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## ARDROSS CASTLE

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### Highlights

Twelve species of fossil fishes have been found at Ardross Castle in Fife, and these include the original specimens of four species, and two species not found elsewhere. Some of the specimens are well enough preserved to show details of how they decomposed before being buried.

### Introduction

The fossil-bearing strata crop out on the foreshore below the ruins of Ardross Castle. Although invertebrates have been found in fair numbers, fishes are rather rare at Ardross, and only now and again are a few specimens found (White, 1937). One of the first people to note the occurrence of fossils at Ardross was Thomas Brown (1861), who described actinopterygian scales, teeth and scales of *Holoptychius*, and a specimen of *Amblypterus ?striatus*. Peach (1902) summarized the fauna, which was described by Traquair (1905c). White (1937) described the fishes from the site, including new specimens and two new species.

### Description

The fishes from Ardross occur in the *Crangopsis* Bed in the Calciferous Sandstone Series, a unit dated as Brigantian (late Viséan) in age by George *et al.* (1976, p. 53). The specimens are preserved in a fine-grained mudstone with a low lime content.

One of the most interesting features of the fossils from this site is the fact that several of them show obvious signs of in-situ disruption and decomposition prior to burial. The scattering of bones shows this: for example, one specimen had lost a large piece from its back, the preorbital region had been scattered, the caudal region telescoped and all the fins disturbed.

### Fauna

The fish assemblage from Ardross Castle is large in numbers of species, but these are represented by very few specimens. Twelve species of fishes have been recorded from Ardross, and in addition 16 species of invertebrates and two plants (White, 1937) occur.

Acanthodii: Acanthodiformes: Acanthodidae

*Acanthodes sulcatus* Agassiz, 1835

Neotype locality Osteichthyes: Sarcopterygii: Actinistia: Rhabdodermatidae

*Rhabdoderma ardrossense* Moy-Thomas, 1937

Type and only locality

Coelacanth indet. (= *Coelacanthopsis curta* Traquair, 1905)

Osteichthyes: Actinopterygii: Rhadinichthyidae

*Rhadinichthys carinatus* (Agassiz, 1835)

*Rhadinoniscus wrighti* White, 1937

Type locality

Osteichthyes: Actinopterygii: Elonichthyidae *Elonichthys robisoni* (Hibbert, 1835)

Osteichthyes: Actinopterygii: Cosmoptychiidae

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*Watsonichthys pectinatus* (Traquair, 1877)

Osteichthyes: Actinopterygii: Amphicentridae

*Cheirodus crassus* Traquair, 1890

Chondrichthyes: Holocephali

*Deltoptychius armigerus* (Traquair, 1888)

*Eucentrurus paradoxus* Traquair, 1905

Type locality for unique specimen helodont teeth

Chondrichthyes: Elasmobranchii

*Euphyacanthus semistriatus* (Traquair, 1894)

The Order Acanthodiformes is distinguished from all other acanthodians by having only a single dorsal fin and spine, in a posterior position. *Acanthodes*, the type genus, is known from the Lower Carboniferous to Lower Permian, virtually worldwide. The type locality for *A. sulcatus* is Wardie (q.v.), but the original material is lost. This was a large acanthodian (about 20 cm long), similar to *A. wardi* Egerton. White (1937) redescribed *A. sulcatus* based on an Ardross complete specimen and separated this species from *A. wardi* and *A. nitidus* on its straight styliform bone and the nature of the scales.

The coelacanth *Rhabdoderma ardressense* is one of the five species recorded from the Carboniferous of Britain that is still recognized as distinct (Forey, 1981): the 15 invalid species that had been erected on the basis of scale ornament are better interpreted as variants of *R. elegans* or *R. tingleyense*. *Rhabdoderma ardressense* is known from only two specimens, which were described by Moy-Thomas (1937c) and Forey (1981). In Britain, *Rhabdoderma* is restricted to the Carboniferous, and mainly to the Late Carboniferous. The type species, *R. elegans* from Linton, Ohio, shows the braincase completely ossified in the adult. *Rhabdoderma* is classified as the primitive sister-group to the Suborder Coelacanthoidei (Forey, 1981; Figure 9.24).

