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Age determination of *Galemys pyrenaicus*

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This paper provides a criterion to determine the age of live Pyrenean desmans *Galemys pyrenaicus* (E. Geoffroy, 1811) by observing dental wear. The criterion is based on the comparison of the estimated age by examining the growth rings on dental sections and the wear observed on the upper canine tooth. Bone matter from different areas in the north of Spain was studied. This species has a high life expectancy. In its natural environment, the desman may live to be over 5 years old.

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Introduction

The Pyrenean desman *Galemys pyrenaicus* (E. Geoffroy, 1811) is endemic to the north of the Iberian Peninsula and to the northern slopes of the Pyrenees. This species is considered to be endangered by different legislation and regulations passed by the governments and the European Union. However, there is very little information on this species, which is why its conservation presents a number of problems, as yet to be resolved. It is essential to apply study methods that do not involve killing the animal when dealing with rare or endangered species. For many biological studies it is necessary to know the animal's age. In the case of the desman, it is not possible to establish relative age classes based on external biometric parameters (body mass and length) as the individuals of a population exhibit a high degree of uniformity in body parameters. (González-Esteban *et al.* 1999). The diet of the desman consists primarily of benthic macroinvertebrates, mainly Trichoptera, Ephemeroptera, Diptera and Plecoptera (Castién and Gosálbez 1995), a diet rich in hard matter. We may assume that this diet causes progressive wear on the desman's teeth. After examining bone matter, Richard (1976), reported a relationship between dental wear and age. This researcher used weight and

sexual maturity as the differentiating criteria in determining the relative age of the animals only in terms of two age classes.

The purpose of this study was to provide a criterion to determine the age of live desmans from dental wear. This criterion was based on a comparison of the estimated age by examining the growth rings on dental sections and the wear observed on the upper canine tooth.

Material and methods

The sample analysed consisted of 83 specimens from different areas in the north of Spain (Appendix I). This material correspond to samples collected between 1980 and 1998. The animals were captured using wire-mesh eel traps in streamlets. Trapped animals were immediately killed in compliance with the international policies of animal care and welfare. All of the animals caught are in storage at the Department of Animal Biology at the School of Biology of the University of Barcelona and are available for use in different research projects seeking to maximise the use of the material. The

