUARESMA (unpublished); d) BLANCO, J.C. & GONZALEZ, J.L (Eds.) 1991; e) HERNANDEZ (1988); f) CABRERA (1914); g) RICHARD (1986); h) BERTRAND (unpublished)

In certain areas, some **illegal fishing activities**, using moving nets and traps, are responsible for the elimination of a considerable number of *Galemys pyrenaicus*. In the north-east of Portugal, the fur of these animals used to be tanned and stored inside wool-clothes. It seems that the smell of musk not only perfumes but also helps to preserve wool against moths.

Other prohibited methods of fishing, like poison and explosives, also have a negative impact. Extremely destructive, they not only destroy all sizes and species of fish but many other organisms, such as macroinvertebrates, and even kill desmans directly. The stream flow generally removes the bodies.

Direct killing of these animals not regarded as one of the major threats. Difficulties in observing and catching this species in its natural habitat may minimise its poaching.

Problems do, however, occur in **fish-farms**. Induced by the entrance of the water, some animals enter the tanks. Fish-farmers used to kill them, alleging they ate or damaged production, especially juvenile fish and spawning. Dietary studies based on 2000 droppings (including samples collected in fish-farm areas) do not show any evidence of predation on fish. Although it is not possible to evaluate the extent of damages, we consider it to be negleglible.

Indirect destruction of some *Galemys pyrenaicus* individuals also occurs as a consequence of *Rattus* ' and *Arvicola'* control.

Pyrenean watercourses, such as the high -altitude lakes, have for many decades been the subject of important manipulations by fisheries, notably the **introduction of exogenous species.**

The disappearance of native high - altitude lake species, such as the flat triton, *Triturus helveticus*, or the Pyrenean Brook salamander, *Euproctus asper*, following the introduction of fish is often noted, although a summary of this event has not, to our knowledge, been published.

In the desman's case, there is no accurate information on the impact of introduced species available. However, the similarity of its feeding regime with that of the fish suggests that there might be feeding competition and this should be subject to accurate research.

The main current threats are:

(1) Quantity of water

Water abstraction is an increasing problem for freshwater habitats in the Iberian Peninsula. It appears that increased demand for irrigated land (for agriculture and tourist land use) associated with several dry years has exacerbated this situation.

In Spain, this problem is particularly serious in the east part of the distribution area (e.g. La Rioja, according to MENDI, pers.com.) - where rivers and streams have a small water flow in summer, caused by their Mediterranean features. Because of this, unnatural deviation can produce the total desiccation of these watercourses for most of the year, with the consequent disappearance of species that depend on a permanent aquatic habitat such as *Galemys pyrenaicus.*

However, recent research in Montesinho Natural Park (NE of Portugal) shows that the desman is able to survive in a naturally small stream even when it is reduced in summer to a series of isolated pools (QUARESMA, unpublished). Questions remain on whether there is enough food (aquatic invertebrates) in the residual water and how many animals can survive under these conditions.

Even when a small amount of water is left in the river, these changes can heavily disturb the composition and the abundance of macroinvertebrate community.

Ecological flow or minimum flow, the remaining water left in its normal course after deviation, is frequently calculated according to fish' s needs. Desmans are probably more demanding since the energetic cost of detecting and catching its normal prey would increase in a situation of reduced prey density.

(2) Water quality

Information gathered in Portugal, Spain and France indicate that the pollution of freshwater is one of the most significant factors in the decline of desman' s populations.

Organic pollutants, from domestic and agricultural land use may change the composition of the macroinvertebrate community. Caddis fly larvae such as Rhyacophilidae and Hydropsychidae families are very sensitive to water pollution and are one of the groups

that immediately decreases. At moderate levels of eutrophication, the diversity is maintained by the replacement of sensitive taxa by generalist and ubiquitous species, and overall biomass will increase (ZWICK, 1992).

According to BERTRAND (1992), the desman is a specialist predator of Rhyacophilidae and Hydropsychidae specimens, in natural and well-preserved streams. These prey are generally bigger than the other macroinvertebrate species and do not build tubes. We can therefore predict that the substitution of these preferred prey items will have negative energetic and behavioural consequences for desmans.

However, SANTAMARINA (1993) records that desmans eat more annelids in degradated aquatic environments. In captivity , for example, animals became generalists and eat a large variety of food items (NIETHAMER, 1970; RICHARD, 1986; QUEIROZ & ALMADA, 1993). In future, the feeding requirements of this species should be clarified.

There are some new data on the occurrence of this species in rivers and streams with a certain eutrophication level: Salat's tributary/St.Girons/France (BERTRAND, 1993); Gerês/Caldas do Gerês/Portugal (GONÇALVES, pers.com.). However, without complete studies it is impossible to know if these occurrences are transient' individuals trying to find a suitable habitat or if there is a resident population with an unknown density.

According to RICHARD (1973) the organic matter in a water solution can influence the permeability of fur, dissolving the sebaceous layer of hair. If so, *Galemys* could not live in such places, since the good condition of fur (for providing thermal isolation) is pre-requisite aquatic mammals. These hypotheses must be confirmed with chemical studies of the behaviour of sebaceous gland secretions in organic solutions. It may be important to remember that desmans inhabit some natural acid and eutrophised habitats, as peat bogs (Serra da Estrela-Portugal; French Pirénées).

In the north-west of Portugal (Porto, Braga and Viana do Castelo districts), the recent development of small industrial factories with scant (or no) systems of effluent disposal is responsible for the degradation of numerous small streams, even for their complete "death". Chemical or hot effluents have a strong effect on the destruction of desman food supply.

In the French Pyrénées, there is also the problem of the spread of de-icing chemicals on the roads. The valleys' road network is often the cause of concrete beds, pillars, and so on, and therefore of profound changes in the structure of ravines. These affect the availability of the natural shelters used by the desman. It is also the cause of considerable pollution (hydrocarbonates, de-icing products).

There is also a synergistic effect between the decrease of water quantity and the increase of pollutant effluents.

(3) Destruction of natural vegetation

a) Destruction of riparian vegetation

Because the primary food source of most streams is organic material supplied by the banks, the first effect of the removal of surrounding vegetation is a reduction in the productivity of the aquatic ecosystem. In some parts, trees have been removed to improve land drainage and reduce the risk of flooding.

Regular weed cutting leaves only those species of invertebrates that are able to tolerate disturbance.

Shading maintains temperatures and oxygen levels; the reductions of shade increases the abundance of aquatic plants.

Desmans use bankside to rest. Since this species does not burrow, its nests are placed in rock crevices, piles of stones or roots of trees (see STONE, 1987). Probably, resting sites are located in centres of activity, which themselves are related to food resources

b) The afforestation of basins (surface, species) is extremely important (GOLLADAY & WEBSTER, 1988; GOLLADAY ET AL., 1989; STOUT ET AL., 1993; WEBSTER ET AL., 1992) and it affects the hydrology as well as the benthic invertebrates' populational structure.

It is believed today that the French Pyrenean slope's original forest was pine (*Abies alba*); from 4000 BP on, the emergence of agricultural and herding activities introduced the beech-tree appear (*Fagus sylvatica*) (see for example JALUT et al. 1984). Before the end of the 19th century, the forest had already been largely reduced. After that, it began to recover and for example, in Ariège, its area doubled in 80 years. Presently, it covers about 42% of the French slope's of Ariège territory. The beech dominates today, but many introduced species have been introduced and forestry is now favouring the pine-tree.

In the Iberian Peninsula, most of the pine-tree planted forest and natural oak formations have been destroyed by fire and intensive cutting. Deforested slopes decrease the input of organic matter to the river and change the hydrologic regime, increasing superficial running water and sedimental erosion.

(4) Hydroelectric and hydraulic schemes

The impact of hydroelectric and hydraulic systems on the watercourses has been well studied and it is clear that these are probably the most important constraints facing the desman, and other species living in the affected watercourses.

The hydroelectric and hydraulic systems' greatest effect is the reduction of the water flow. The impact of such flow reductions on the aquatic biocenosis has been the subject of many studies (for a summary see, for instance, ANON, 1990) and it can be seen at three main levels:

- Effects on the water chemical properties: these can be direct or indirect effects, but often they are firstly, a consequence of variation in both the amount of dissolved oxygen and the pH and of the creation of lethal or sub lethal conditions for many aquatic organisms.

- Effects of thermic cycles: any reduction in watercourse flow will involve a change in temperature, which is inversely proportional to the average depth.

- Morphodynamic effects: since the flow of the annual floods or the amount of solid materials transported by the flow is substantially modified, the sedimentation as well as the compaction by the substrate sands changes with the modification of the drainage "facies".

