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The relationships of Lynx shansius Teilhard

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A sample of specimens of *Lynx shansius* Teilhard has been compared to similar samples of *L. lynx* from Sweden and Finland, *L. pardina* from Spain, and *L. issiodorensis* from Etouaires. Results show that *L. shansius* is only subspecifically distinct from *L. issiodorensis*. No conclusions can be drawn concerning the evolution of *L. lynx* on the basis of *L. shansius*.

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1. Introduction

Lynx shansius was first described by Teilhard (1945) as a distinct species of *Lynx*, and has been so considered by subsequent authors who have dealt with the fossil history of this genus (Chi 1975, Sotnikova 1979, Werdelin 1981). However, no adequate comparison has been made between *L. shansius* and other species of *Lynx*, whether recent or fossil, due to the very limited *L. shansius* material available. An attempt was made by Werdelin (1981) to interpret the history of the genus *Lynx* in Asia on the basis of material available at that time. This attempt cannot be said to have produced more than some general guidelines for future research. The current state of affairs concerning *L. shansius* is unfortunate, as the evolution of *Lynx* in China and eastern Siberia is crucial to the understanding of the history of the genus in both Europe and North America.

We have recently been able to obtain measurements of specimens of *L. shansius* located in the Frick Collection of the American Museum of Natural History. This material now makes it possible to assess the taxonomic status and relationships of this species.

2. Material and methods

Measurements of the skull, mandible, and dentition of *L. shansius* were obtained from the Frick Collection specimens using Vernier calipers. Additional measurements of specimens of this species were taken from the literature (Zdansky 1924, Chi 1975, Sotnikova 1979, Tang 1980). These data are presented in Appendix 1. The measurements of *L. shansius* were compared with measurements of samples of several recent and fossil species of *Lynx*. These included Swedish and Finnish recent populations of *L. lynx*, recent specimens of *L. pardina* from Spain, and fossil specimens of *L. issiodorensis* from Etouaires. The Etouaires material has been described previously by Kurtén (1978). Summary statistics for these samples are given in Appendix 2.

The method used for sample comparisons in this paper is the ratio method of Simpson (1941).

The following abbreviations of variables are used in this paper: LC_i, WC_i, LC^s, WC^s: lengths and widths of lower and upper canines; LP_3, WP_3, LP_4, WP_4, LP^3, WP^3, LP^4: lengths and widths of lower and upper premolars; WaP^4: anterior width of upper carnassial; $WblP^4$: blade width of upper carnassial; LM_1, WM_1: length and width of lower carnassial; BL: basal length of skull; C-C: rostral width of skull across canines.

The following abbreviations of institutions are used: F:AM, Frick Collection of the American Museum of Natural History; MNHN, Museum National d'Histoire Naturelle, Paris; PIN, Paleontological Institute, Moscow; UPM, Paleontological Museum, Uppsala; IVPP, Institute of Vertebrate Paleontology and Paleoanthropology, Beijing.

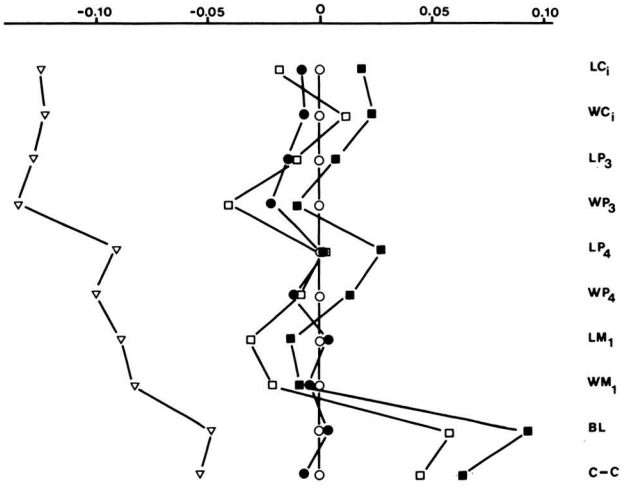

Fig. 1. Ratio diagram of lower dentitions and skull variables. ○ (standard) = *L. lynx*, Sweden, ● = *L. lynx*, Finland, ▽ = *L. pardina*, Spain, ■ = *L. issiodorensis*, Etouaires, □ = *L. shansius*.

