

## Fossil pardel lynx (*Lynx pardina spelaea* Boule) from a cave in southern France

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A felid skull from the Aven du Puech Margal, St. Jean de Maruejols (Gard) is referred to the large Pleistocene subspecies of pardel lynx, *L. pardina spelaea* Boule. It confirms the presence of pardel lynx in southern France in the late Pleistocene. Some diagnostic characters differentiating the fossil pardel lynx from the equally large *L. lynx* are discussed.

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### 1. Introduction

In a recent exploration of the Puech Margal Cave, M. Bruno Guy discovered a felid skull which was kindly entrusted to us for study. It was found to represent the large extinct subspecies of pardel lynx, *Lynx pardina spelaea* Boule. Material of this form is comparatively rare and no detailed study has been made. The intention here is to put this find on record, to compare it with samples of *Lynx pardina* (Temminck) and *Lynx lynx* (Linnaeus), and to point out some distinctive characters. We wish to thank M. Guy for entrusting us with this task, and for information on the circumstances of the find.

### 2. Locality

The cave of Puech Margal is situated by the river Cèze, Gard. For a description of the cave, see SCSF (1984:37–39), from which the plan (Fig. 1), slightly simplified, is taken. The present entrance to the cave is at its southern end. The lynx skull was found in the "Salle du Crâne" in the northwestern part of the cave, at a depth of 15 m, measured from the entrance. For a photograph of the skull *in situ*, see SCSF (1982:24). The original entrance to the cave, now blocked by rock fall, appears to have been the part named Trémie. The fossil was thus situated only about ten metres away from the original opening into the cave.

In a gallery branching to the south from the Salle du Crâne, fossil deer antlers were found. There are also many traces of Man in the cave, including painted signs, pottery, etc. The site is still being actively researched and it appears that it has been inhabited in Pleistocene as well as in Holocene times.

### 3. Material

The specimen, which will be stored in the Museum of Ales, is a skull without the lower jaw (Fig. 2). The dorsal side is encrusted in a stalagmite which makes it impossible to obtain precise observations on most of the cranial features. The ventral side with the palate and dentition could be studied, and some salient skull width measurements taken. Unfortunately, the hind part of the palate is damaged. Of the dentition, the left I<sup>2</sup> and P<sup>3-4</sup> and the right canine and P<sup>3-4</sup> are preserved; the remaining teeth are represented by alveoli. There are no alveoli for P<sup>2</sup>; this is the typical condition in the genus *Lynx*.

Measurements of this specimen are given in Table 1. The measurements are abbreviated elsewhere as follows:

C-C, rostral width at canines (including bone); P-P, width between outer faces of carnassials; ZW, bizygomatic width. For tooth measurements, L = length, W = width, H = height (measured externally, on unworn teeth only, from basal incurvation to tip of main cusp). Wbl is carnassial blade width, measured at the junction of paracone and metastyle; Lp and Lm respectively, lengths of paracone and metastyle, measured lingually.

For comparison we have used data on recent and fossil *L. lynx* and *L. pardina*; the material is the same as that used by Werdelin (1981). Statistics for these samples are given in Table 2.