These physico-chemical effects causes changes in the biocenosis, which can be summarised into two essential points:

- Profound changes in the animal populations, either with the reduction or with the disappearance of various Trichoptera families, such as the Rhyacophilidae and the Hydropsychidae and the increase of more limnophilic groups (e.g. Annelidae, Chironomidae Diptera).

- Increase in the qualitative and quantitative importance of the invertebrate drift phenomena.

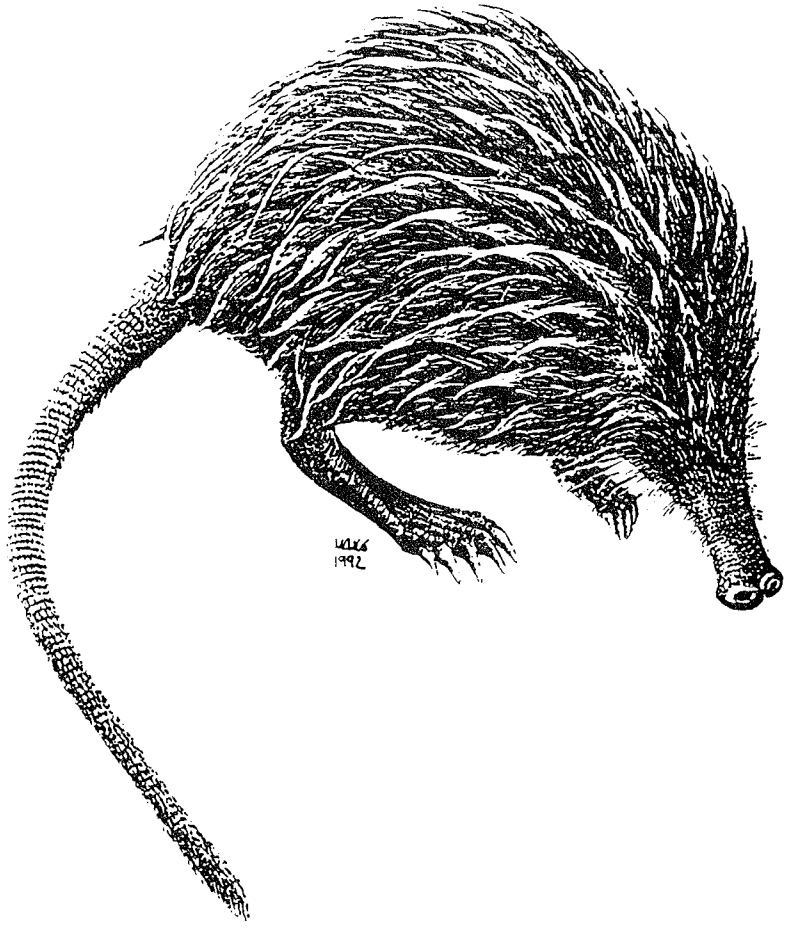
For more detailed these two points see for example: BOUGUENEC ET AL., 1984; BRITAIN & EIKELAND, 1988; CHAUVET, 1983; CLERGUE-GAZEAU & GAZAGNES, 1986; CLERGUE-GAZEAU ET AL., 1987; COWX ET AL., 1984; GAZAGNES, 1983; IRVINE, 1987; MACKAY & WATERS, 1986; MINSHALL & WINGER, 1968; WATERS, 1972.

Little information is available on the impact of the under-structures of arrangements such as dams, deviating canals, turbines, and so on. However, the predicted impact on desman habitats and populations has already been listed (QUEIROZ et al, 1993). Negative impacts on desman populations as a result of fragmentation are:

- The fragmentation of a population in to very small units is usually accompanied by an increase of inbreeding with a consequent depression in variability and fertility. On a large scale, the reduction of genetic diversity may affect the potential of the population to adapt to new conditions.

- It is important to remember that fertility in this species is low. Small insectivores are also highly susceptible to stress, which can inhibit reproduction. In a confined river section, there are serious risks of aggression and stress due to the inability of juveniles to move out of the parental home-range. This may further decrease the reproductive output of the population and increase mortality.

- The sub-populations in a river system cut by several ecological barriers may become so small that they may be at high risk of local stochastic extinction. The formations of barriers that the animals are unable to cross also means that local extinctions are not compensated by immigration from the areas where the population density is high.



MAIN THREATS	ECOLOGICAL EFFECT
Direct killing	- reduction of desman populations effective;
Roads' construction	- profound changes in the structure of ravines and destruction of natural shelters used by the desman;
Water quality **a) organic pollution** **b) chemical pollution**	- increase in the abundance of some non-sensitive invertebrate taxa; - decrease in the abundance of desmans' natural preys; - sterilisation of some river reaches; - fragmentation of the distribution area and isolation of small desman populations;
Water quantity	- detriment in desman food supply;
Destruction of natural vegetation **a) banks** **b) basins**	-detriment in desman's food supply; without shading, the water temperature increases and the oxygen concentration decreases; - destruction of potential shelters for desmans. - changes in the hydrological regime; - deforestation decreases the input of organic matter and desman's food supply;
Hydroelectric and hydraulic schemes	On the environment: - detriment in desman food supply; - problems in prey catching and difficulty in "anchoring" on the bottom; - increase in the energetic costs of diving and/ or reduction in the available time to forage; - destruction of desman' s shelters and nest sites; - unavailability of shelters and nest sites in the new shore line; On the population: - fragmentation of the distribution area and isolation of small desman populations.

Table 3 - A summary of the main pressures facing *Galemys pyrenaicus* populations and its habitats.

3. Conservation measures

River conservation for desmans must be tackled at a large scale. Discontinuity in any given river continuum fragments the stream network, disconnecting upper sections of catchment system and turning them into separate island-like systems. Local (or occasional) damage to individual stream animal populations may turn into large-scale extermination in cases where distances between populations are greater than average dispersal capacity. There are large risks of isolation and accidental extinction for species that can only disperse within watercourses.

Three river-management principles should be regarded in order to preserve wildlife habitats (according to NEWBOLD, et al. 1983):

1. Certain rivers or parts of rivers are of such outstanding nature conservation value that they should not be touched except for some minimal maintenance to sustain wildlife interest;

2. Rivers or parts of rivers which are less than outstanding but still of high nature conservation value should be carefully assessed to decide whether to omit the whole or part of them from any proposed river works;

3. Whenever rivers are subjected to flood alleviation schemes or routine maintenance, certain design procedures should be followed to integrate environmental sensitivity with the engineering aims. The habitat value of an impoverished stream could thus enhanced, and damage to existing wildlife habitats minimised.

For species whose biology and ecology are well known, such as the otter (*Lutra lutra*), this scheme may lead to the establishment of a long term species and habitat management framework. In the case of *Galemys pyrenaicus* similar management may not be done without carrying out previous essential studies.

The lack of biological knowledge on *Galemys pyrenaicus* population parameters, densities and reproduction, prevents the application of direct species conservation measures. Consequently, it is obvious that introductions, reintroductions or any sort of transfer of animals from one place to another should be avoided, for that could involve demographic and genetic consequences that we would be unable to assess.

Ecological requirements for this species are also partially undefined. The present knowledge on the feeding ecology of this species is mainly based on data collected in France. This knowledge is large enough to allow outlining of the first habitat management measures and defining the priority research lines that will make available the required knowledge to start up long term coherent and efficient actions.

So far, the current knowledge on the ecology of desman does not allow us to define:
- the minimal water-flow to ensure desman's food supply;
- the minimal viable population, i.e. the smallest population that guarantees the persistence of the species;
- technical ways of ensuring the connection between isolated populations.

Essential studies to a better knowledge of the species' ecology should therefore focus on:
- completing and updating distribution;
- evaluate and caracterise habitats of occurrence;
- the refinement of knowledge on feeding strategies, trying to achieve a more accurate identification of taxa and in particular of Trichoptera, comparing them through the major kinds of aquatic habitats they occupy, may provide details that will allow taking practical conservation measures on the watercourses where the species is seriously threatened.
- the refinement of knowledge about the feeding strategies of other vertebrates that are aquatic predators of benthic invertebrates, discriminating the autochthonal and the alochthonal species, particularly the Salmonidae, to clear up how trophic resources are divided by the semi-aquatic vertebrates of the pyrenean floods' guild.
- the reproductive biology, densities and demographic parameters, which are crucial in assessing the effectiveness of conservation actions that might be proposed.

The management of desman populations and habitats must be regarded within the framework of the conservation of other aquatic species and their respective habitats, mainly those of fish, and in particular Salmonidae.