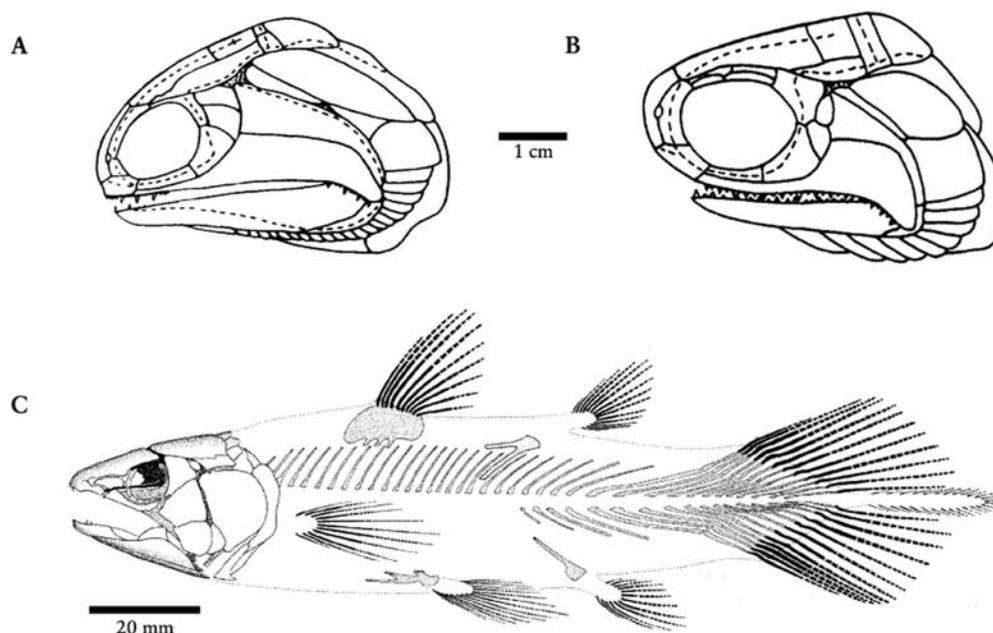


Figure 9.24: Ardross Castle site fossil actinopterygians: (A) *Watsonichthys pectinatus* Traquair, skull in lateral view (after Gardiner, 1963); (B) *Rhadiniscus wrighti* White, skull in lateral view; (C) the coelacanth *Rhabdoderma*, restoration in lateral view (after Forey, 1981).

A specimen of *Rhadinichthys carinatus*, originally said to be from Wardie (q.v.), was described by White (1937) from Ardross. The specimen shows signs of having decomposed fairly extensively prior to burial; the head bones have all but gone, the scales are scattered and some of the fins are missing.

*Rhadiniscus* is distinguished from *Rhadinichthys* by fewer branchiostegal rays and the more divided lepidotrichia. It is confined to the Lower Carboniferous of Scotland (Lehman, 1966), and is an elongated early actinopterygian with a stout caudal peduncle, rhombic body scales which are strongly serrated behind, and with a very oblique suspensorium. Only small marginal teeth are known and the branchiostegal rays never exceed four pairs (White, 1937). *Rhadinichthys wrighti* was described by White (1937) from a single specimen which lacks skull and ventral fins (Figure 9.24 B).

A nearly complete specimen of *Elonichthys robisoni* from Ardross Castle was described by White (1937) and had originally been referred to a new species by Traquair, but White (1937) synonymized it with the species from Burdiehouse (Traquair, 1877–1914). This species is the commonest fish in the Lower Carboniferous of the Forth Basin.

*Watsonichthys* (Figure 9.24) is distinguished from *Elonichthys* by the presence of an epipreopercular, by a rounded snout, by the very long, fringed anal fin and by the lepidotrichia of the pectoral fins being separated at the base (Lehman, 1966). It is known from the Lower Carboniferous of Scotland and the Upper Dwyka (Karoo System) of South Africa (Gardiner, 1963; Lehman, 1966). Only one species occurs in Scotland, *W. pectinatus* from Gilmerton. The *Watsonichthys* terminal group (Gardiner and Schaeffer, 1989) includes *Rhabdolepis*, *Cosmoptychius*, and *Streph-eoschema* amongst others, besides *Watsonichthys*. *Watsonichthys* lacks a postleithrum, a feature that is common in lower actinopterygians such as *Cheirolepis* and *Stegotrachelus* (Gardiner and Schaeffer, 1989). *Watsonichthys pectinatus*, a large fusiform species reaching almost 1 m in length, was described by Gardiner (1963).

*Cheirodus crassus* was 0.14–0.15 m long and the same height. A nearly complete specimen was described by White (1937), which showed for the first time the shape and other features of this species, which had previously only been known from the type suite of seven scales from Abden (q.v.; Traquair, 1890c).

The holocephalan *Eucentrurus paradoxus* Traquair, 1905 is based on a distorted unique specimen, and is the sole representative of the Eucentruridae bradyodonts (Moy-Thomas 1937d) of the Order Chondrenchelyiformes. This order contains three species, *Chon-drenchelys problematica*, *Harpagofututor volsellorhinus* and *E. paradoxus*. The head of *E. paradoxus* is an undescribable mass that contains a bradyodont-type tooth plate, and the body made up of minute 'spinelets' (Traquair, 1905c; Moy-Thomas, 1937d). The remains of pectoral and pelvic girdles and of calcified centra in the tail can be seen. Zangerl (1981) stated that *Euphyacanthus semistriatus* was described from spines and cannot be assigned with certainty to any group of elasmobranchs because the remains are too fragmentary.

Other fish species from Ardross Castle are more fully described in the Foulden, Glen-cartholm and Abden reports (q.v.).

## Interpretation

In the absence of detailed sedimentological information to the contrary, this environment could be compared to that at Granton (Briggs and Clarkson, 1983; Cater, 1987), where shrimps mostly represent an indigenous fauna inhabiting a stagnant lagoon with fluctuating salinities into which marine incursions brought marine forms and caused mass mortalities of the existing species. This might explain the rarity of fish specimens at Ardross Castle, and decomposition shown by some specimens.

The coelacanth *Rhabdoderma* is a common species in the Late Carboniferous of Europe and North America, where its distinctive scales occur commonly in freshwater deposits. There are also some occurrences in marine beds, which suggests a euryhaline habit.

## Conclusions

The conservation value of the Ardross Castle site lies in the diversity of its fish fauna, which may include 12 species of acanthodians, coelacanth, actinopterygians, sharks and holocephalians. Specimens are rare, perhaps because of inimical environmental conditions. The assemblage of fishes is different from that at other sites of equivalent age in the Forth area, notably in the low percentage of small actinopterygians. Elsewhere, these dominate the faunal assemblage, and those present at Ardross are common forms, such as *Elonichthys robisoni* and *Rhadinichthys carinatus*, both of which may have been able to tolerate a wide range of habitat.

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