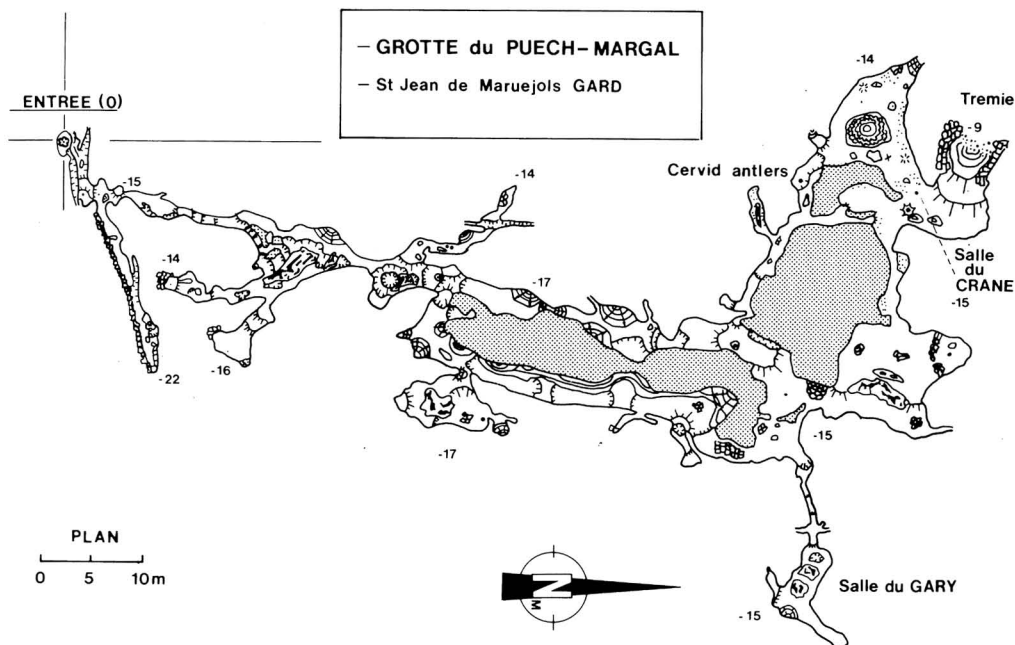


Fig. 1. Plan of Puech Margal Cave showing location of lynx skull in the Salle du Crâne, and close to the original entrance, Tremie. Simplified from SCSP (1984).

#### 4. Identification

The skull represents a fairly large lynx, well within the range of the northern lynx *L. Lynx*. Although the stalagmite masking the dorsal side of the skull makes it impossible to obtain a precise measurement of its length, the prosthion-inion distance appears to be of the order of 155 mm. This is larger than in Recent *L. pardina*; however, it is known that the Pleistocene pardele lynx tended to have larger dimensions than its living descendant (Boule 1910, Werdelin 1981). It is also known that the pardele lynx ranged well into France during the Pleistocene (Kurtén 1968). The possibility of the specimen representing a pardele lynx, rather than a northern lynx, thus had to be considered.

The upper dentitions in the two species differ in minor details but there is considerable overlap in morphological as well as metrical characters. The fossil pardele lynxes from Spain (a sample from Gibraltar and from the Moyá caves) give some information on the large Pleistocene form but even these average somewhat smaller than the present specimen. What is needed is an adequate sample of Pleistocene pardele lynx from the area north of the Pyrenees to furnish a standard of comparison. This is not available at present.

For the present purpose, recourse has been made to a ratio diagram of the dimensions of the teeth and skull recorded in Tables 1–2. The diagram is Fig. 3. In the diagram, means for Recent Finnish *L. lynx* are used as a standard of comparison (100 %) and the means for Recent and fossil *L. pardina*, as well as the

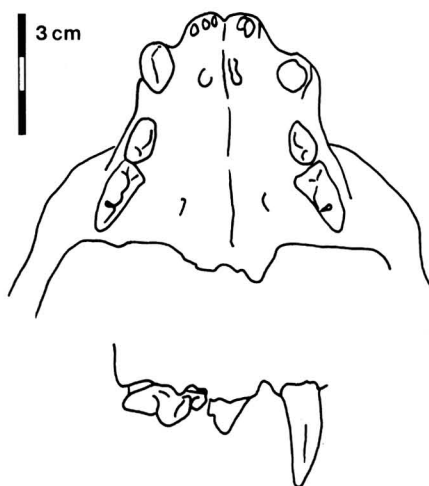


Fig. 2. *Lynx pardina spelaea*. Puech Margal. Palate, ventral view; right canine and premolars, buccal view.

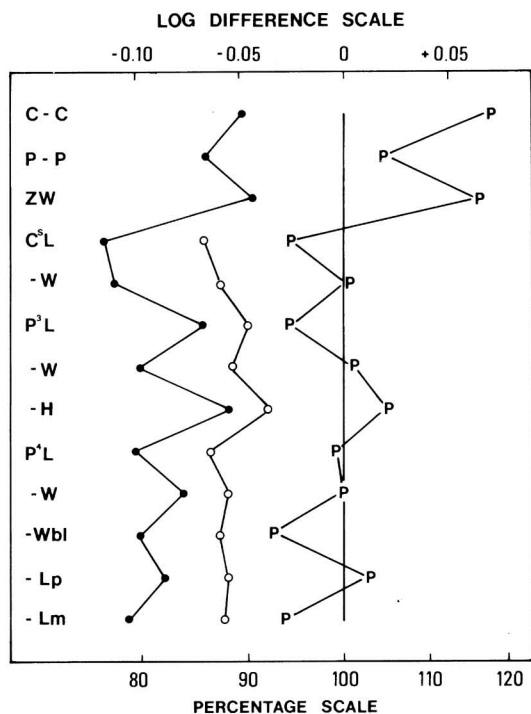


Fig. 3. Ratio diagram comparing cranial and dental dimensions in the following samples. Standard of comparison (100 %), *Lynx lynx*, Recent, Finland, means; filled circles, *L. pardina*, Recent, Spain, means; open circles, *L. pardina*, late Pleistocene, Iberian Peninsula, means; P, *L. p. spelaea*, Puech Margal, single specimen. Data in Tables 1–2.

measurements of the Puech-Margal cat, are expressed as percentages of the standard.

