

# The Iberian desman *Galemys pyrenaicus* (É. Geoffroy Saint-Hilaire, 1811) in Portugal: status and conservation

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Muturluzea *Galemys pyrenaicus* (É. Geoffroy Saint-Hilaire, 1811) Portugalen: estatusa eta kontserbazioa

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## ABSTRACT

The Iberian desman *Galemys pyrenaicus* (E. Geoffroy Saint-Hilaire, 1811) is protected by law and classified as Vulnerable in the Portuguese Red Data Book. Although no national surveys have been conducted since the first survey (1990-1996), the available data indicate that there may be less than 10,000 adults in the Portuguese population, following contractions along the periphery of their range in Portugal. The Iberian desman is threatened mainly because it is bound to a vulnerable habitat restricted in a geographic area in the north of the country, characterized by higher altitudes, permanent water regime and higher water quality. Its main threats in Portugal have been the reduction of water quality, habitat degradation, and the use of impacting fishing methods (nets, poisons and explosives). The species is now faced with new threats including predation by exotic species, increasing habitat fragmentation and loss caused by the construction of hydroelectric infrastructures. The great challenge for the conservation of the Iberian desman in Portugal is the compromise between biodiversity and natural habitat protection and the use of water for hydroelectric power. If the present course of environmental and energy policies are maintained, there is no guaranty that enough water basins will be preserved to prevent the fragmentation of Iberian desman populations and the consequent loss of genetic variability.

**KEY WORDS:** Conservation, habitat, *Galemys pyrenaicus*, Portugal, status.

## RESUMEN

En Portugal, el desmán ibérico *Galemys pyrenaicus* (E. Geoffroy Saint-Hilaire, 1811) está protegido por la Ley y clasificado como Vulnerable en su Libro Rojo nacional. Aunque no existen estudios nacionales llevados a cabo desde el primer sondeo (1990-1996), las estimaciones indican que su cifra es menor de 10,000 adultos en la población portuguesa, debido a la disminución en la periferia de su área de distribución en Portugal. El desmán ibérico está amenazada principalmente porque está ligado a un hábitat vulnerable restringido a un área geográfica muy concreta en el norte del país, caracterizada por altas altitudes, régimen permanente de agua y una alta calidad del agua. Sus principales amenazas en Portugal han sido la reducción de la calidad del agua, la degradación del hábitat, y el uso de métodos agresivos de pesca (redes, venenos y explosivos). La especie se enfrenta ahora a nuevas amenazas como la depredación por parte de especies exóticas, el aumento de la fragmentación y la pérdida de hábitat causada por la construcción de infraestructuras hidroeléctricas. El gran desafío para la conservación del desmán ibérico en Portugal es la coexistencia entre la biodiversidad y la protección del hábitat natural y el uso de agua para la energía hidroeléctrica. Si se mantiene el rumbo actual de las políticas de medio ambiente y energía, no existen garantías de que las cuencas hídricas vayan a ser preservadas para evitar la fragmentación de las poblaciones de desmán ibérico y su consiguiente pérdida de la variabilidad genética.

**PALABRAS CLAVE :** Conservación, *Galemys pyrenaicus*, hábitat, Portugal, status

## LABURPENA

Portugalen, muturluzea *Galemys pyrenaicus* (E. Geoffroy Saint-Hilaire, 1811) Legeak babesten du eta Estatu mailako Liburu Gorrian kalteberatasuneko sailkapena du. Lehen azterketatik (1990-1996) egindako Estatu mailako ikerketarik ez dagoen arren, estimazioen arabera, haien kopurua 10.000 heldu baino gutxiagokoa da Portugalgo populazioan banaketa-eremuko periferian gertatu den jaitsiera dela eta. Muturluzea herrialdearen iparraldeko oso eremu zehatzera mugatuta dagoen habitat kalteberari lotuta dagoelako dago batez ere mehatxatuta. Hango ezauzgarri nagusiak dira honako hauek: altitude altuak, uraren etengabeko erregimena eta uraren kalitate handia. Portugalgo mehatxu nagusiak honako hauek izan dira: uraren kalitatea gutxitu izana, habitataren degradazioa eta arrantzako metodo agresiboak erabiltzea (sareak, pozoiak eta lehergaiak). Espezieak orain mehatxu berriei egin behar die aurre: espezie exotikoen predazioa eta azpiegitura hidroelektrikoak eraiki izanak eragindako habitataren galera eta haustura ugari izana. Portugalen, muturluzea zaintzeko erronka nagusia bioaniztasunaren eta habitat naturalaren babesaren, eta energia hidroelektrikorako uraren erabileraren arteko baterako existentzia da. Ingurumen- eta energia-politiken egungo bideari jarraituz gero, ezingo da bermatu arro hidrikoak zaindu egingo direnik muturluze-populazioaren zatikatzeta saihesteko eta horrek dakarren aldagarritasun genetikoaren galera ekiditeko.