In this context, the best suggestions to manage watercourses included in the desman's distribution area are those which **prevent denaturalisation.**

In other cases, rehabilitation or **restoration of the natural conditions** must be achieved. Firstly, minimising factors that contribute to the fragmentation of desman populations and detriment of its known requirements in terms of food and rest, should be given full priority. This goal can be achieved at (1) the watercourse level and at (2) the river basin level.

(1) Taking the desman into account while managing iberian and pyrenean watercourses should be considered at many levels: concern over the desman will not produce positive outcomes unless basic research is carried out:

- at the level of the flow disturbing arrangements, objective and accurate data must be available in order to attend to the minimal flow required by the desman and not only to that required by salmonids, who have hitherto been the single concern. Spanish specialists in otter conservation, facing to the same problem, suggest the preservation 30-60 Km of favourable conditions in each watercourse, and to ensure 1m3 per second minimal flow (RUIZ-OLMO et al, 1989).
- the systematic treatment of domestic and industrial waste.
- on all fishery related "manipulations", such as the fish-farm installation or exotic species introductions.

(2) At the basin management level the main subjects are:

- Forestry measures : restoring the natural vegetation of the river slopes with native tree species, namely deciduous oaks in the northern part of Iberian Peninsula, avoiding the replacement of burned forests by pine (e.g., *Pinus pinaster*) or eucalyptus. In the French Pyrenees and in the northern Cantabric cornise similar questions may exist with the extensive programs of forestation with exotics, such as the beech (*Fagus sylvatica*).

There are European Union financial incentives to forest managers (Reg. C.E.E.- nº 2080/92).

- Agricultural measures: preventing the use of biocides and restoring bank vegetation, maintaining the renaturalised riparian formation.

Measures must be implemented through land-use contracts between farmers and conservation organisations, in order to prevent agricultural activity in the river' s borders and to ensure the conservation of the riparian ecotones. These habitats, supporting a great biodiversity, are essential to retain chemical products incorporated into the field soils. The agro-environmental framework must be taken into account, and financial compensations to private field owners should be provided to engage them in river conservation.

New protected areas must be sufficiently large to support a viable population . Again, we stress that the delimitation of "special areas for the conservation" of this species under the NATURA 2000 network, cannot be a substitute for the urgent need of integrated river conservation policy. The designation of "sites" and the protection of the populations' "strong nucleus" must be lead to the abandonment of the perspective of conservation of all the habitats of the species, such as is required to avoid fragmentation.

The comparison of the **protection legislation** for this species, summarised in Table 4,

shows differences which concern direct protection (absent in Portugal) and similarities concerning indirect protection of habitats conservation.

In France, other diplomas for the protection of the Atlantic salmon (*Salmo salar*) and the freshwater small lobster (*Austrapotamobius pallipes*)' habitats, lead to the partial protection of desman's habitats. It may also be achieved by the application of law 84-512, from 29 June 1984, relative to fishing and fish managing.

In Spain, autonomic communities, hydrographic confederations (one for each basin) and central government participate in the management of freshwater environments. According to MANTEIJA (1992), water management (for public supply, irrigation or hydroelectric production, e.g.) has taken precedence over the river conservation.

In Portugal, the protection of freshwater and riparian environments is also achieved by the application of decree 213/92, that rules the "National Ecological Reserve" (R.E.N.). This diploma is supported by the philosophy of the "continuum naturalae". In this context, all the watercourses and their flooded bankside (not the riparian zone, as would be desirable!) are safe from human interventions. Exclusions exist but require the approval of the Environmental Ministry.

Although we have not reviewed all the existent legislation in subjects related with the freshwater environments it seems that more detailed instruments, such as **management plans** for each basin would be the best way to attain a successful conservation policy for desmans.

Special environmental education programs with local populations should also be proposed. Fishermen, agriculture and forestry managers, and all those responsible in hydraulic and hydro-electric exploitation are the subjects of these programs. With an accurate knowledge on the ecology of *Galemys pyrenaicus* direct killing and some indirect damages in habitat conditions may be minimised.

For this purpose, small information leaflets were already published in Portugal and France.

	Protection legislation
PORTUGAL	- specific legislation does not exist; - present in some protected areas; - indirectly, by habitat protection legislation;
SPAIN	- included in R.D. 439/1990, from 30 March, that regulates the National Catalogue of Threatened Species, as " a species of special interest" - present in some protected areas; - indirectly by the habitat protection legislation;
FRANCE	- integral protection of this species: ministerial decree from 17.04.81; - present in some protected areas; - indirectly by the habitat protection legislation.

Table 4 - Information about legislation for desman protection existent in Portugal, Spain and France.

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PART II - *Desmana moschata*

1. Distribution

This report contains data that were gathered during fieldwork conducted in the regions of Russia, Byelarus, Ukraine and Kazakhstan where the Russian desman lives, between 1963 and 1993. Much of the information came from questionnaires which were circulated to the regional hunting departments. Bibliographical and hunting statistics data have also been extensively used.

Studies which provide information on the Russian desman distribution in the countries concerned are the following:

- **Russia**: D.I.ASPISOV (1962), I.I.BARABASH-NIKIFOROV (1967,1968,1971,1975,1977), L.P.BORODIN (1963,1967), M.P.PAVLOV (1973), A.A.PARAMONOV (1928), G.V.KHAKHIN (1974, 1977), G.V.KHAKHIN & B.N.LOPAREV (1973), G.V.KHAKHIN & A.A.IVANOV (1979,1981,1986,1990), L.V.SHAPOSHNIKOV (1933, 1967), B.S.YUDIN (1982).

- **Ukraine**: V.I.ABELENTSEV (1967), M.E.PISAREVA (1967), I.I.SAKHNO (1967), V.N.SERDYUK (1973).

- **Belarus**: L.P.BORODIN (1963), M.P.PAVLOV (1973), O.N.MIKHOLAP & Yu.N.SERZHANIN (1973).

- **Kazakhstan**: I.I.BARABASH-NIKIFIROV (1977), A.BEKENOV (1970), G.V.KHAKHIN & A.A.IVANOV (1981).

Data on wildlife reserves was provided by hunting statistics and by the studies of A.M.SHALYBKOV & K.V.STORCHEVOY (1985), G.V.KHAKHIN & A.A.IVANOV (1990).

Techniques of Russian desman census are presented in the works of L.P.BORODIN (1963) and V.S.KUDRYASHOV (1976).

The studies by G.A.SKREBITSKY (1940), G.A.SHESTAKOV (1940), K.N.SHURYGINA (1949), N.I.ASOSKOVA (1968), G.V.KHAKHIN & A.A.IVANOV (1990) describe the feeding habits of the Russian desman.

The results of the reintroduction projects are set out in the studies by L.P.BORODIN (1963), V.N.SERDYUK (1972, 1978), M.P.PAVLOV (1973), G.V.KHAKHIN & A.A.IVANOV (1990).

The breeding in captivity problem has been discussed in a large number of studies, such as L.V.SHAPOSHNIKOV (1933), V.P.KRASOVSKY (1954), I.I.BARABASH-NIKIFOROV & O.A.LAKOMKINA (1971), P.N.ROMANOV, G.V.KHAKHIN & A.A.IVANOV (1982), S.N.CHICHIKINA (1983).

Measures that can be taken against killing of Russian desmans when fishing or hunting Muskrats and other animals are outlined in the studies by G.A.SHESTAKOV (1940), L.P.BORODIN (1963), G.V.KHAKHIN & A.A.IVANOV (1986).

Factors detrimental to the Russian desman are described by D.I.ASPISOV (1952), L.P.BORODIN (1963), G.V.KHAKHIN (1974,1977), G.V.KHAKHIN & A.A.IVANOV (1990).

1.1. Russia

a.The Dnieper Basin

Until the end of the 1950 's the Russian desman was hunted in the Bryansk Region: this activity was abolished because of a sharp decrease in its numbers.

By the end of 1980 's, the Russian desman occurred only in very small numbers along the rivers Ostr and Iput. It is very rare in the area of the Dnieper river head.

Through introductions in 1956, 1960 and 1961, the Russian desman is now also present in the area of the rivers Seym and Svopa (in the Kursk Region). In all these places, 609 individuals were released.

Actually, the total number of Russian desmans in the Dnieper Basin is now more than 2000.

b. The Don Basin

In the Don Basin, the Russian desman settles along the left tributaries of the middle part of the river. It is plentiful in the Voronezh river head (in the Tambov Region). In the middle and lower reaches of the river Voronezh and along its tributaries (in Lipetsk and Voronezh Regions) it is not frequent.

The Russian desman is quite plentiful in the bottom-lands of the rivers Bityug and Khoper and in its tributaries (in Tambov, Saratov, Penza and Voronezh Regions). It is found here in every type of habitat that suits it.