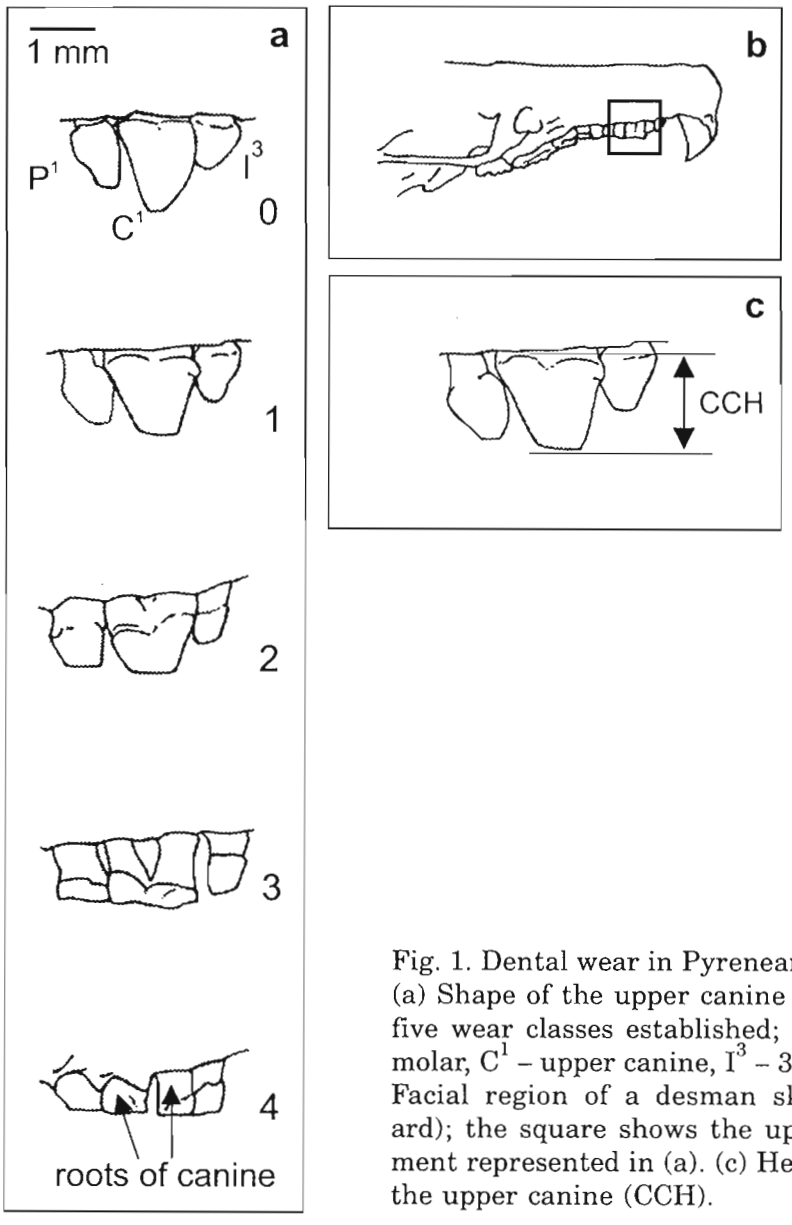

Fig. 1. Dental wear in Pyrenean desmans in Spain. (a) Shape of the upper canine (labial side) for the five wear classes established; P^1 – 1st upper premolar, C^1 – upper canine, I^3 – 3rd upper incisor. (b) Facial region of a desman skull (lateral standard); the square shows the upper maxillary fragment represented in (a). (c) Height of the crown of the upper canine (CCH).

date of capture was recorded for each animal. The evaluation of dental wear was carried out by examining the upper canine tooth, chosen for its size and position in the dental series, which made it possible to record wear in live animals.

We used the index D = (CCH/CBL) × 100, where CCH is the height of the crown of the upper canine (Fig. 1) and CBL is the condylobasal length (measured according to Juckwer 1990). The CCH was measured on the right canine, assuming that both upper canine teeth had equal wear. We observed the wear of the same tooth assigning each individual to one of the following classes: 0 – canine intact or slightly blunted, 1 – the canine has a blunt cusp, with wear affecting about a fourth of the crown, 2 – wear affects half of the crown, 3 – wear reaches the maximum width of the crown affecting approximately three-fourths of the tooth, 4 – total wear of the crown, the two roots of the tooth can be seen separately and are similar in size and shape to incisors 2 and 3 (Fig. 1).

The age of the specimens was determined by counting the growth lines that form on the tooth cementum. Cementum-annulus counts are a reliable technique for estimating age in many mammals species (Klevezal and Kleinenberg 1967, Fancy 1980, Lodal and Grue 1985). We assumed that the lines found in the tooth cementum of the desman pertained to the period of slow growth which takes place during the winter, when food is much scarcer. Moreover, the first growth line was assumed to be formed during the first winter.

The canine and the first premolar on the right hemi-jaw were extracted. The teeth were decalcified in 5% (v/v) HNO_3 and later cut into longitudinal sections 10 μm thick in a freezing microtome. The sections were dyed with Mayer's haemalun and mounted with Canada Balsam.

There is no specific information on the birth season or the duration of the gestation period of these animals, but considering that Richard (1986) observed the greatest number of gestating females in February, March and May and that the gestation period must be similar to that of the *Talpa europaea* (5 weeks; Gorman and Stone 1990), in this paper we assumed that desmans were born between March and June. Taking this period as an initial reference point, in addition to the observation of the growth lines and the information on the date of capture, it was possible to calculate the age of each individual examined. As we were unable to pinpoint the date of birth with greater accuracy, we were forced to express age in four month periods.

Results

The degree of wear seen on the upper canine (index D) correlates strongly with the age of the animals ($r_S = -0.913$, $p < 0.001$, $n = 83$). The sample analyzed was evenly distributed in age from birth to 3–4 years old (Table 1). After this age, the number of animals analyzed decreased sharply. Only one individual was found to reach 5–6 years of age. No differences were found in age structure between males

Table 1. Distribution of the specimens of Pyrenean desman in terms of estimated age by counting growth lines; 18 age classes, each class = 4 months.

Sex	Number of individuals in age four-month classes					
	1–3	4–6	7–9	10–12	13–15	16–18
Males	3	8	8	6	2	0
Females	7	6	5	8	1	1
Unknow	10	9	4	4	1	0
Total	20	23	17	18	4	1
Percent	24.0	27.7	20.5	21.7	4.8	1.2

Table 2. Distribution of the specimens of Pyrenean desman according to their estimated age (in 18 age four-month classes) carried out by counting the growth lines on the tooth cement and the dental wear of the upper canine. 0 – canine intact or slightly blunted, 1 – the canine has a blunt cusp, with wear affecting about a fourth of the crown, 2 – wear affects half of the crown, 3 – wear reaches the maximum width of the crown affecting approximately three-fourths of the tooth, 4 – total wear of the crown, the two roots of the tooth can be seen separately and are very similar in size and shape to incisors 2 and 3 (Fig. 1).