3. Results

Genus Lynx Kerr, 1788

Species *Lynx shansius* Teilhard, 1945

Synonyms:

Felis sp. Zdansky 1924, p. 144, pl. 27, fig. 5
Lynx sp. Teilhard et Piveteau 1930, p. 110, pl. 21
Lynx sp. Teilhard 1938, p. 14, fig. 8
Lynx sp. Teilhard 1940, p. 31, fig. 20
Felis cf. *lynx* Teilhard et Leroy 1942, p. 48
Lynx shansius Teilhard, in Teilhard et Leroy 1945, p. 28, figs. 13-15
Lynx sp. I Teilhard, in Teilhard et Leroy 1945, p. 32, fig. 16(2)
Lynx sp. II Teilhard, in Teilhard and Leroy 1945, p. 32, fig. 16(1)
Lynx shansius, Chi 1975, p. 170, pl. 1, fig. 8
Lynx shansius, Sotnikova 1979, p. 23, figs. 1-3
Lynx shansius, Tang 1980.

The first step of the study was to ascertain that the present sample of *L. shansius* was homogeneous enough to be used as a single unit in the analyses. To this end the basic statistics for the sample were calculated. The results are shown in Table 1. The coefficient of variation (*V*) is low for most variables, lower than in, for example, *L. pardina* from Spain (see Appendix 2), showing that the sample is relatively homogeneous. One specimen which is used in the following analyses was studied separately. This is a specimen classified as *Felis* sp. by Zdansky (1924). This specimen is similar in all respects to *L. shansius*, and differs from true *Felis* in the ways characteristic of the genus *Lynx*. This analysis is not figured due to limitations of space.

Ratio diagrams comparing the dentition of *L. shansius* with the other species mentioned above were constructed, and are presented in Figs 1 and 2. In both diagrams the Swedish sample of *L. lynx* is used as the standard against which the other samples are plotted.

The differences between the two samples of *L. lynx* illustrate the degree of variation which can be expected between two adjacent populations of the same species. A comparison of the lines for *L. lynx* and *L. pardina* shows the differences which exist between two Recent species. It will be noted that the differences between *L. lynx* and *L. issiodorensis* from Etouaires are of approximately the same magnitude as those between the two Recent species.

Fig. 1 shows the difference in the lower dentition between *L. shansius* and *L. issiodorensis* to be very slight. The only consistent difference is that *L. shansius* is on the average slightly smaller than *L. issiodorensis*. Otherwise the differences between the two fossil samples are such as could be expected between two closely related populations of the same species.

The above observations apply equally to Fig. 2, which depicts the upper dentition variables. The only slight exception here lies in the relative blade width of P^4, which is broader in *L. shansius* than in *L. issiodorensis* from Etouaires. The difference in size between the canines of *L. shansius* and *L. issiodorensis* is probably exaggerated due to the small sample size of *L.*

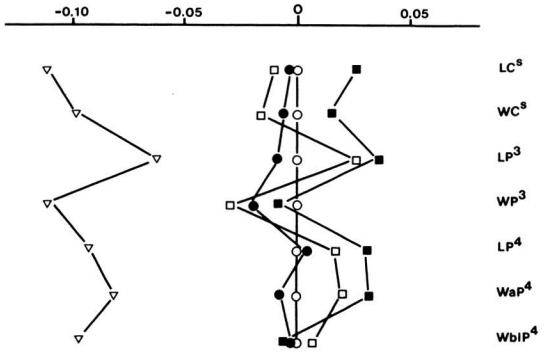

Fig. 2. Ratio diagram of upper dentition variables. Symbols as in Fig. 1.