**GAKO-HITZAK:** Kontserbazioa, *Galemys pyrenaicus*, habitata, Portugal, estatusa.

## SPECIES ECOLOGY

In Portugal, the Iberian desman *Galemys pyrenaicus* (E. Geoffroy Saint-Hilaire, 1811) is confined to small mountain streams with fast flowing cold water, matching the trout or salmon areas. The available data indicate no presence of the species in rivers and streams of permanent flow but excessive depth, high sedimentation and / or lack of river bank shelters along considerable extensions. Other unsuitable habitats include watercourses of intermittent nature that are physically or ecologically isolated; small coastal streams flowing directly into the sea; sections of rivers that show a high degree of pollution (organic or chemical); or lentic habitats, such as dams and natural ponds at high altitude (e.g. lakes of Serra da Estrela, central Portugal) (Queiroz *et al.*, 1998). At a micro-habitat level, sections of running water with shallow depth and the existence of riverbanks shelters (e.g. root systems associated with tree and shrub vegetation, stone banks and walls, or other underground cavities) are singled out as requirements for Iberian desman presence (ICN, 2006).

In Portugal the main studies on the species were conducted through a LIFE program - Natural habitats and flora species of Portugal (1994-1997), conducted by the Instituto da Conservação da Natureza e da Biodiversidade (presently the Institute for the Conservation of Nature and Forests - ICNF - the national state institute responsible for nature conservation). From this resulted the reference document for the species in Portugal, namely the Bases for the Conservation of the Iberian desman *Galemys pyrenaicus* ("Bases para a Conservação da Toupeira-de-Água") (Queiroz *et al.*, 1998). The major outputs of this study were the knowledge on the desman distribution and the identification of important sites for the conservations of existent desman populations. Earlier studies addressed in detail the characteristics of the riverbank vegetation and the water quality used by desman populations (Ramalhinho & Tavares, 1989) and other morphological and biological descriptors of their habitat (Queiroz, 1991). Queiroz *et al.* (1998) confirmed that the Iberian desman prefers small mountain streams with fast flowing, cold and clear water. It preys mainly on the larvae of aquatic invertebrates, using riverbanks for shelter.

Studies in Sabor and Paiva River (Douro basin) described densities of around 5-10 individuals per km (Quaresma *et al.*, 1998; Chora, 2001). However, others suggest that the species can occur in lower densities (Silva, 2001). Additionally, these studies have shown that individuals have reduced vital areas ranging from a 300 to 450 m stretch of river for resident females and males, up to 600 m for transient individuals of both sexes (see review in Chora, 2002).

There are also several studies on the species related to small hydroelectric infrastructures. Chora (2001) confirmed the species' capability to traverse the Fráguas small hydroelectric plant (Rio Paiva Douro basin), using the existing fish ladder and a watermill channel located in one side of the plant. In a subsequent study in the Nunes small hydroelectric plant (Tuela River) one animal was detected using the

fish ladder but with no successful crossing (Chora, 2002). This fish passage was only functional during a short time in the day, outside the typical period of desman activity. Furthermore, the prohibitory length of the fish ladder (a total of 45 successive basins with a total length of 95 m) represents a high energy cost for individuals. Therefore, although fish ladders can be used occasionally by the species, their suitability is limited (Chora, 2002).

According to Marcos (2004), the small hydroelectric plants in the Andorinhas stream (Sabor basin) affected the species in several ways: creating a barrier to the dispersal of individuals, altering the macroinvertebrate community, decreasing food availability, and reducing the availability of potential habitat.

The last published study on the species including Portugal was conducted by Barbosa *et al.* (2009). These authors modelled 10×10 km presence/absence data from Portugal (Queiroz *et al.*, 1998) and Spain using 23 predictor variables related to different macro-environmental factors affecting desman distribution, extrapolated each model to the other country, and compared predictions with observations. The model for Portuguese territory predicted that Iberian desman distribution on a wider scale was influenced by variables related to geographical location (e.g. latitude and slope), humidity and precipitation, and disturbance (distance to large towns).

