

The Story Begins...

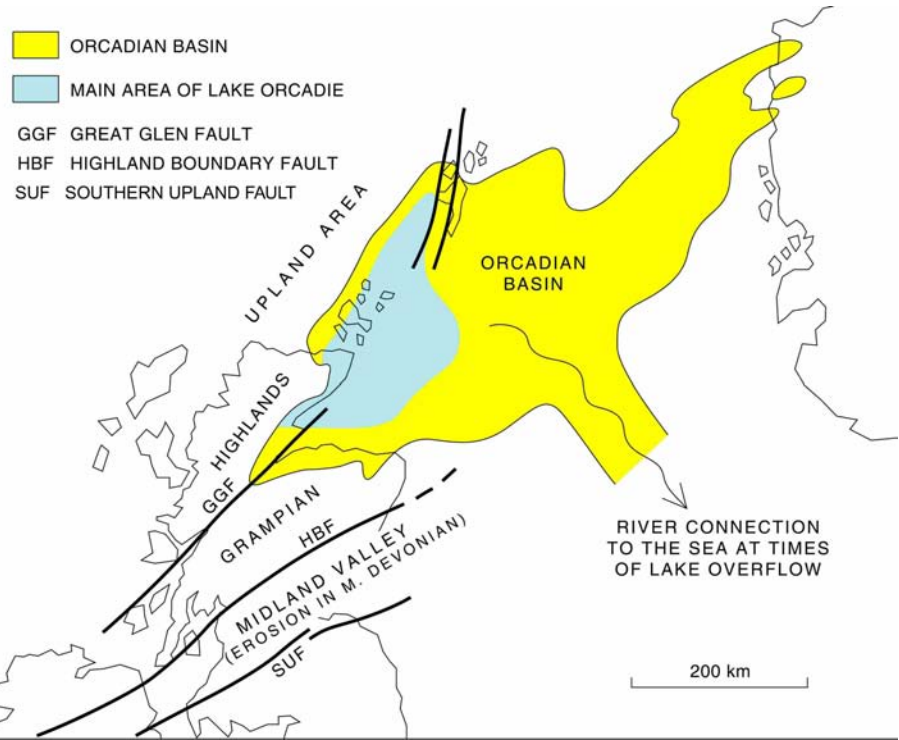
Imagine an ancient tropical lake so deep and dark that the bottom had no oxygen or much life of any sort. Most living things had to live in the shallows where the unpredictable climate made them vulnerable to storms and changes in temperature or salt levels. In this fragile home fish suffered occasional mass deaths and their dead bodies floated out and sank into the mud at the bottom of the lake. 4000 years went by, 2 metres of mud and fish bodies accumulated.....and there the fish lay, perfectly preserved and undisturbed for the next 385 million years.

Now step forwards through time. The dinosaurs came and went. Lake Orcadie where the fish used to live is long gone. But the amazing fossilised fish are still here in the Caithness Flagstone. They were discovered when Achanarras Quarry was first worked for flagstones and roofing slates in the 1870s and their story helps us understand evolution and the geological formation of Scotland.



Ancient Geography

Scotland has not always looked like it does today. 400 million years ago it was south of the equator and part of a huge mountain range, higher than the Alps, that stretched from North America to Norway. The mountains were formed when ancient oceans were destroyed and continents collided together. Millions of years of erosion gradually wore down the high peaks and powerful rivers washed the sand and mud into lakes. In the lakes it settled in layers and helped preserve the remains of plants and animals. This is what happened at Lake Orcadie and other similar lakes that existed in the area that now lies between Shetland and Inverness.