The lower reaches of the river Khoper (in the Volgograd Region) are less densely inhabited. Here, Russian desmans live only in the bottom-lands of the rivers Khoper and Buzuluk. In the lower part of the Don Basin, the Russian desman is reported in the upper reaches of the river Kunaryuchya (MARCHENKO, 1977).

In the Don bottom-land, it is rare and occurs only in the middle part of the river.

Current numbers for the whole of the Don Basin total about 12000 individuals.

c. The Volga Basin

In the upper reaches of the basin, the Russian desman occurs along the rivers Ustye, Kotorosl (in the Yaroslavl Region) and Unzha (in the Kostroma Region). Not more than 500 individuals live here, and there are only a few dozens of them in the Unzha bottom-land.

The majority part of desmans are found along the river Oka, but they are unevenly distributed. The Russian desman occurs essentially at the river Zhizdra bottom-land and the river-mouths of its tributaries from the town of Kozelsk till the Zhizdra river mouth (in the Kaluga Region). In the late 1970s, there were more than 300 individuals. Further along the Oka river, in the Kaluga, Tula and Moscow Regions, the Russian desman is absent. A few rare catches have been recorded at the river Tsna (in the Moscow Region). In the middle part of the Oka, it is plentiful (in the eastern part of the Ryazan Region). The Russian desman is widespread along the Oka's tributaries. It is common in the lower reaches of the river Moksha and along the river Tsna (in Tambov and Ryazan Regions). It is to be found here in every type of habitat that is suitable for it. In the middle part of the river Moksha (Mordovia) it occurs in fewer numbers. In the lower Oka (in Gorky, Ivanov, Vladimir and Moscow

Regions), the Russian desman settles at the flood plains of the river Klyazma and its tributaries. The Oka bottom-land (in Gorky and Vladimir Regions) is less inhabited. Along the river Klyazma, the Russian desman occurs from the eastern part of the Moscow Region, where only single findings have been recorded, until the mouth of the river. The majority of the Klyazma population is found along at the middle and lower reaches of the river.

In the middle part of the Volga Basin, the Russian desman occurs along the river Sura in the Penza and Ulyanovsk Regions. In Mordovia, it has been recorded at the river Alatyr (in the Ardatov Region). The total number of desmans in the Sura Basin is not more than 300 individuals. In Tataria, the Russian desman occurs in small numbers. It has been noted at the river Vyatka, in the Kirov Region, where introductions were made in 1959, 1961 and 1977 (accordingly 93, 71 and 12 individuals). Within the boundaries of the Kuibyshev (now Samara) and the Orenburg Regions, it occurs at the river Samara flood-plain.

In the Lower Volga, the Russian desman lives only in the Volga-Akhtuba bottom-land (in the Astrakhan Region) with between 150-300 individuals. It is known to be found in the Volga delta.

Currently, the total number of Russian desmans in the Volga Basin is estimated to be 23000.

d. The Ural Basin

The Russian desman lives on the Ural flood-plain and the outfalls of some of its tributaries (in rivers Ilek, Utva, Vyazovka, Kushum, Solyanka, Barbastau) within the boundaries of the Orenburg and Uralsk Regions (BARABASH-NIKIFOROV, 1977). Its range stretches down the river Ural to the village of Kalmykovo (the Uralsk Region).

e. The Transural area

A Russian desman introduction project was carried out at the border between the Chelyabinsk and the Kustanai (Kazakhstan) Regions in 1961. 74 animals were released along the river Uy. The operation has been successful, the animals have settled along the rivers Uy and Tobol. In 1976, the Russian desman population had increased to an estimated of 300 individuals (KUZMINYKH, 1977), and to 2500 in 1985.

In Tomsk and Novosibirsk Regions, where two releases were made in 1958 and 1968 (236 and 114 individuals respectively), animals have survived in very small numbers.

The populations of the Russian desman in the Transural area now totals 2500 animals.

1.2. Belarus

The Russian desman appeared in Belarus, along the river Oster (in Mogilyev Region), in 1949, probably due to individuals coming from the Smolensk Region (Russia) where it was reintroduced.

From 1955 to 1961, 580 animals were released along the rivers Sozh and Ptich (in Mogilyev and Minsk Regions), but they have not survived (BORODIN, 1963). Although it was considered extinct by DEZHKIN (1983), the Russian desman is still found sometimes along the river Ptich in the Mogilyev Region.

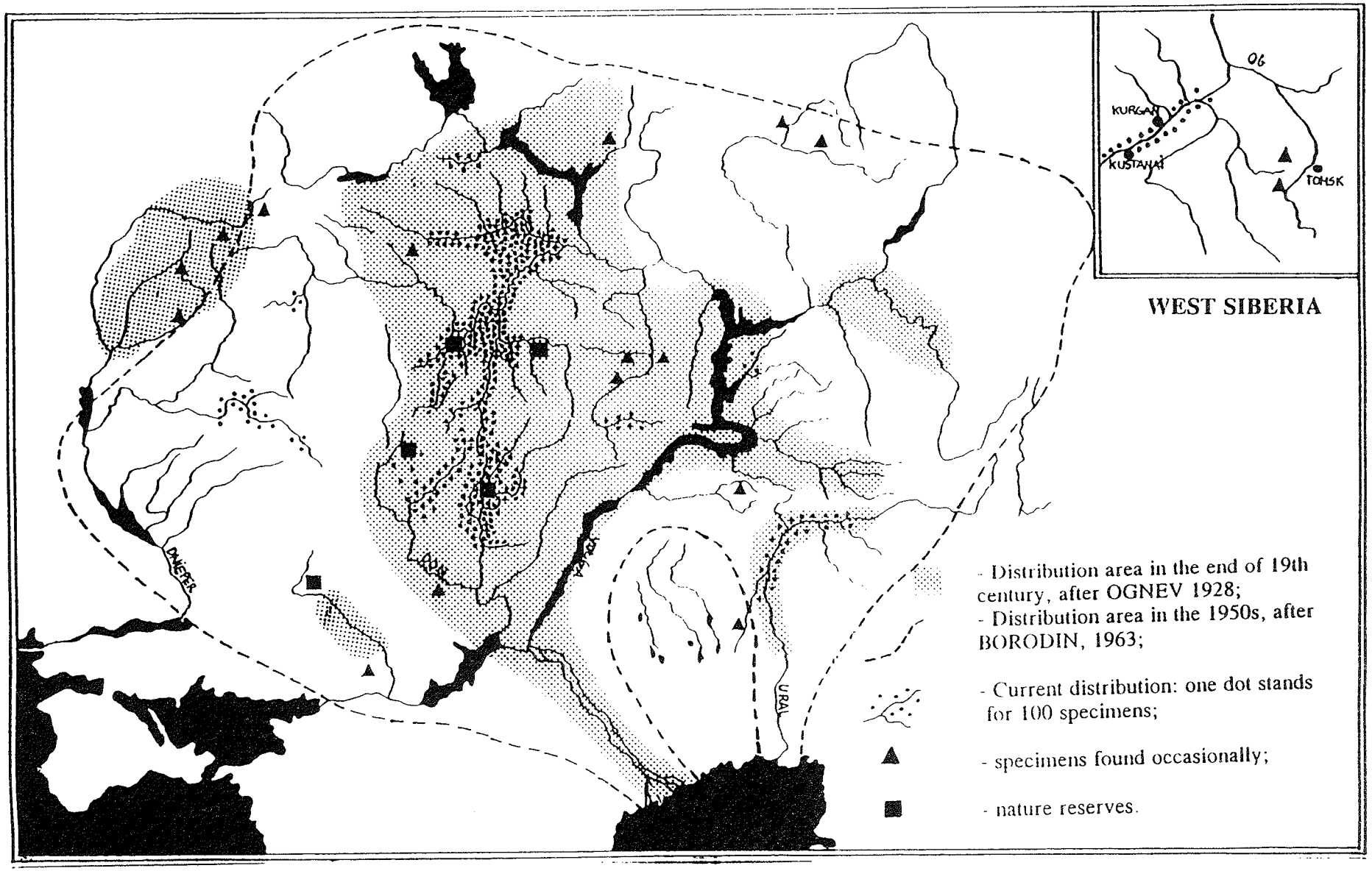

Figure 1 - Distribution of the Russian desman in the Eastern Europe and Western Siberia

1.3. Ukraine

In the past, the Russian desman occurred along the rivers Dnieper and Severski Donets. By the beginning of the 20th century, it had disappeared from the Dnieper area. The Severski Donets population (in Lugansk Region) numbered 500 individuals in the mid-1950s (BORODIN, 1963, SAKHNO, 1967) but by the end of the 1960s it had vanished despite reintroduction attempts (BARABASH-NIKIFOROV et.al. 1971). From 1929 to 1940, 366 animals were released in the Dnieper and Severski Donets basins. According to PAVLOV (1973), this reintroduction scheme failed, and by the late '60s, the Russian desman seemed to have disappeared from the Ukraine. It reappeared in the river Seym bottom-land (in Sumy Region) in the early 1970s, probably due to individuals coming from the Kursk Region. According to SERDYUK (1978), a few dozens of the animals lived here in three bottom-land lakes in autumn 1975. The population now seems to survive, due to continuous recolonization from the Kursk Region.