Tooth wear	Estimated age (in periods of four months) by counting growth lines																	
	1st year			2nd year			3rd year			4th year			5th year			6th year		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
0	4	16																
1				2	15	1												
2					3	2	3	1										
3							1	4	5	7	6	1	1	1				
4							1	1	1	1	1	2		2			1	

and females in the sample analyzed here ($\chi^2 = 1.60, p = 0.81$). The animals having a C^1 intact or slightly blunted (class 1) were in their first year of life (Table 2). Animals with a quarter or half of the C^1 crown worn (classes 1 and 2) had already lived through their first winter and were in their second year of life. When dental wear was found to cover the maximum width of the crown or when the crown had disappeared (classes 3 and 4) the desman was at least three years old.

No significant correlation was found between body mass and age ($r_S = -0.133$, $p = 0.390$, $n = 58$; Fig. 2). The body mass of young specimens showed a variation

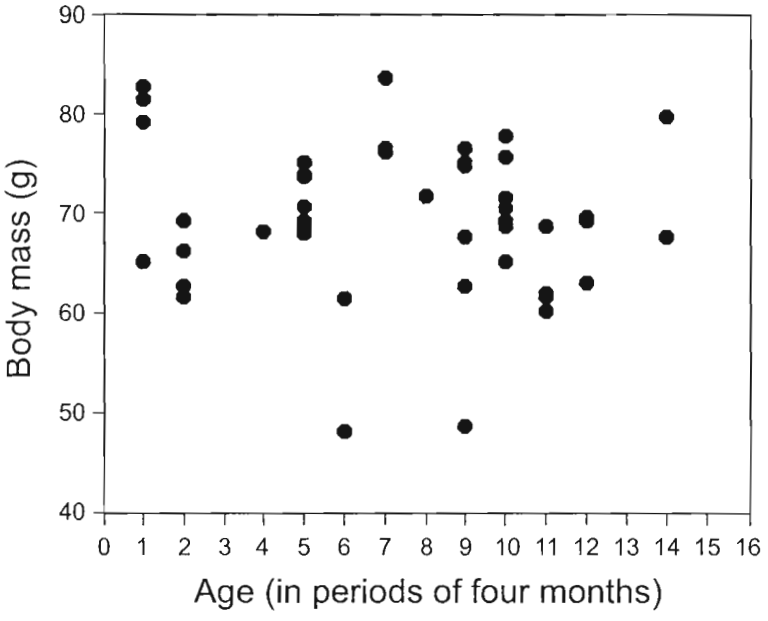

Fig. 2. Body mass of Pyrenean desmans in relation to age.

range similar to that of the adult fraction of the population (adults: mean = 70.6 g, SE = 2.45, range = 61–82, n = 10; young: mean = 69.2 g, SE = 1.01, range = 48–83 g, n = 48).

Discussion

There are only two observations available on the longevity of the desman: Niethammer (1970) kept a male in captivity for 16 months and Richard (1976) recaptured a male 2 years after it had been caught for the first time. Richard (1976) estimated that the species had a longevity of at least 3 years. He reached this conclusion after he had analyzed the correlation between dental wear and the relative age of the animals. Although he did not have the age of the specimens studied, his conclusions have been corroborated by this paper.

Our data reveal that the species has a high life expectancy. In its natural environment, the desman may live to be over 5 years old. Lodal and Grue (1985) have reported a similar longevity in *Talpa europaea* (1 animal reached 6 years of age, n = 426), but only 10% of the animals in the sample were over 3 years old.

The criterion put forth to determine age has led to the establishment of three groups. In the first two groups it is possible to ascertain the year of life the animal is in. If we consider that the life expectancy of the desman is around 2–3 years, this criterion is an appropriate tool for determining the structure of a population without having to sacrifice the animals.

Stone (1987) used body mass as a criterion to estimate the relative age of desmans. Our results showed that young specimens join the population with a mass that is similar to adults, which is why we believe that this parameter should not be used in estimating the relative age.

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Appendix I. Origin of the studied Pyrenean desmans *Galemys pyrenaicus* from Spain.

Province	Location	No. skulls
Asturias	Caleao	1
La Rioja	Aldeanueva de Cameros	1
	San Andrés	3
	Viniegra de Abajo	2
León	Candemuela	6
	San Emiliano	1
Lugo	Barbeitos	1
	San Román	1
	Cadramón	1
Navarra	Akerreta	1
	Aoiz	1
	Garzaron	2
	Guerendiain	1
	Huitzi	2
	Itoiz	1
	Lanz	2
	Orbara	1
	Oricain	1
	Oroz-Betelu	1
	Ostériz	1
	Quinto Real	46
	Ripa	1
	Saigós	1
	Santesteban	4