## STATUS AND DISTRIBUTION

In Portugal, the Iberian desman is protected by law (DL nº 140/99 and DL nº 49/05 of the Habitats Directive 92/43/CEE, and DL nº 316/89 of the Bern Convention) and is classified as Vulnerable (VU) in the Portuguese Red Data Book (Cabral *et al.*, 2005). This classification was justified by the overall desman population estimate of less than 10,000 mature animals and a possible decline of at least 10% in the last decade, with isolated sub-populations of less than 1,000 individuals (Cabral *et al.*, 2005). Additionally, the majority of these sub-populations do not exceed more than a few hundred individuals and some isolated populations only have a small number of animals.

Iberian desman distribution in Portugal is conditioned by the present potential habitat for the species, mostly located in higher altitudes, with permanent water regime and higher water quality, including the water basins of the north of the country.

### Past situation

Data from the national monitoring programme conducted in the 1995 and 1996 and additional available field data from 1990 to 1996 showed that in Portugal the Iberian desman occupied the river basins situated north of Douro River (Minho, Âncora, Lima, Neiva, Cávado, Ave and Leça river basins), most of the main Douro river sub-basins, the medium and upper areas of Vouga and Mondego river basins, and the upper section of Zêzere River (Tejo basin) (Queiroz *et al.*, 1998) (Fig. 1).

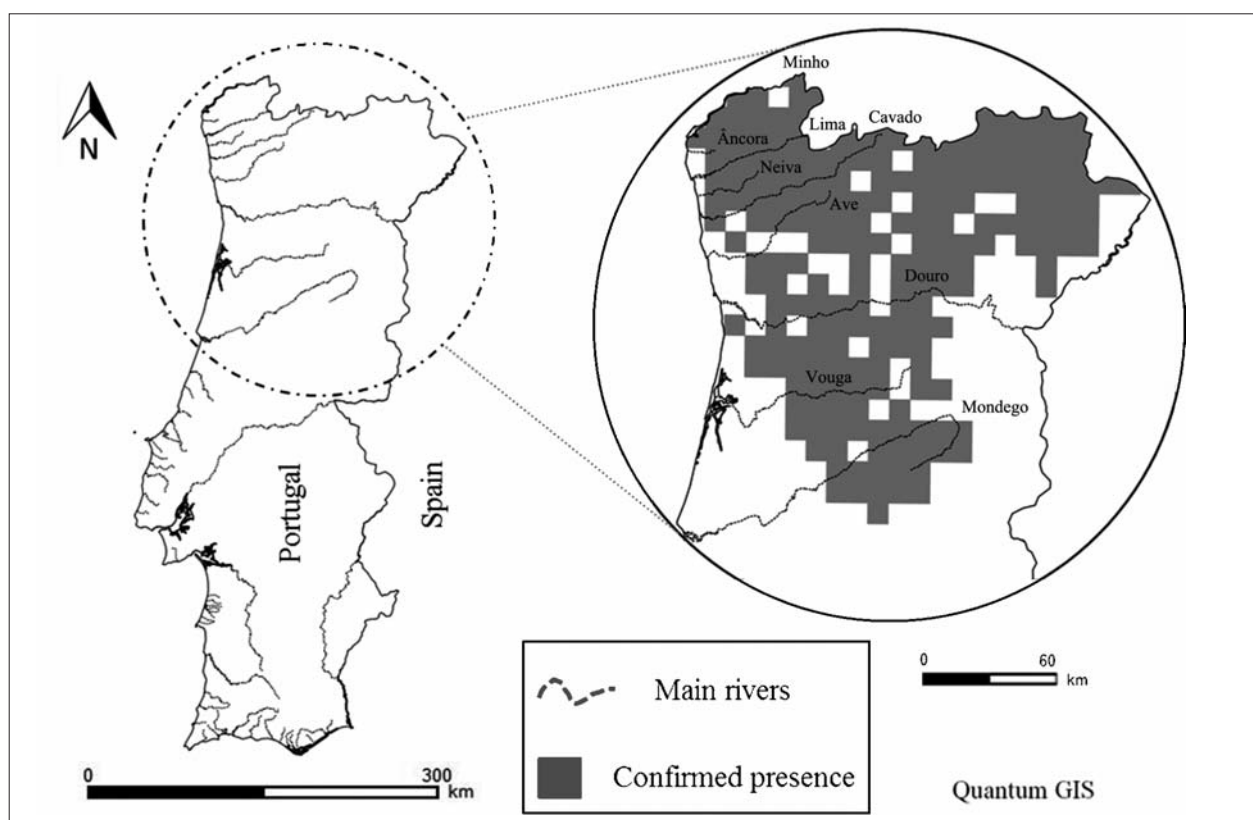


Fig. 1. - *Galemys pyrenaicus* distribution in Portuguese territory 1990-1996 (10x10 km UTM, adapted from Queiroz *et al.*, 1998).