1.4. Kazakhstan

In Kazakhstan, the Russian desman occurs in two areas: in the Uralsk Region, at the river Ural flood-plain, and in the Kustanai Region. The second area is a part of the Uy-Tobol population which resulted from the introduction in 1961. The Russian desman used not to live here.

There are no data on the numbers of Russian desmans in the Kustanai Region, but judging from the Chelyabinsk and Kurgan Regions population size, it may be safely suggested that several hundreds of animals live here.

a. The Uralsk Region

ASPISOV (1952) and BORODIN (1963) have summarized all the data gathered on the Russian desman distribution in the Uralsk Region between 1930 and 1950. It has been observed in the middle part of the river Ural, from the northern to the southern border of the Uralsk Region with the greatest density in the area of the town of Chapaevo. BEKENOV (1970) has defined more exactly the limits of the distribution area pointing out that Russian desmans occur toward the South till the village of Kalmykovo and their density peaks at the river Ural tributaries north of Uralsk-Sity. These data have been supported by BARABASH-NIKIFOROV (1977).

Observations from 1980 have shown that the distribution area of the Russian desman stretches down the river Ural to the town of Chapaevo. From the Orenburg Region border to the village of Skvorkino, it is found in every bottom-land reservoir that is suitable for it to live in. Southward of Chapaevo the Russian desman is rare.

Sightings have been recorded in the Kushum Canal, but this irrigation canal can not be regarded as a good habitat because of considerable water-level fluctuations. Further south, conditions are unfavourable for the Russian desman though sightings are possible because some animals are swept down the Ural by spring floods every year.

In the early 1980s, the estimated number of Russian desmans for the whole of the Uralsk Region was between 1000 and 1500 individuals.

2. Introductions and reintroductions

Releases of Russian desmans, the purposes of which was species reintroduction as well as establishment of new populations in the areas where it used not to live, were started

in the former Soviet Union in 1929. Altogether, 165 releases have been made in 30 republics and regions of the former USSR, and 10000 animals have been released.

Until 1941, reintroduction and introduction works were very wide in scope. 3411 individuals were released in 18 republics and regions in the European part of the country. After World War II, these works slowed down, but in the late '50s they were carried out very actively again. From 1957 till 1964, 5022 animals were released (PAVLOV 1973). In succeeding years Russian desmans were released in fewer amounts and, after the species was included in the USSR Red Data Book in 1975, all activity in this field has practically stopped.

The results of the releases are summarised in Table 1.

We use the term "a successful release" to mean that this release has resulted in the establishment of a new population in some area where the species vanished or used not to live, and it being known that the population still exist and is healthy. Examples are provided by releases in the Smolensk Region where the current population is stable though its density is not high, as well as in the Kursk and Chelyabinsk Regions where the numbers of Russian desmans are increasing and the distribution area is expanding. Releases of Russian desmans to the river Zhizdra bottom-land can also be regarded as successful because the healthy population has been surviving here for more than 20 years despite some unfavourable conditions (VORONIN 1969).

The term "conventionally-successful releases" implies that the populations resulted from these releases existed for many years (15-20 or more) but have not survived till now because of diverse reasons. Examples of this are seen in Bashkiria (at the river Belaya), the Kuibyshev Region (at the river Samarka) and in Tatarstan (at the river Ik). The release of 39 animals in the Buzuluk Nature Reserve (the Orenburg Region) was also regarded as successful by many authors (PAVLOV et.al. 1973). According to BORODIN, however, this release was made into the area where the Russian desman was still present. One way or the other, from 1957 to 1959, i.e. in 23 years after the release, 190 animals were caught here for further releases within the region. Now, however, the Russian desman does not occur in this area.

Of special note are releases of Russian desmans in Western Siberia (in the Tomsk and Novosibirsk Regions). The result of these has been only the existence of a few individuals in some sites though, at first, a considerable increase in numbers was observed here. It should be noted that an increase in numbers during the first years after the release can not be regarded as a success of any (re)introduction project as the situation is quite common to such undertakings which may prove to be failures in the end.

The results of 78 releases remain unknown, because there were no observations during the ensuing years or because releases were made in areas where the Russian desman was still present, and often in great numbers. A large number of releases ended in complete failure. It is known with assurance for 56 releases (2881 animals) in 13 republics and regions of the former USSR. There are several reasons for that. In some cases Russian desmans were released in areas with unfavourable conditions for them. For example, 280 individuals were released in lakes which are not situated in bottom-lands, such as Raifskoye lake (Tatarstan), Zhuvintas and Anikshta lakes (Lithuania), Argazy and Shutovskoye lakes (the Chelyabinsk Region), Tatarskoye lake (the Ryazan Region), etc. All attempts to introduce the Russian desman in these lakes failed. A similar situation held when Russian desmans were released in bottom-land lakes or rivers which, however, were not quite adequate for their needs. Such releases took place in the Moscow and Orenburg Regions, in Mari Republic (375 individuals) and in Byelarus and the Ukraine (765 ones). In many release sites Russian desmans did not survive because of carnivores (mink /*Mustela vison)* and competitors (muskrat /*Ondatra zibethicus*) living there in large numbers.

Region	Successful releases		Unsuccessful releases		Releases with unknown results	
	Nº releases	Nº animals	Nº releases	Nº animals	Nº releases	Nº animals
Belarus	-	-	5	580	-	-
Lithuania	-	-	2	70	-	-
Ukraine	-	-	15	366	-	-
Russia						
Bashkiria	11*	583	-	-	-	-
Bryansk Region	1*	159	-	-	-	-
Chelyabinsk Region	1	74	2	161	-	-
Chuvashia	-	-	-	-	3	108
Gorky region (now Nizhni Novgorod)	-	-	-	-	9	493
Kaluga Region	2	206	-	-	-	-
Kirov (Vyatka) Region	-	-	4	197	-	-
Kuibyshev (Samara)Reg.	2*	383	10	738	2	116
Kursk Region	6	609	-	-	-	-
Mari Republic (now Mariy-El)	-	-	2	170	-	-
Mordovia	-	-	-	-	2	193
Moscow Region	-	-	5	67	-	-
Novgorod Region	-	-	1	38	-	-
Novosibirsk Region	1*	114	-	-	-	-
Orenburg Region	1*	39	1	100	3	292
Penza Region	-	-	-	-	6	147
Ryazan Region	-	-	1	14	11	675
Saratov Region	-	-	-	-	10	565
Smolensk Region	3	363	1	5	-	-
Tambov Region	-	-	-	-	1	30
Tatarstan	2*	564	2	35	1	46
Tomsk Region	2*	338	-	-	-	-
Ulyanovsk Region	-	-	-	-	1	24
Vladimir Region	-	-	-	-	21	625
Volgograd Region	-	-	-	-	1	26
Voronezh Region	-	-	1	61	2	180
Yaroslavl Region	-	-	2	120	5	247
Total	12	1252	56	2722	78	3767
	20*	2180*				

* - conventionally-successful releases

Table 1 - Results of Russian desman reintroduction projects

In other cases the reasons for the failure are attributed to economic activity and poaching. For instance, Russian desmans released at the banks of the rivers Lunka (the Yaroslavl Region) and Irpen (the Kiev Region) died out after the areas had been drained for agricultural uses. SAKHNO (1967) indicates that the same situation took place in a few other release sites in the Ukraine. Reintroduction attempts made in some areas of the Kuibyshev, Dnepropetrovsk and other regions ended in failure as illegal fishing with anchored nets was a widespread activity there. According to BORODIN (1963), the Russian desman population along the river Samara was almost wiped out by fishermen.

The reasonably large number of animals released is undoubtedly a prerequisite to the success of a reintroduction project. All projects with few animals released either failed or the results of them remain unknown.

In most cases, the failure was the result of the interaction between a variety of factors, human activity playing the leading part.