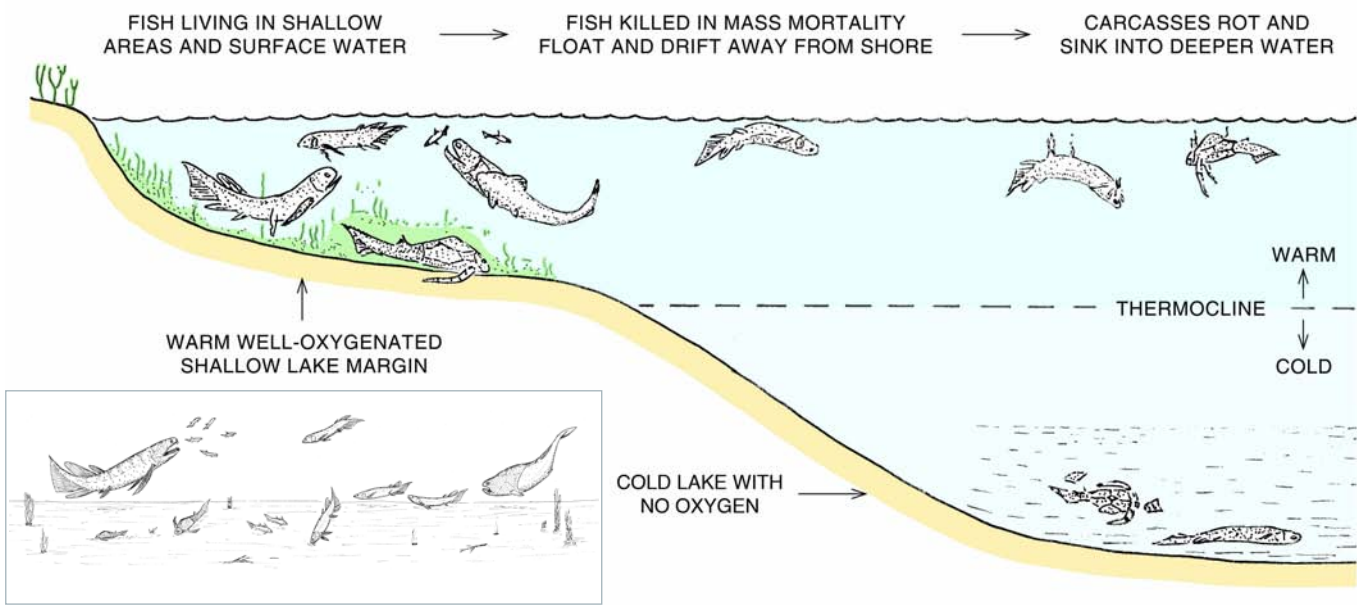
Achanarras Quarry Site of Special Scientific Interest (SSSI)

Achanarras Quarry was once part of Lake Orcadie and there, in what is known as the *fish bed*, you can find more species of Old Red Sandstone fossil fish than anywhere else in Scotland. These include fossils of armour-plated fish, the ancestors of species we see in the fishmonger's today. The armour plating offered some protection from larger predators, whose fossils can also be found. Achanarras Quarry SSSI is renowned all over the world for its well preserved fish of the Middle Devonian age (385 million years ago) and is managed by Scottish Natural Heritage (SNH).