The comparison shows that, although the Puech-Margal specimen is close to *L. lynx* in size, its relative proportions are very different, and tend to resemble those in the *L. pardina* samples. There appears to be an especially valuable character pair in the width across the rostrum at the canines (C-C) and the palatal width across the carnassials (P-P). The rostral width is greater in relation to the palatal width in *L. pardina*. To test this conclusion, a bivariate

Table 1. Measurements (mm) of skull and upper dentition of Puech-Margal lynx.

Rostral width across C	46	P <sup>3</sup> height	8.7
Width across P <sup>4</sup>	63	P <sup>4</sup> length	18.9
Zygomatic width	119	P <sup>4</sup> width anterior	8.8
C <sup>1</sup> length	8.9	P <sup>4</sup> width of blade	6.3
C <sup>4</sup> width	7.5	P <sup>4</sup> length paracone	8.2
P <sup>3</sup> length	11.5	P <sup>4</sup> length metastyle	7.3
P <sup>3</sup> width	6.4		

Table 2. Statistics for skull and upper dentition measurements (mm) in samples of *Lynx*.

	N	Mean ± SE	SD	Range
Rostral width across C				
<i>Lynx lynx</i> , Recent	24	39.1±0.4	1.9	36–43
<i>L. pardina</i> , Recent	13	35.0±0.6	2.0	31.8–38
Width across P <sup>4</sup>				
<i>Lynx lynx</i> , Recent	23	60.2±0.4	0.4	57–63
<i>L. pardina</i> , Recent	13	51.8±0.5	1.8	49–56
Zygomatic width				
<i>Lynx lynx</i> , Recent	24	102.6±1.1	5.2	94–113
<i>L. pardina</i> , Recent	12	93.0±1.4	4.9	81–101
C <sup>1</sup> length				
<i>Lynx lynx</i> , Recent	22	9.43±0.14	0.65	7.8–10.9
<i>L. pardina</i> , Recent	13	7.26±0.12	0.45	6.5–8.0
fossil	16	8.10±0.13	0.53	7.3–9.1
C <sup>1</sup> width				
<i>Lynx lynx</i> , Recent	21	7.47±0.10	0.48	6.4–8.3
<i>L. pardina</i> , Recent	12	5.81±0.10	0.36	5.4–6.4
fossil	15	6.51±0.13	0.51	5.5–7.3
P <sup>3</sup> length				
<i>Lynx lynx</i> , Recent	22	12.21±0.13	0.60	10.5–13.0
<i>L. pardina</i> , Recent	13	10.48±0.13	0.46	9.8–11.3
fossil	6	11.00±0.18	0.43	10.5–11.5
P <sup>3</sup> width				
<i>Lynx lynx</i> , Recent	19	6.33±0.10	0.43	5.1–6.9
<i>L. pardina</i> , Recent	13	5.05±0.07	0.25	4.6–5.4
fossil	6	5.60±0.25	0.62	5.0–6.7
P <sup>3</sup> height				
<i>Lynx lynx</i> , Recent	17	8.32±0.12	0.49	7.0–9.2
<i>L. pardina</i> , Recent	10	7.35±0.08	0.26	7.0–7.8
fossil	5	7.70±0.06	0.12	7.6–7.9
P <sup>4</sup> length				
<i>Lynx lynx</i> , Recent	23	19.00±0.17	0.83	16.8–20.2
<i>L. pardina</i> , Recent	13	15.08±0.24	0.86	13.8–16.2
fossil	11	16.41±0.17	0.57	15.5–17.2
P <sup>4</sup> anterior width				
<i>Lynx lynx</i> , Recent	20	8.80±0.11	0.47	7.5–9.6
<i>L. pardina</i> , Recent	13	7.37±0.13	0.48	6.4–7.9
fossil	11	7.74±0.13	0.41	7.1–8.5
P <sup>4</sup> blade width				
<i>Lynx lynx</i> , Recent	17	6.71±0.09	0.37	5.9–7.3
<i>L. pardina</i> , Recent	11	5.36±0.09	0.31	4.7–5.9
fossil	8	5.86±0.10	0.29	5.5–6.3
P <sup>4</sup> paracone length				
<i>Lynx lynx</i> , Recent	19	7.98±0.08	0.37	7.1–8.7
<i>L. pardina</i> , Recent	13	6.54±0.10	0.37	6.0–7.0
fossil	10	7.03±0.08	0.24	6.7–7.4
P <sup>4</sup> metastyle length				
<i>Lynx lynx</i> , Recent	18	7.78±0.11	0.45	6.6–8.3
<i>L. pardina</i> , Recent	13	6.14±0.11	0.38	5.5–6.6
fossil	10	6.83±0.09	0.29	6.4–7.3