From the above it might be assumed that despite the great number of attempts good results have been few and far between. As a rule a considerable increase in numbers was observed in the first years after the release. It was concluded that the release was a success, and new groups of animals were being released in the same place. But, very often, the opposite situation occurred during the ensuing years and, in some cases, the Russian desman disappeared completely from the release sites, after all. Only 12 out of 165 releases (7,3 %) can be considered successful now.

Reintroductions and introductions of the Russian desman were not supported by any grounding in theory and were conducted using trial-and-error, and this has been the main reason why half-a-century of efforts have not been more successful. Nonetheless, broad experience on catching, keeping in captivity, transporting and releasing animals have been gained. This experience will undoubtedly be of use for future reintroduction projects which should be preceded by a thorough examination of habitats and be compatible with regional programs of economic development.

3. Hunting

In the past, the Russian desman was plentiful in Russia and was hunted on a large scale for commercial purposes. For example, from 1817 to 1819 Russia exported 325500 furs to China; and 100,000 furs were sold to the home market at the Nizhni Novgorod Fair in 1836 (KAPLIN 1960). The great demand for Russian desman furs resulted in a sharp decrease in numbers of the animal. From 1892 onwards some measures were taken to restrict the hunting but proved to be ineffective. In 1920 hunting was abolished but that did not improve the situation either. In 1923 and 1925, at least 9,200 Russian desmans were killed. In 1933 hunting was permitted and then abolished again from 1934 on. Between 1940 and 1956 only hunting under licence was permitted. BORODIN (1963) referred to a total culling of 175858 animals for this period. The numbers of Russian desmans continued to drop and from 1957 hunting was banned again. As large scale fishing with nets was permitted over the major part of the Russian desman's distribution area, the Russian Hunting Management Department allowed official bodies in charge of fur purchases to buy furs of accidentally killed animals. From 1957 onward the Russian desman appeared only as 'unintentionally killed' in hunting statistics.

In 1975, the Russian desman was included in the USSR Red Data Book and became a strictly protected species. It meant, however, that it was no longer included in the list of game, and regional control hunting organizations were no longer in charge of the census work. It was also excluded from the Fur Price List, and fur-storing offices could no longer purchase Russian desman furs from hunters and fishermen. Consequently, there is no way

of monitoring the Russian desman population, as census work is now conducted only by researchers in rare regions. Elimination of the species from hunting statistics only creates the illusion that it is well protected but, actually, it rules out the possibility of obtaining the small amount of information which we used to have.

There have also been some changes for the better. Owing to including in the Red Data Book, better protection has been afforded for the Russian desman. The USSR Law on Conservation and Sustainable Use of Wildlife adopted in 1980 provides higher personal and collective responsibility for the direct killing of animals included in the Red Data Book, as well as for the alteration of their habitats. Studies on the "Red-book" species receive wide recognition as one of the topical areas in current research and secure the financial backing of the government.

4. Current threats

Russian desman numbers continue to drop. The estimation of current numbers for the whole population is 40-50 thousand individuals, i.e. 30-40 % less than they were in 1970.

The Russian desman's distribution area has generally changed: some populations have vanished and some new ones have appeared due to releases made in the areas where the species used not to occur.

Economic development and man's encroachment upon natural habitats are the causes which affect the Russian desman as well as many other species. The land privatization process, hydroelectric power station construction, fishing with immovable fish-nets (anchored and fastened on the riverbanks), and grazing are the main threats which lead to the decline of suitable bottom-land habitats throughout the distribution area. Therefore, conservation of bottom-land habitats is crucial for the future of the Russian desman. But for a real success in a conservation and land management policy, it is extremely important to achieve compatibility of economic development with the natural functioning of ecosystems.

Population distribution and development

The Russian desman population trend shows a progressive drop in numbers. Human activity appears to have been the main factor affecting population and distribution area developments.

In the Dnieper basin Russian desman numbers have halved within the last two decades. In the Don and Volga basins the distribution area has split up and the population has decreased two by thirds over the past thirty years. In the Ural basin, the major area is situated on the border between Russia and Kazakhstan, and the population is relatively stable. In Western Siberia, the Russian desman population established by introduction shows an increase in numbers.

Russian desman numbers in the original distribution area of the species has dropped, on the average, by two thirds, and add up to 40 000 individuals.

Destruction and alteration of the habitat

Destruction and reduction of the size of the habitats are caused by various factors, and namely:

- **construction of hydroelectric power stations** poses a threat to the continued existence of the species in some regions where reservoirs have been made (the Volga-Kama region, etc.);

- **draining of lands** for agricultural uses leads in some cases to the total destruction of the Russian desman populations;
- **water pollution** from industrial sources often turns the small rivers into gutters with no organisms living in.

Alteration and regression of the habitat are usually associated with:

- grazing on the banks of rivers and reservoirs;
- ploughing up bottom-lands;
- reductions in areas of shrub vegetation.

These land-use changes lead sometimes to the complete disappearance of the species in the region in question.

Direct kills

No precise data exist on deliberate killing.

Lots of Russian desmans are known to die in anchored fish-nets. The number of deaths caused by fishing is sometimes so considerable that populations become in danger of disappearance in the areas where this problem is particularly pressing.

Some of the Russian desman populations are adversely affected by the **introduction of the muskrat** (*Ondatra zibethicus*). Russian desmans comprise up to 25% of the animals killed in the traps set for muskrats. There is a need in areas where the Russian desman is present, to change the forms of fishing and catching muskrats so that they should not harm the animal.

5. Conservation measures

Protected natural areas are of primary importance in the conservation of the Russian desman. On the territory of the former Soviet Union, there are 5 strict nature reserves - "zapovednik"[1] (four in Russia and one in the Ukraine) and 80 "zakazniks"[2] where the species is present. They occupy an area of 10 000 sq.km. (4 000 sq.mi.) which is not large when compared with the range of the species but more than 30% of the whole population live there. In some regions, the Russian desman has survived only in the "zakazniks".

The state of a Russian desman population can be improved by a number of means. Among them there are:

(1) the plantation of shrubs and the building of various shelters on the riverbanks with poor vegetation;

(2) rafts and hollow trunks of trees can be used in order to prevent the animals from being swept down by spring floods (Fig.2);

(3) the replacement of muskrat kill traps by live traps. Figure 3 demonstrates a round funnel submarine trap with wire screen sells of 45x45 mm.

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[1] "zapovednik": a research reserve with the protected territory completely excluded from any human activity except scientific and, in some cases, environmental education programs.

[2] "zakazniks": a natural area set up to ensure protection of one or more components of the natural complex within which specific types of activity are regulated or not allowed.

(4) when fishing in rivers where Russian desmans live, seines or nets with sells of a large size (50x50 mm or bigger) should be used.

A combined program of conservation should be implemented to reverse the current situation with the species. On the first stage: (1) a thorough examination of appropriate habitats; (2) the establishment of wildlife reserves specifically for the Russian desman; (3) the development of breeding-in-captivity techniques. (4) research about numerical population tendencies, current distribution and other aspects.

On the second stage: (1) to establish breeding centres; (2) to carry out reintroduction projects; (3) monitoring and compiling the cadaster of the Russian desman populations. These considerations are summarized pictorially in Figure 4.

Introductions and reintroductions of the Russian desman that were carried out from 1929 till 1977, have been much responsible for the current distribution area of the species. Altogether, 10 000 animals have been released. 32 releases have been successful, 56 ones have ended in failure, and the results of 78 remains unknown. The most successful project is considered to have been the release of Russian desmans in Western Siberia, along the river Uy, which has resulted in the establishment of a new healthy population.

The reasons for the failures are economic activity, poaching, an unfortunate choice of release sites, and to not enough animals being released.

In the future, reintroduction projects must of necessity be preceded by the inventory of habitats and be compatible with long-term regional programs of economic development.

The **strategy for the Russian desman conservation** involves research into some aspects of the species' biology, the breeding-in-captivity problem, and the set of conservation and reintroduction measures.

The following tasks of paramount importance are worth stressing in this context.