Fig. 1. - Distribución de *Galemys pyrenaicus* territorio portugués en 1990-1996 (10x10 km UTM, adaptado de Queiroz *et al.*, 1998).

### Current situation

In the revision of the Portuguese Red Data Book (Cabral *et al.*, 2005) it was suggested by the ICNF a regression of the desman distribution area and the fragmentation of several populations in the country. This was based on additional monitoring done in 2000/2001 on national protected areas and other supporting information. Although no mapping of this distribution is available, the new evaluation states that the population decline has been accompanied by a loss of peripheral populations along the western, southern, and eastern edges of the Iberian desman range in Portugal (Cabral *et al.*, 2005). This regression was apparent in several river basins situated in its western range (Áncora, Cávado, Ave, Douro and Vouga), being more evident in the left bank Douro River sub-basins (Tejo basin - Zêzere River; and Mondego basin - Alva River). The decline of desman populations due to habitat fragmentation also occurred in other streams, mainly in Lima and Cávado rivers (Quaresma, 2001).

No national surveys have been conducted for the Iberian desman in Portugal since the 90's (Queiroz *et al.*, 1998), nor regional or local monitoring since 2000/2001. As a result there is no overall data to compare or estimate trends in species distribution or populations. However, it is expected that the regression that the species faced in

the last decade is still ongoing as the causes of population decline identified in previous surveys are still present with additionally new threats emerging.

### THREATS AND REGRESSION CAUSES

The Iberian desman is threatened mainly because it is bound to a specific (and vulnerable) habitat within a restricted area.

Human disturbance is a key threat, resulting in aspects such as water organic and chemical pollution, destruction of riverbanks natural, and restriction of water flow, gravel and sand extractions. Also the use of nets, poisons and explosives as fishing methods or the direct persecution from fishermen who mistakenly believe the species competes for fish stocks are among these human threat factors. These direct and indirect actions on the stream morphology, hydraulic regime and water quality compromise not only desman habitat and shelter availability but also food availability (Cabral *et al.*, 2005).

The construction of hydroelectric infrastructures has a major impact on the quantity and quality of suitable Iberian desman habitat and is a matter of concern regarding the species conservation. Portugal has more than 160 working large dams and there are plans for at least 10 more in the near future.

As a protected species, the desman is targeted for impact assessment studies and development of mitigation and compensation measures. Recent studies on Iberian desman have been conducted in the context of environmental impact assessments for large dams located in the north of Portugal (e.g. Sabor, Foz Tua, Padroselos, Gouvães, Daivões and Alto Tâmega dams). These studies address already known impacts on the Iberian desman ecology. Increasing water depth, altering a lotic environment into a lentic one and the consequent modification of substrate granulometry are some of the changes imposed upon the formation of a reservoir of a large dam. These changes will consequently affect food availability for desmans, with the species facing a modification of benthic macro invertebrate community. The uniform structure of these new habitats provides few places for shelter and refuge from predators. Furthermore, the construction of hydraulic and hydroelectric projects in a watercourse will cause habitat fragmentation, creating areas with unfavourable features or insuperable barriers, leading to population isolation. Consequently, the viability of these small populations may then be affected by demographic and / or genetic factors.

So far, the studies conducted in Portugal suggest that the dams of medium and large size (e.g. height of 10 m and/or extension of reservoir above 1000 m) are likely to have a very significant but negative impact on Iberian desman populations and habitats. Nevertheless, smaller hydraulic and hydroelectric projects can, in some cases, be compatible with the conservation of the species if the projects are optimized and accompanied by appropriate measures to minimize impacts (e.g. fish ladders adapted to the behaviour and motor skills of the species).

Another concern relates to the impact of invasive alien species on local prey and native species (Jaksic *et al.*, 2002). The American mink *Neovison vison* (Schreber, 1777) probably escaped from mink farms in northwest Spain. Since its introduction it is expanding its range and becoming invasive in Portugal (Vidal-Figueroa & Delibes, 1987). First detected in 1985 in the Minho River it is now present in the majority of the region's hydrographic basins: Minho, Lima, Neiva, Cávado, Ave and Sousa (Rodrigues *et al.*, 2014), overlapping part of the Iberian desman distribution. The mink competes (for food and habitat) with the Eurasian otter *Lutra lutra* (Linnaeus, 1758) (Sidorovich *et al.*, 2001), a widely distributed species in Portugal, and although there is a lack of clear proof, the Iberian desman is quoted as possibly vulnerable to mink predation (Bravo, 2007). In the UK, it was proved that mink predation highly augments the probability of extinction of water vole *Arvicola terrestris* (Linnaeus, 1758) fragmented populations (Jefferies, 2003). This predator may be behind a number of the desman's contingent absences in Spain (Barbosa *et al.*, 2009).

