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FOSSIL HISTORY OF THE GRASS SNAKE (NATRIX NATRIX) WITH EMPHASIS ON THE BRITISH FOSSIL RECORD

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INTRODUCTION

Fossils of the Grass Snake, *Natrix natrix* (Linnaeus), have been reported from more European localities than any other snake (Szyndlar, 1984). They are first known from the uppermost Miocene of Polgardi, Hungary and occur in a few late Pliocene and numerous Pleistocene localities (Szyndlar, 1984). All of the fossil localities where this species has been found occur within its present range.

Fossil *Natrix natrix* have usually been identified on the basis of isolated vertebrae. Trunk vertebrae are often specifically diagnostic (Auffenberg, 1963; Holman, 1979), but cervical and caudal vertebrae pose specific taxonomic problems and are usually not utilized in fossil studies.

Natrix natrix has been identified on the basis of vertebrae (mainly trunk vertebrae) and cranial bones such as frontals, parietals, basiparasphenoids, basioccipitals, quadrates, maxillae, and dentaries. Ribs are not usually considered to be diagnostic for the identification of genera and species of fossil snakes. The present paper will address (1) criteria for the identification of fossil *Natrix natrix* on the basis of isolated trunk vertebrae; (2) the general fossil history of *Natrix natrix* in continental Europe; and (3) a more detailed discussion of the fossil record of the Grass Snake in Britain.

IDENTIFICATION OF FOSSIL *NATRIX NATRIX*

Entire fossil snake skeletons or even skulls are practically non-existent, as the common elements that are usually excavated are vertebrae and broken ribs. The ratio of fossil snake vertebrae to cranial elements is often more than one hundred to one; and most of the cranial elements tend to be fragmentary.

As previously stated, trunk vertebrae are the most reliable ones for identification purposes. Cervical vertebrae of snakes (Fig. 1a) may be distinguished from trunk vertebrae (Fig. 1c) on the basis of being thinner-walled, with longer dorsal and ventral processes, and with proportionally much larger neural canals. Most caudal vertebrae (Fi. 1b) of snakes may be distinguished from trunk verterbrae (Fig. 1c) on the basis of having extra anterior vertebral processes called lymphapophyses.

The trunk vertebrae of *Natrix natrix* (Fig. 1c) may be easily distinguished from those of the European colubrine genera (ie *Coluber, Coronella, Elaphe*) on the basis of having a long ventral hypapophysis, a structure that is lacking in these colubrine genera (Fig. 1d). Trunk vertebrae of Viperidae (Adders) (Fig. 1f) also have hypapophyses; but vertebrae of *Natrix natrix* may be distinguished from the Viperidae in having a more rounded neural arch (as seen in posterior view); the anterior and posterior borders of the neural spine more undercut (as seen in lateral view); and the hypapophysis shorter, less gracile, and less distally pointed (compare Fig. 1c with Fig. 1f).

This leaves only comparisons with the other two *Natrix* species, *Natrix maura* and *N. tessellata.* Syndlar (1984) has provided criteria for distinguishing trunk vertebrae of *Natrix natrix* from these species. *Natrix natrix* tends to have its hypapophysis rounded distally, and its parapophyseal process relatively massive (Fig. 1c). *Natrix maura* and *N. tessellata* tend to have the hypapophyses pointed distally and the parapophyseal process more gracile (Fig. 1e).