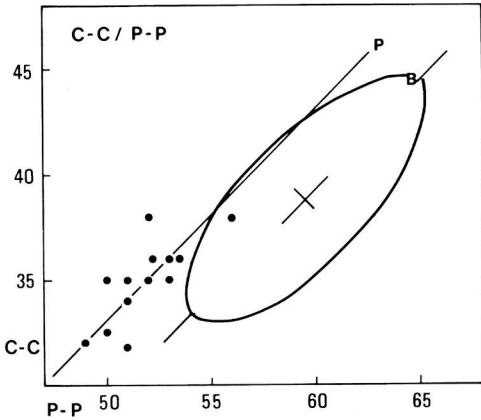


Fig. 4. Relationship between rostral width (C-C) and palatal width at carnassials (P-P) in lynxes. Filled circles, *L. pardina*, Recent, Spain; P, Puech Margal specimen; 95 % equi-probability ellipse for *L. lynx*, Recent, based on 94 specimens from Europe; B, Beeston Tor specimen; unreduced major axes based on Recent samples only.

study of C-C/P-P has been carried out (Fig. 4, Table 3). This was based on a much larger material of Recent *L. lynx* from Northern and Central Europe. The result was quite conclusive. The *L. lynx* sample shows high correlation and a fossil specimen (from Beeston Tor in Britain) lies exactly on the major axis of the 95 % equi-probability ellipse for this sample. The Puech-Margal specimen, on the other hand, takes a position well outside the ellipse, but falls exactly on the extension of the major axis for the *L. pardina* sample. (The two unreduced major axes have identical slopes,  $b = 1.03$ ).

The tooth rows are somewhat less divergent in the fossil specimen than in *L. lynx*. In this respect, the fossil pardel lynx resembles the Villafranchian *L. issiodorensis* (see Kurtén 1978) which is thought to be the immediate ancestor of *L. pardina* (Werdelin 1981).

The conclusion is, therefore, that the specimen from Puech-Margal belongs to the large Pleistocene subspecies of the pardel lynx, *Lynx pardina spelaea* Boule 1910.

## 5. Discussion

The discovery from Puech-Margal extends the known range of the pardel lynx in the Pleistocene of France. At the same time, it contributes to the building-up of a sample of *L. p. spelaea* from the area north of the Pyrenees, for future reference.

Table 3. Relationship between rostral width (C-C) and palatal width across carnassials (P-P) in samples of *Lynx*.

	<i>L. pardina</i> Recent, Spain	<i>L. lynx</i> Recent, Europe
<i>N</i> (sample size)	13	94
Mean C-C	35.0±0.6	39.2±0.2
Mean P-P	51.8±0.5	59.8±0.2
<i>r</i> (coefficient of correlation)	0.76	0.87
<i>b</i> (major axis slope)	1.03	1.03

Distinguishing this large pardel lynx from the northern lynx is not easy, and detailed measurements and observations should be gathered for all available specimens. In the present case, it turned out that the relatively broad rostrum of the pardel lynx was a diagnostic feature. Other important differences may be found in the skull, mandible, and dentition, as well as in the postcranial skeleton (see also Dubois & Stehlin 1933).

The name *L. lynx spelaea* is based on a specimen from the Riviera and thus pertains to the very large form of which the specimen from Puech-Margal is a representative. The Pleistocene pardel lynxes from Spain appear to average somewhat smaller (though larger than the Recent) and this indicates the existence of a cline with size increase to the north. Analogous clines have been noted e.g. for the spotted hyena (Kurtén 1957) and the American puma (Kurtén 1973, 1976). However, metrical study of further material from north of the Pyrenees will be necessary for reliable assessment of the differentiation. In any case, it appears that the pardel lynx is more plastic in size than the northern lynx, which has not changed appreciably in size since the Pleistocene (Kurtén 1960).

Although some of the large lynxes from the Pleistocene of Europe clearly represent the pardel lynx, there are also specimens which definitely represent *L. lynx*, for instance the above-mentioned Beeston Tor specimen and the Willendorf lynx described by Thenius (1957). However, there seem to be no reliable records of *L. lynx* prior to the Eemian (Kurtén 1968). *L. pardina* in Europe is known from the Holsteinian or earlier (Werdelin 1981) and is thought to have evolved directly from the ancestral *L. issiodorensis* (Werdelin 1981), whereas the northern lynx is a later immigrant. It is possible that the immigrant species ousted and replaced *L. pardina*, except in the Iberian peninsula, where it has survived as a relict.

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