## CURRENT AND FUTURE CONSERVATION ACTIONS

### **Monitoring and conservation measures**

The Iberian desman is one of the chosen species for monitoring under the Water Framework Directive, the Ha-

bitats Directive and the Natura 2000 Network as part of the general monitoring of biodiversity in Portugal over the next few years. The species is also targeted in Environmental Impact Assessments of hydroelectric infrastructures in Northern Portugal. Additional information on species distribution and ecology are expected to come from these future studies.

Regarding conservation and management measures, although a National Species Conservation Action Plan specific for the Iberian desman does not yet exist, there are clearly defined guidelines for the species protection, to be applied especially in protected areas of Portugal where the species is present and/or places considered SIC *Galemys* (Important Sites for Conservation of Iberian desman) (ICN, 2006). These include limitations to specific landscape interventions (such as constrain the construction of new dams with significant negative impacts on the species; limit non-naturalisation of the riverbanks and beds of watercourses; limit both water extraction from rivers in the months of lowest flow and extraction of sand and gravel at any time). It is also crucial to prevent the use of illegal methods of fishing and to promote habitat restoration and improved water quality. Moreover, there is the need to consider distribution areas of the species when in Environmental Impact Assessment studies and monitor compliance with mitigation measures, compensation of impacts and monitoring plans contained in the assessments.

Finally, it is very important to promote research on the species, mainly: to assess the effectiveness of mitigation measures for hydraulic and hydroelectric projects - including studies on installed crossing devices; to develop new population estimation methods (e.g. benchmarking, trapping, genetic analysis of spraints for individual identification); to assess the suitability and carrying capacity of aquatic habitats, as well as to determine the minimum viable population and the genetic population variability in different river basins.

### **The challenge of Iberian desman conservation in Portugal**

The baseline for determining protection measures and defining conservation plans for endangered species is the monitoring of present distribution and abundance. Without this information it is not possible to detect a potential trend of population decrease and fragility. Therefore, monitoring surveys should be conducted in the current known distribution area of the Iberian desman.

There are still several aspects of Iberian desman ecology that are rather unknown. Melero *et al.* (2012a) presented a possible new view of the social structure and organization of this species describing a higher frequency of social interactions and highlighting the importance of resting sites in desman social organisation. These preliminary data, if further tested, help in planning studies on population monitoring and abundance data, as well as actions related to habitat management. Also, the expansion of American mink, considered one of the most nefarious invasive species (Melero *et al.*, 2012b), into areas of



Iberian desman distribution needs to be assessed. This small carnivore is one of the most effective invasive species in Europe and, as a consequence, several eradication actions have been carried out so far (Bonesi & Palazon, 2007). Ecological studies in areas where these two semi-aquatic mammals are in sympatry are urgently needed as the Iberian desman population is already fragile and the American mink is known to place strong pressure on small rodent populations in its invasive range (Jefferies, 2003).

The great challenge of Iberian desman conservation in Portugal may be to find a balance between the protection of biodiversity and natural habitats and the use of water for the production of electricity. Portugal has adopted a policy of developing alternative renewable energies to the common fossil fuels, typically involving the construction of small and large hydroelectric power plants and wind turbines. This has created a large debate in Portugal, with all agreeing to the need of reduction of the fossil fuel use, but only some defending the implementation of more hydroelectric projects (due to all its negative impacts in biodiversity), and others fighting for energy efficiency measures and the lowering of the energy needs.

What is clear is that, whenever possible, the implementation of new hydroelectric infrastructures should be done in previously disturbed water bodies as opposed to areas with currently favourable ecological status.

These guidelines, and the suggested conservation measures, should be clearly translated into management plans in order to secure the future of the Iberian desman in Portugal. However, there have been several examples where the necessity for electricity production and development surpassed the interest in the conservation of biodiversity in general, and Iberian desman in particular. Recently, several large dams were built or approved in areas of the species distribution (e.g. Daivões, Alto Tâmega) or in Natura 2000 Network areas (e.g. Sabor Dam, Gouvães Dam). If the present course of environmental and energy policies is maintained, there are no guarantees that enough water basins will be conserved in such a way to prevent the fragmentation of Iberian desman populations and the consequent loss of genetic variability in Portugal.

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