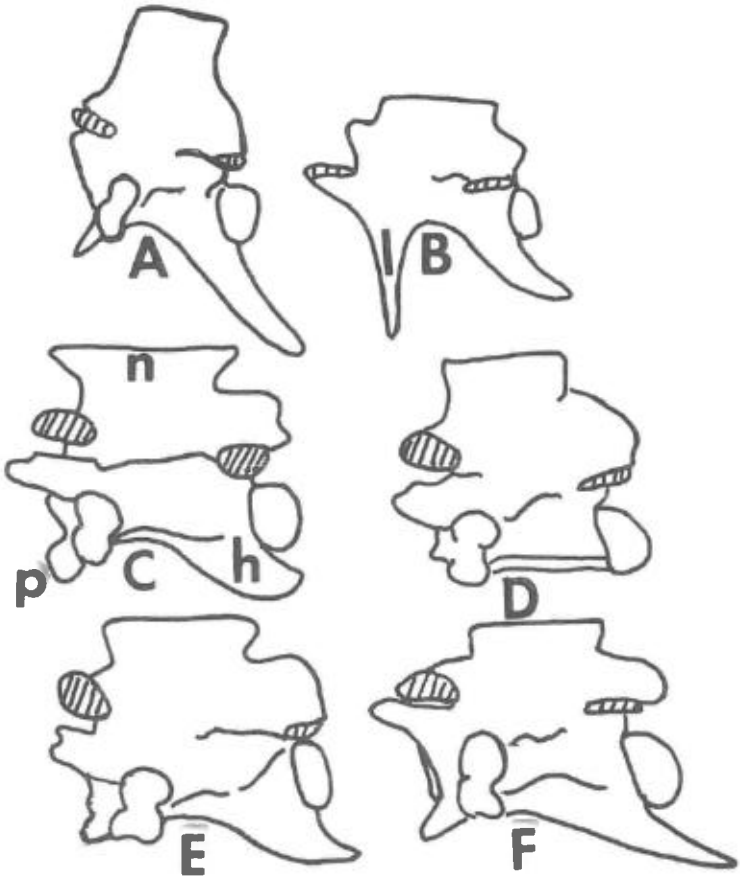

Figure 1. Outline drawings of various snake vertebrae. Capital letters depicting individual vertebrae: A, generalised snake cervical vertebra; B, generalised snake caudal vertebra; C, trunk vertebra of *Natrix natrix*; D, trunk vertebra of *Elaphe longissima*; E, trunk vertebra of *Natrix maura*; F, trunk vertebra of *Vipera berus*. Small letters depicting structures on individual vertebrae: h, hypapophysis; l, lymphapophysis; p, parapophyseal process.

GENERAL FOSSIL HISTORY OF *NATRIX NATRIX* IN CONTINENTAL EUROPE

The following section is arranged chronologically into Miocene, Pliocene, and Pleistocene sections.

Miocene - the earliest record of *Natrix natrix* is from the uppermost Miocene of Polgardi, Hungary (authors cited in Szyndlar, 1984, pp. 50 and 119), but the identification was made on the basis of parietals only. I would feel more comfortable with this record if vertebral remains had been studied as well, for the parietal is somewhat individually variable in natricine snakes.

Natrix tessellata was also reported from the same site (same authors cited in Szyndlar, 1984, pp. 50 and 119) on the basis of basiparasphenoid and compound bones only, both of which are also somewhat individually variable in nafriciues. I would consider the records of both *Natrix natrix* and *N. tessellata* slightly questionable on the basis of individual variability of the bones utilized and on the basis that neither author cited by Szyndlar (1984) figured or gave a diagnostic description of the bones.

Pliocene - the Pliocene record of the Grass Snake is confined to Central Europe. *Natrix natrix* was reported from the Upper Pliocene of Deutsch Altenburg, Austria, by Mais and Rabeder (1977), but these authors did not describe or figure the fossils. Other authors have recorded *Natrix natrix* from the Upper Pliocene of Hungary and Rumania (specific sites are given in Szyndlar, 1984).

It is noteworthy that in the most comprehensive study of Miocene through Pleistocene snakes that has ever been done in a restricted area of Europe (Poland: Szyndlar, 1984), that all of the pre-Pleistocene records of *Natrix* were of extinct species. This might make one curious about the above records of *Natrix natrix* from the Upper Miocene and Pliocene.

Pleistocene - Pleistocene records of *Natrix natrix* are abundant in continental Europe and are usually based on relatively complete individual elements, including many vertebrae and some cranial elements.

The most comprehensive study of Pleistocene fossil Grass Snakes has been done in Poland where 12 of 13 localities studied for herpetological fossils have yielded *Natrix natrix* (Szyndlar, 1984). A total of about 108,700 vertebrae were identified as Grass Snake, including 1068,500 from one locality! The next most abundant bone that was identified was the dentary where 246 were recorded. The ratio of vertebrae to other skeletal elements identified in the Pleistocene of Poland was 179 to 1. Lower, Middle and Upper Pleistocene sites contained Grass Snake fossils.