Table 1. Basic statistics for *L. shansius*. N = number of specimens, SD = standard deviation, V = coefficient of variation.

	N	Mean	SD	V	Range
LC_i	9	9.10	0.75	8.24	8.3-10.1
WC_i	9	7.48	0.52	6.95	6.8- 8.3
LP_3	18	10.09	0.76	7.56	8.1-11.3
WP_3	18	5.08	0.28	5.53	4.6- 5.6
LP_4	19	12.64	097	7.30	11.0-14.4
WP^3	8	6.18	0.44	7.12	5.5- 6.9
LP^4	11	19.51	1.17	5.99	17.5-21.4
WaP^4	10	9.38	0.83	8.86	8.0-10.3
$WblP^4$	7	6.89	0.41	6.01	6.2- 7.4
BL	2	140.00	1.41	1.01	139- 141
C-C	5	43.90	1.64	3.73	42.0-45.6

shansius for this variable (see Table 1 and Appendix 1).

Two cranial measures, basal length and rostral width, are also included in Fig. 1, although here the sample size of *L. shansius* is so small as to preclude any definite statements. It appears, however, that *L. shansius* is similar to *L. issiodorensis* and different from *L. lynx* in having a large skull in relation to tooth size.

4. Discussion

In view of the very minor differences between *L. shansius* and *L. issiodorensis* which are seen in Figs 1 and 2, it must be considered at present indefensible and highly confusing to separate between the two specifically. There are nevertheless some consistent differences, and we therefore propose that *L. shansius* henceforth be considered a subspecies, *L. issiodorensis shansius*, of *L. issiodorensis*.

Since populations of *L. issiodorensis* from western Europe and East Asia are so similar, this leaves no clue as to where geographically the recent species, particularly *L. lynx* have evolved. One can only hope that new finds may help to clear up this question.

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Appendix 1. Raw data for *L. shansius* used in this paper. a = approximately.

Specimen	LC_i	WC_i	LP_3	WP_3	LP_4	WP_4	LM_1	WM_1	LC^s	WC^s	LP^3	WP^3	LP^4	WaP^4	$WblP^4$	BL	C-C
1.	10.0	8.3	11.0	5.0	12.1	5.8	15.3	6.2	-	-	-	-	-	-	-	-	-
2.	-	a7	10.0	4.6	12.5	5.7	14.0	6.1	-	-	-	-	-	-	-	-	-
3.	9.7	7.8	10.0	5.6	12.9	6.4	14.6	7.0	-	-	-	-	-	-	-	-	-
4.	8.3	6.9	9.7	5.3	12.0	5.9	14.4	6.8	-	-	-	-	-	-	-	-	-
5.	-7.8	10.5	5.3	12.5	6.0	14.6	6.3		-	-	-	-	-	-	-	-	-
6.	-	-	10.5	5.5	13.4	6.2	14.5	6.8	-	-	-	-	-	-	-	-	-
7.	8.6	7.3	10.0	4.8	12.2	5.8	-	-	-	-	-	-	-	-	-	-	-
8.	8.5	-	8.9	4.8	12.0	5.8	14.1	6.1	-	-	-	-	-	-	-	-	-
9.	10.1	8+	-	-	12.4	6.4	14.3	6.9	-	-	-	-	-	-	-	-	-
10.	-	-	8.1	4.8	11+	5.6	-	-	-	-	-	-	-	-	-	-	-
11.	8.5	7.1	10.6	4.7	12.9	5.8	15.3	7.0	9.3	7.7	13.8	6.4	21.4	8+	7+	-	45?
12.	a8.6	6.8	10.0	5.1	13.6	6.3	14.6	6.7	-	-	-	-	-	-	-	-	-
13.	a9.1	7.3	10.2	5.3	12.9	6.1	14.2	6.4	8.8	7.2	13.2	6.0	19.2	8.0	6.2	141	44
14.	8.5	-	11.3	5.1	13.0	5.8	14.0	6.3	-	-	-	-	-	-	-	-	-
15.	-	-	9.8	5.4	12.6	6.1	14.1	6.8	-	-	-	-	-	-	-	-	-
16.	-	-	-	-	-	-	-	-	-	-	13.0	6.9	19.0	9.8	7.2	-	45.5
17.	-	-	-	-	-	-	-	-	-	-	-	-	19.9	9.6	6.9	-	45.6
18.	-	-	-	-	-	-	-	-	-	-	12.8	-	-	-	-	a134	42.6
19.	-	-	-	-	-	-	-	-	9.1	7.0	13.4	6.3	18.6	9.2	6.5	139	42.0
20.	-	-	-	-	-	-	-	-	-	-	-	-	20.2	10.3	7.4	-	-
21.	-	-	-	-	-	-	-	-	-	-	a13	-	18.5	9.7	7.1	-	-
22.	-	-	-	-	-	-	-	-	9.9	7+	13.7	5.8	18.9	9.0	6.9	-	-
23.	9.7	8.0	9.5	5.2	13.2	6.1	15.1	6.7	-	-	-	-	-	-	-	-	-
24.	-	-	10.5	5.0	13.8	6.2	15.5	7.0	-	-	-	-	-	-	-	-	-
25.	-	-	10.0	5.0	12.0	6.0	15.5	6.5	-	-	-	-	-	-	-	-	-
26.	-	-	11.0	5.0	13.0	6.0	16.5	6.7	-	-	-	-	-	-	-	-	-
27.	-	-	-	-	-	-	-	-	-	-	13.8	6.5	20.8	10.0	-	-	-
28.	9.3	7.1	9.7	5.0	?11.2	?5.2	14.4	?5.9	-	-	-	-	-	-	-	-	-
29.	-	-	-	-	-	-	-	-	-	-	11.0	5.5	17.5	8.0	-	-	-
30.	-	-	-	-	-	-	-	-	-	-	12.8	6.0	18.1	9.8	-	-	-
31.	-	-	-	-	-	-	-	-	-	-	14.4	6.0	20.6	10.2	-	-	-