1. Conducting of an examination and inventory of habitats suitable for the Russian desman.

2. Compilation of the Russian desman cadaster.

3. Discovering and preservation of the major areas where the Russian desman is present.

4. Selection of several areas which may serve as natural "genetic banks".

5. Development of techniques for breeding Russian desmans in captivity.

6. Preparation of legislation concerned rules of fishing with nets.

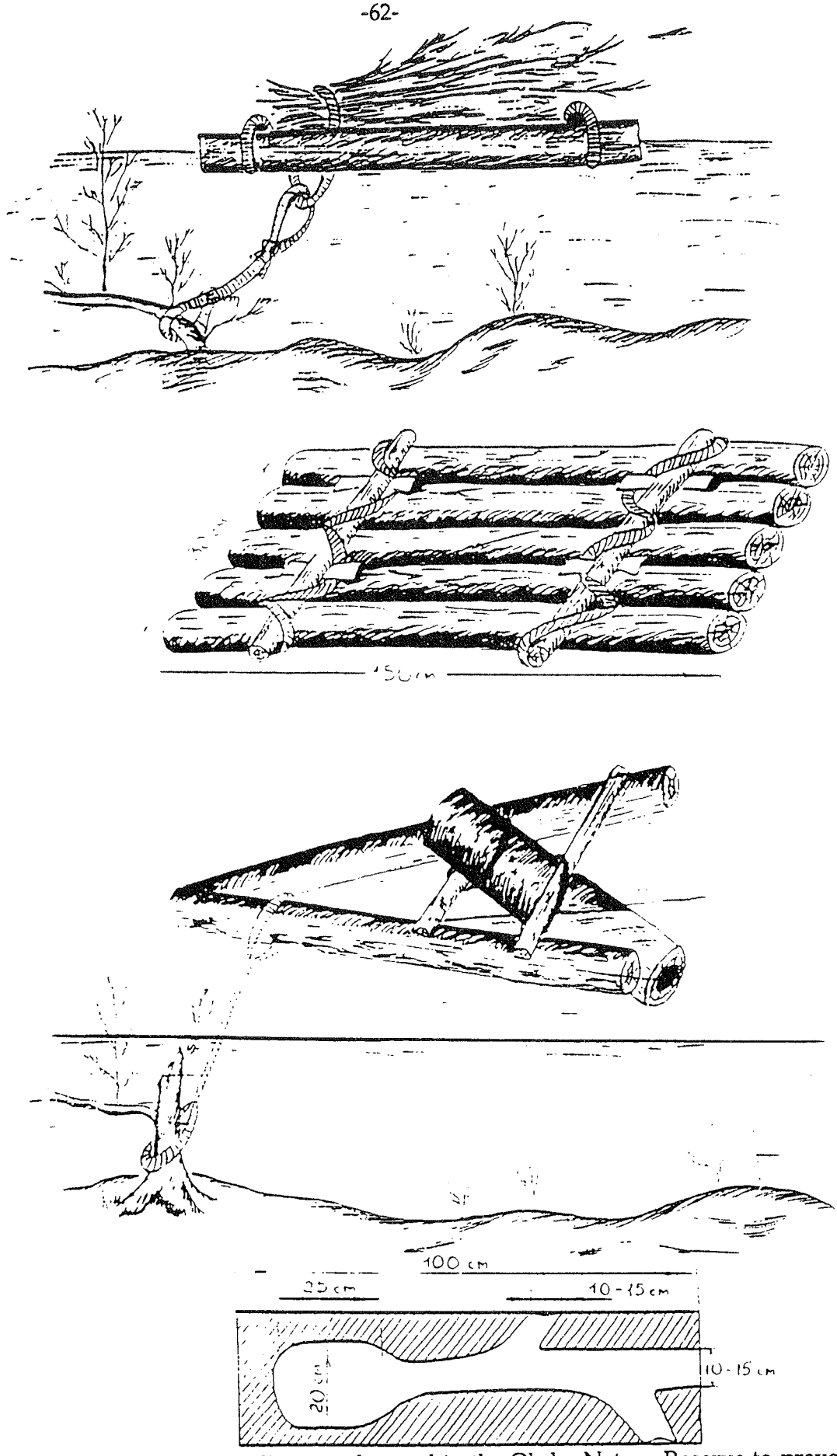

Figure 2 - Rafts of logs and hollow trunks used in the Oksky Nature Reserve to prevent Russian desmans from being swept away by the floods.