Countries other than Britain and Poland where *Natrix natrix* has been identified as a Pleistocene fossil include Austria, France, Germany, Hungary, and Rumania where Lower and Middle Pleistocene records of Grass Snakes occur; and Bulgaria and Germany where Upper Pleistocene fossils of Grass Snake occur. A list of locality names and authors for these localities are given in Szyndlar (1984, pp. 120-121).

FOSSIL HISTORY OF *NATRIX NATRIX* IN BRITAIN

The fossil record of *Natrix natrix* in Britain is thus far restricted to the Middle and Upper Pleistocene. All Grass Snake records are from interglacial deposits. In fact, the only cold-stage deposit herptiles known are *Rana* sp., *Bufo* sp., *Rana temporaria*, and *Lacerta vivipara* (Holman, 1990).

British Pleistocene Stages with *Natrix natrix* Fossils

UPPER PLEISTOCENE

Stage	Beginning at:	Estimated Duration
FLANDRIAN POSTGLACIAL	10,000 BP	10,000 yrs.
IPSWICHIAN INTERGLACIAL	120,000 BP (est)	10,000 yrs.

MIDDLE PLEISTOCENE

Stage	Beginning at:	Estimated Duration
HOXNIAN INTERGLACIAL	200-250,000 BP	10,000 yrs. (?)
CROMERIAN INTERGLACIAL	350-500,000 BP	10,000 yrs. (?)

The following accounts are based only on fossils that I have been able to identify myself or that I have been able to re-examine from previous studies. This includes almost all of the Quarternary snake fossils known from Britain.

Middle Pleistocene Sites with *Natrix natrix*

Natrix natrix is known from both of the Middle Pleistocene interglacial stages, the Cromerian and the Hoxnian stages.

Cromerian West Runton Freshwater Bed, Norfolk - Fifty-four Grass Snake vertebrae were recorded from the West Runton site (Holman et al., 1988), and one vertebra was identified from this site by Holman (1989). The scene at this site in the Pleistocene was a slow-flowing river, rich in aquatic vegetation and fringed by fen, as is found in a typical English lowland river today (Holman et al., 1988). The exotic species *Rana arvalis* and *Rana "esculenta"* or *ridibunda* occurred with Grass Snake at this locality.

Hosnian Ingress Vale Site, Swanscombe, Kent - Three Grass Snake vertebrae were identified from this site by Holman (1987a). The fossiliferous sediments of this site consisted of a series of fluviatile gravels, sands, and silts that occupied a broad channel cut by a Pleistocene River Thames (Stuart, 1982). *Natrix natrix* occurred with the exotic species *Emys orbicularis* at this site (Holman, 1987a).

Hoxnian Cudmore Grove Site, Mersea Island, Essex - Eighty-four Grass Snake vertebrae were recorded from this lcoality by Holman et al. (1990). The fossils at this site originated mainly from a detritus mud deposited under lower-energy aquatic conditions. These muds contained mainly freshwater mollusca as well as the herpetological fossils. Several exotic taxa (*Hyla* sp., *Rana arvalis, R. "esculenta"* or *ridibunda, R. lessonae, Emys orbicularis*, and *Elaphe longissima*) occurred with *Natrix natrix* at this important herpetological site.

Hoxnian (? or Ipswichian) Greenlands Pit Site, Purfleet, Essex. - Six vertebrae were reported from this locality as *Natrix* cf. *Natrix natrix* by Holman and Clayden (1988). The bones came from a shell seam in a fluvial deposit that also contained several species of fishes. The Grass Snake occurred with the exotic species *Rana arvalis* at this locality (Holman and Clayden, 1988).

Late Pleistocene Sites with *Natrix natrix*

Natrix natrix is known from both the Ipswichian (last interglacial) and Flandrian (postglacial) stages.

Ipswichian Swanton Morley Site, Norfolk - Four Grass Snake vertebrae were identified from the Swanton Morley Site by Holman (1987b). The fossils and the sediments of this locality indicate a back channel of a meandering river. The exotic species *Rana arvalis* and *Emys orbicularis* occurred with Grass Snake at this site (Holman, 1987b).