Key to specimens: 1-10. F:AM 63-B766, Tsao Chuang, Shansi. — 11. F:AM 62-B749, Tsao Chuang, Shansi. — 12. F:AM 87-B945, Loc? — 13. F:AM 60-B724, Loc? — 14. F:AM 53-B671, Fan Tsun. — 15. F:AM 101219, Mafang, Shansi. — 16. F:AM 62-B756, Tsao Chuang, Shansi. — 17. F:AM 62-B754, Tsao Chuang, Shansi. — 18. F:AM 67-B819, Hsia Chang, Shansi. — 19. F:AM 96-B1042, Loc? — 20. F:AM 78-B390, Loc? — 21. F:AM BX69 B-8, Loc? — 22. F:AM 50-B587, Loc? — 23. MNHN, Nihowan. — 24. PIN 2975-2, Beregovaia (Sotnikova 1979). — 25. PIN 3381-5, Shamar (Sotnikova 1979). — 26. PIN 3381-7, Loc? (Sotnikova 1979). — 27. PIN 2975-1, Beregovaia (Sotnikova 1979). —28. UPM, Loc 32 (Zdansky 1924). — 29. IVPP V4581, Lantian, Shensi (Chi 1975, Tang 1980). — 30. IVPP, Hebei (Tang 1980). — 31. IVPP, 21.648 (Tang 1980).

Appendix 2. Basic statistics of the comparison samples used in this paper. Abbreviations of statistical parameters are as in Table 1.