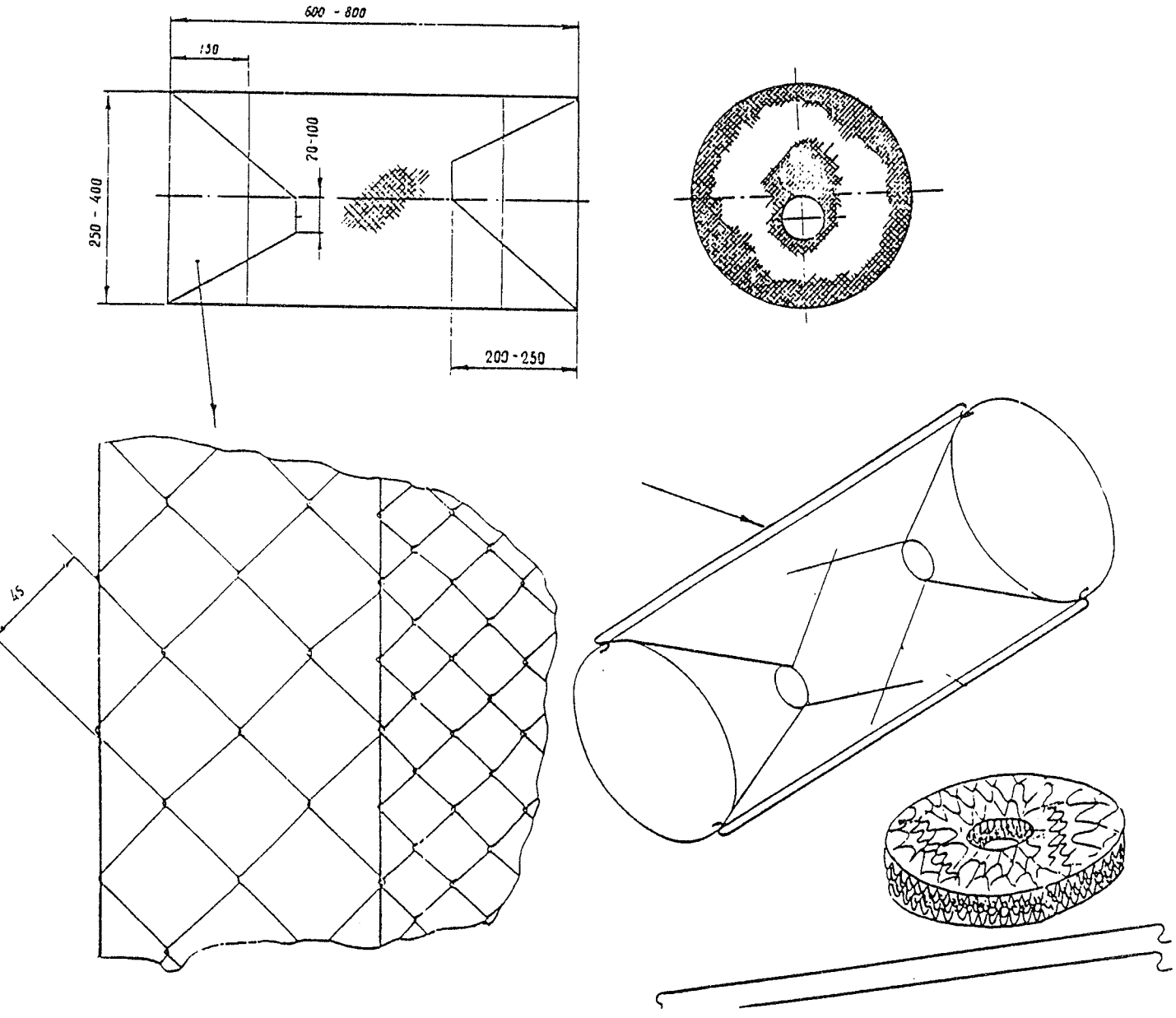

Figure 3 - Round funnel submarine trap

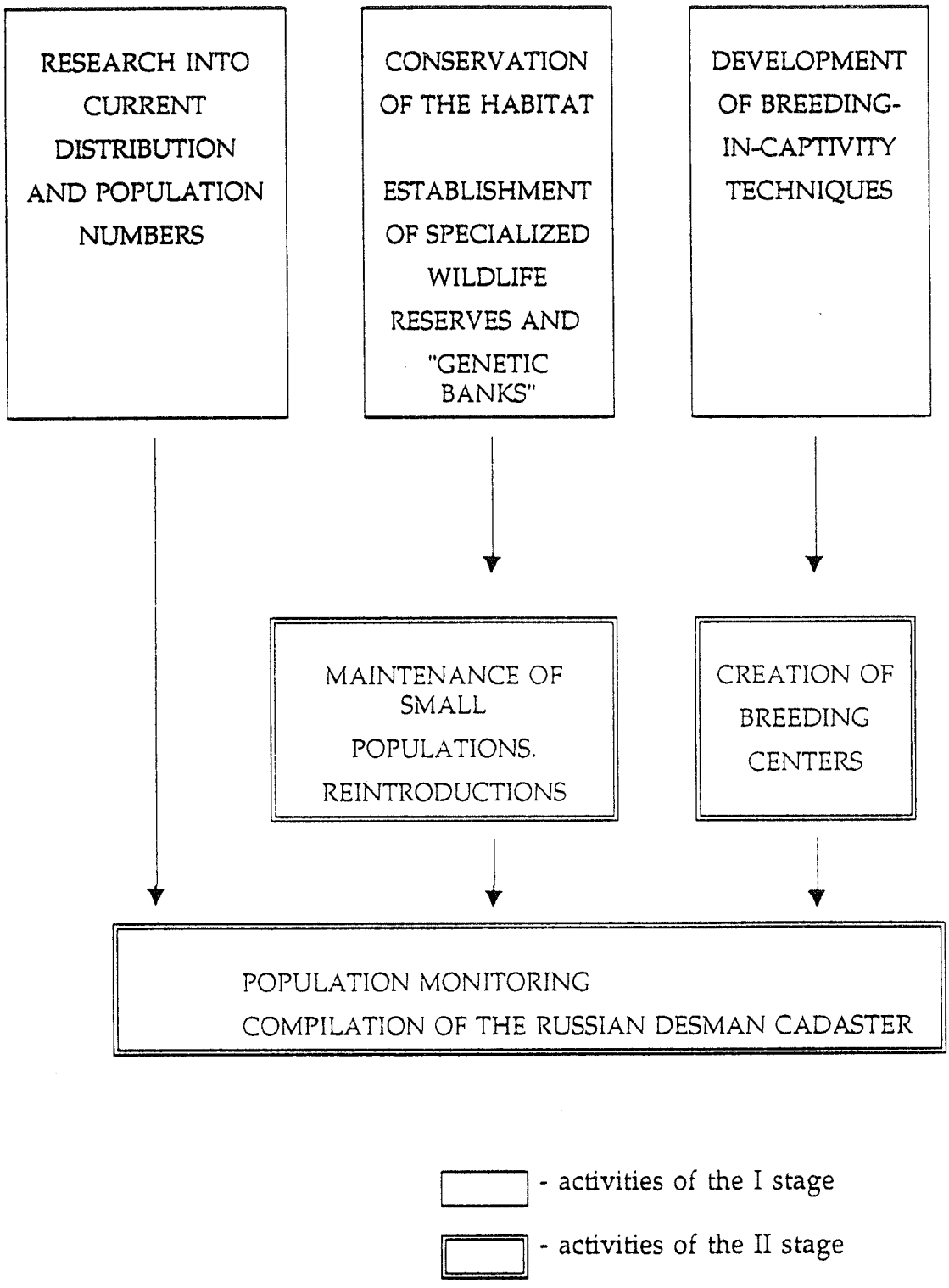

Figure 4: The scheme of activities on the Russian desman conservation

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CONCLUSIONS

After review the published and unpublished data on the status and conservation of the Pyrenean desman (*Galemys pyrenaicus*) and Russian desman (*Desmana moschata*), the following points should be stressed:

1. The DESMANINAE is a relict group of aquatic insectivores, a heritage of the ancient European fauna, that are currently **threatened;**

2. The IUCN Red Data Book places these two species in the **VULNERABLE** category, what which seems relatively consistent with the National status attributed for each country;

3. The current distribution of these two species shows its **endemic** characteristic: *Galemys pyrenaicus*, from the Iberian Peninsula and the Pyrenean region, and *Desmana moschata* from the Eastern Europe;

4. Changes in the naturalness of their aquatic environments, namely in their hydrobiological features, are responsible for the disappearance of these species from a significant number of places; this stresses their **bio-indicator** characteristic;

5. Biological knowledge of these two species is very scarce - **priority studies** concern ecology, reproduction, genetic, physiology and behaviour.

a) with *Galemys pyrenaicus*,which was largely ignored in the past, all the field methods on catching, handling, marking and surveying need to be improved in order to obtain accurate population parameters;

b) with *Desmana moschata*, which was legally hunted in the past, and for which data exist on population parameters, the major urgent needs concern updating distribution and evaluating optimal habitats;

6. Only with a **global conservation policy for the ecological aquatic units** - the river basins - will successful conservation of these species be achieved. In this context, management and restoration should be performed taking desmans into account.

7. Concerning international protection legislation:

a) *Galemys pyrenaicus* must be considered as **priority species** of the annexe II of EC Habitats Directive;

b) *Desmana moschata* must be considered as **strictly protected species** and included in the annexe II of Bern Convention.

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ANNEXE I

QUESTIONÁRIO SOBRE O ESTATUTO E A CONSERVAÇÄO DA TOUPEIRA-DE-AGUA (*Galemys pyrenaicus*)

(Portugal e Espanha)

Para remeter a: Ana Isabel QUEIROZ
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Telefax: 351-1-574771

Para cada uma das respostas, indique qual a resposta correcta e complete com os seus comentários numa folha separada, mencionando o número da respectiva pergunta.

Se näo gosta de questionários, pode ler as questöes e dar o seu parecer sobre a evoluçäo da distribuição e as necessidades de conservaçäo da espécie da forma que lhe for mais agradavel.

Pode responder em português ou em espanhol.

REFERÊNCIAS

Nome:

Endereço:

Tel: *Telefax:*

1. DISTRIBUIÇÄO

1.1. Tem conhecimento de trabalhos em curso no seu país (ou na sua regiäo) sobre a distribuição e o estatuto da toupeira-de-água?

sim *näo*

Se tem informações sobre um trabalho em curso, indique:

** os nomes e endereços dos responsaveis por esse estudo.*

** o objectivo (por exemplo, pesquisa histórica, actualizaçäo da área de distribuiçäo, acompanhamento das populaçöes naturais)*

** métodos utilizados (por exemplo, pesquisa bibliográfica, inquéritos, prospecçöes de terreno, animais mortos, observaçöes)*

1.2. Tem conhecimento sobre a evoluçäo recente da distribuiçäo da toupeira-de-água no seu país (ou na sua regiäo)?

sim *näo*

Se sim, precise:

** a tendência da evoluçäo: desaparecimento - regressäo/fragmentaçäo - sem alteraçäo notavel - expansäo*

** as regiöes a que a sua resposta diz respeito; se possivel, junte uma carta*

** fontes de informaçäo*

2. AMEAÇAS E CONSERVAÇÄO

2.1. Na sua opiniäo a espécie é:

näo ameaçada *näo existem informaçöes precisas* *existem certas ameaças*

Se identifica algumas ***ameaças****, indique as fontes e as regiöes a que dizem respeito:*

2.1.1. Alteraçöes do habitat

a. Qualidade da água / Poluiçäo orgânica / Poluiçäo química

b. Margens / Destruiçäo da vegetaçäo ripícola

c. Leito / Extracçäo de inertes

d. Obras hidraulicas (mini-centrais, barragens, regularizaçäo)

e. Quantidade de água / captaçäo / condiçöes climáticas-seca

2.1.2. Fragmentaçäo das populaçöes

a. Factores genéticos

b. Factores demográficos

2.1.3. Doenças

2.1.4. Outras ameaças

2.2. Conhece áreas que deveriam merecer especial atenção tendo em vista a Conservação desta espécie ?

sim *näo*

Se sim, precise:

** razões por que lhe parecem particularmente interessantes (a espécie é bastante abundante; a espécie encontra-se em regressäo acentuada mas a tendência pode ser revertida; nucleo populacional isolado / limite da área de distribuição, etc.).*

** se possivel, junte uma carta.*

2.3. Conhece alguma campanha de informação ou programa de educação do público que tenha incluido referências a esta espécie?

sim *näo*

2.4. Conhece outras publicações científicas sobre a toupeira-de-água que näo constem da lista em anexo ?

sim *näo*

Se sim, indique:

AUTORES, ano, título, revista, nº de páginas para revistas/nome do editor para os livros

Muito obrigado.

ANEXOS:

1. Lista de artigos e publicações científicas sobre a toupeira-de-água.

2. Lista de investigadores e instituições aos quais foi enviado este inquérito.

ANNEXE II

BIBLIOGRAPHIC REFERENCES ABOUT *GALEMYS*

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Desmans are semi-aquatic insectivora comprising two species: the Pyrenean desman *Galemys pyrenaicus* and the Russian desman *Desmana moschata*. The Pyrenean desman inhabits the north of the Iberian Peninsula and the Pyrenean range. The Russian desman is present in a large area that includes part of Russia, Belarus, Ukraine and Kazakhstan.

This report presents the main features of their biology, distribution and causes of decline, proposing some conservation measures.

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