Ipswichian Itteringham Gravel Pit Sit, Norfolk - Sixten *Natrix natrix* vertebrae were identified from the Itteringham Site (Hallock et al., 1990). The fossils came from detrital muds and organic sands that indicate deposition in a low energy aquatic situation. The Grass Snake occurred with the exotic taxa *Hyla* sp., *Rana "esculenta"* or *ridibunda*, and *Emys orbicularis* at the Itteringham locality.

Ipswichian Shropham Gravel Pit Site, Norfolk - Sixteen Grass Snake vertebrae were recovered from the Shropham locality (Holman and Clayden, 1990). *Natrix natrix* fossils of this site came from a layer of detritus mud, indicating that the bones were deposited in a low energy aquatic situation. The exotic species *Rana arvalis, Rana* (exotic "water frog" taxon), *Emys orbicularis*, and *Natrix cf. Natrix maura* or *tessellata* occurred with Grass Snake at this locality.

Flandrian Ightham Fissures Site, Sevenoaks Area, Kent - Two hundred seventy-seven vertebrae, five dentaries and 16 other various bones were identified at this site (Holman, 1985) which could represent a time span between a few hundred years ago to about 8,500 years ago. The bones from this site were mainly collected around the turn of the Century. Of interest, is the occurrence of two presently endangered species (*Bufo calamita*, and *Coronella austriaca*) with Grass Snake at this locality relatively near London (Holman, 1985).

Flandrian Dog Holes Site, Warton, Lancashire - One Grass Snake vertebra was identified from a collection of bones donated to the Natural History Museum, London, in 1910 from the Dog Holes Site. It appears that these bones could be as young as only a few hundred

years old. Ninety % of the herptile bones identified from the Dog Holes were *Bufo bufo* and *Rana temporaria*, and the only other herptile remains represented *Anguis fragilis* (Holman, 1987a).

Flandrian Happaway Cave Site, Torquay, Devon - One Grass Snake vertebra was identified from this cave site (Holman, 1987a). These bones came from a collection donated to the Natural History Museum, London, in 1896, and could also represent material only a few hundred years old. The only other herptiles identified from this assemblage were *Bufo bufo* and *Rana temporaria* (Holman, 1987a).

SUMMARY

Grass Snakes have been reported from more Continental European Fossil localities than any other snake and the same is true for Britain where *Natrix natrix* has been reported from 10 localities. Three British Grass Snake sites are from the middle Pleistocene (one Cromerian and two Hoxnian); one is from a "Hoxnian or Ipswichian" site; and six are from the late Pleistocene (three Ipswichian and one Flandrian).

The next most common fossil snake in Britain is *Vipera berus* which has been reported from one middle Pleistocene (Cromerian) and four late Pleistocene (two Ipswichian and one Flandrian) sites. The Smooth Snake (*Coronella austriaca*) has been reported only once from Britain as a fossil, and that was from the Flandrian Ightham Fissure Site near Sevenoaks, Kent.

Characters on individual trunk vertebrae allow one to distinguish fossil *Natrix natrix* from other European snake genera and from *Natrix maura* and *N. tessellata*. But it is quite difficult or perhaps impossible to distinguish the latter two species on the basis of vertebral characters. It has been suggested that vertebrae from one Hoxnian (Cudmore Grove, Essex) and one Ipswichian (Shropham, Norfolk) site represent either *Natrix maura* or *N. tessellata*. A total of 455 vertebrae and 21 other various bones of *Natrix natrix* have been reported from the British Pleistocene sites listed here.

All of the fossil localities of *Natrix natrix* lie within the present range of the species. *Natrix natrix* is first recorded from the uppermost Miocene of Hungary, but the identification was made on the basis of parietal bones which may be individually variable. Fossil Grass Snakes have been reported from Upper Pliocene localities in Austria, Hungary, and Rumania and from Pleistocene sites in Austria, Bulgaria, France, Germany, Hungary and Rumania. In the most comprehensive study of *Natrix* fossils that has ever been done in one area (Poland: Szyndlar, 1984), only extinct species of *Natrix* were found in pre-Pleistocene deposits. *Natrix natrix*, however, was very abundant in the Pleistocene of Poland.

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