	N	Mean	*SD*	*V*	Range	*N*	Mean	*SD*	*V*	Range
	L. lynx, Sweden					*L. lynx*, Finland				
LC_i	39	9.47	0.51	5.37	8.5-10.3	19	9.32	0.62	6.64	7.8-10.2
WC_i	26	7.29	0.48	6.61	6.5- 8.4	19	7.17	0.52	7.27	6.1- 8.3
LP_3	42	10.34	0.45	4.34	9.2-11.4	20	10.03	0.69	6.86	8.6-11.4
WP_3	43	5.61	0.40	7.18	4.9- 6.8	21	5.33	0.36	6.72	4.4- 5.9
LP_4	42	12.61	0.47	3.73	11.6-14.3	20	12.64	0.59	4.66	11.4-13.6
WP_4	42	6.11	0.27	4.34	5.5- 6.8	19	5.96	0.30	5.01	5.2- 6.4
LM_1	49	15.81	0.71	4.47	14.0-17.3	21	15.99	0.70	4.36	14.0-17.0
WM_1	49	6.96	0.34	4.85	6.3- 7.7	19	6.87	0.32	4.67	6.1- 7.4
LC^s	39	9.50	0.55	5.77	8.5-10.9	22	9.43	0.65	6.86	7.8-10.9
WC^s	34	7.57	0.36	4.75	7.0- 8.7	21	7.47	0.48	6.41	6.4- 8.3
LP^3	43	12.46	0.53	4.27	11.4-14.0	22	12.21	0.60	4.94	10.5-13.0
WP^3	36	6.62	0.32	4.91	6.0- 7.3	19	6.33	0.43	6.82	5.1- 6.9
LP^4	49	18.76	0.64	3.43	17.1-20.1	22	18.94	0.81	4.26	16.8-20.2
WaP^4	49	8.94	0.43	4.86	8.1- 9.8	21	8.79	0.46	5.27	7.5- 9.6
$WblP^4$	32	6.74	0.29	4.24	6.2- 7.4	17	6.71	0.37	5.54	5.9- 7.3
BL	38	122.40	6.48	5.29	106 -135	28	123.40	5.48	4.44	113 -132
C-C	40	39.70	2.01	5.07	35.5-45	28	39.10	1.86	4.77	36 -43
	L. pardina					*L. issiodorensis*, Etouaires				
LC_i	13	7.14	0.54	7.60	6.1- 8.0	7	9.89	0.65	6.62	9.0-10.8
WC_i	10	5.50	0.48	8.66	4.7- 6.3	9	7.69	0.55	7.20	6.8- 8.5
LP_3	13	7.73	0.51	6.62	6.8- 8.6	10	10.52	0.60	5.70	9.7-11.3
WP_3	12	4.12	0.20	4.95	3.7- 4.4	9	5.48	0.34	6.18	4.9- 6.1
LP_4	13	10.25	0.53	5.22	9.4-11.2	9	13.44	0.62	4.62	12.4-14.3
WP_4	13	4.86	0.23	4.79	4.3- 5.2	8	6.33	0.35	5.53	5.7- 6.8
LM_1	13	12.91	0.62	4.82	12.0-13.9	10	15.37	0.77	5.00	14.0-16.3
WM_1	13	5.74	0.45	7.81	5.1- 6.6	9	6.82	0.55	8.09	6.3- 8.2
LC^s	14	7.31	0.46	6.34	6.5- 8.0	6	10.08	0.52	5.15	9.1-10.5
WC^s	13	5.87	0.40	6.90	5.4- 6.6	6	7.85	0.45	5.74	7.1- 8.4
LP^3	14	10.54	0.50	4.72	9.8-11.4	6	13.52	0.80	5.89	13.0-14.4
WP^3	13	5.12	0.33	7.61	4.6- 5.9	5	6.48	0.19	2.97	6.2- 6.7
LP^4	14	15.14	0.86	5.71	13.8-16.2	7	20.14	0.35	1.74	19.6-20.5
WaP^4	14	7.44	0.53	7.07	6.4- 8.3	6	9.63	0.45	4.67	8.9-10.3
$WblP^4$	12	5.41	0.33	6.13	4.7- 5.9	6	6.67	0.27	3.99	6.4- 7.0
BL	6	109.50	3.94	3.60	103-115	2	151.50	9.19	6.07	145 -158
C-C	14	35.10	1.96	5.58	31.8-38	3	45.90	1.96	4.28	43.6-47