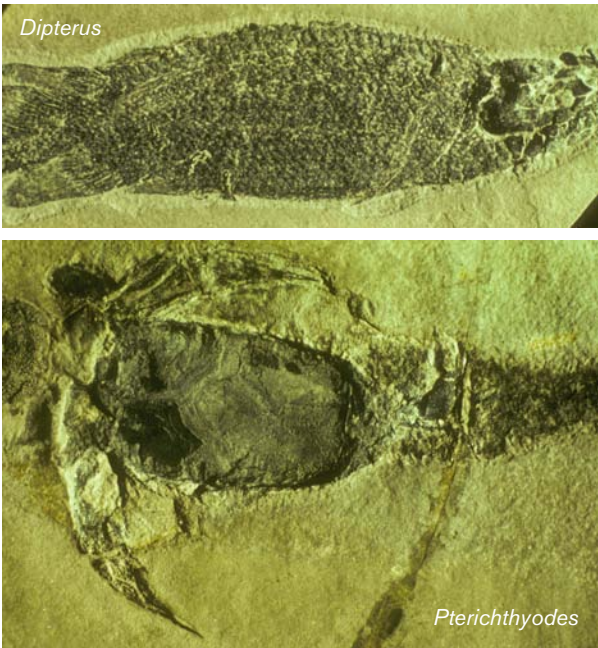
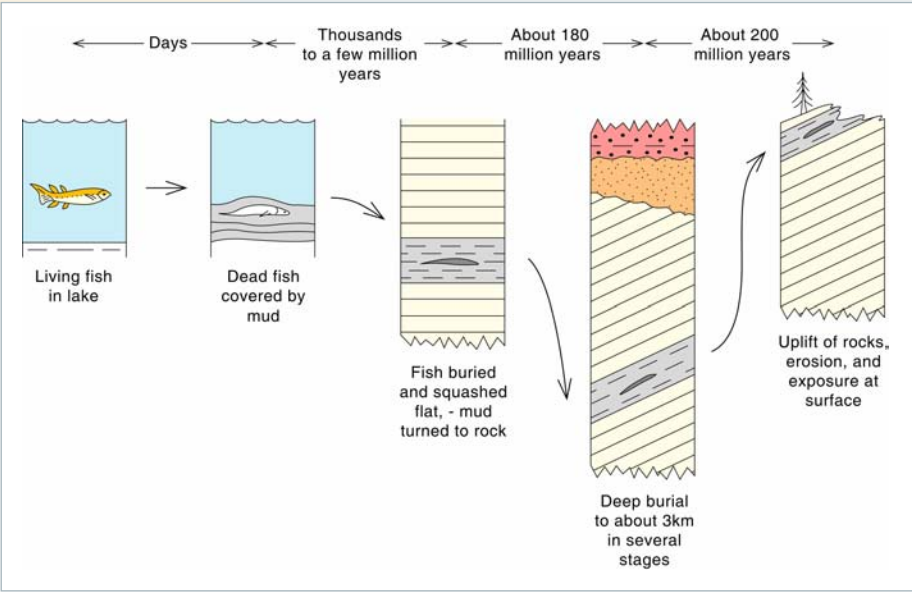
The Lake Environment

Lake Orcadie expanded and contracted as the Middle Devonian climate varied. At times of low water supply, when the climate was warm and dry, it was reduced to a salty *inland desert drainage basin*. However during wetter and probably cooler periods, the lake filled and overflowed, allowing fish to migrate into it from the sea. The *fish bed* was deposited when the lake was full, and the water tens of metres deep. Fine layers in the bed record a seasonal climate as the sediment was being deposited over some 4,000 years. The fish mainly lived in the shallow oxygen rich water of the lake margins and mass deaths might have been caused by algal blooms (a rapid increase in the population of simple plants) removing oxygen from the water, storm activity, and the water getting too hot or salty. All these processes cause fish mortality events even today.



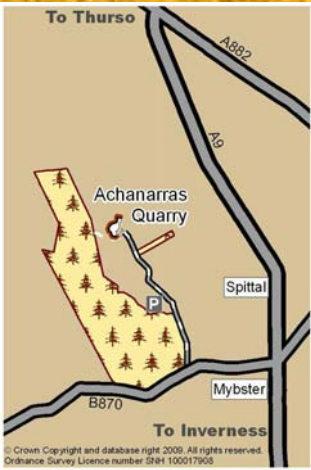
Preservation of the Fish

The fish are preserved in flagstones of the *fish bed*. The detail of preservation is such that delicate fin structures and even skin outlines are seen in the best specimens. The fish carcasses were gently covered by sediment and gradually buried and during this phase the internal structure of most of the fish decayed. Further burial squashed the fish flat and the lake mud was converted to solid rock. Many millions of years later the rocks were uplifted, eroded and finally quarried to reveal the *fish bed*.



Directions to the Quarry

On travelling North up the A9 towards Thurso turn left on to the B870 at Mybster. This turning is just before you reach the village of Spittal. On the B870 take the first turning on the right (about 1km west of the Mybster junction beside a forestry plantation). Both of these turnings are marked with brown tourist signs for 'Achanarras Quarry'.



This track will take you to the quarry car park. Once at the car park, there is a panel with a map indicating where the quarry is located. Please shut any gates you open behind you as you walk to the quarry.

Please note that there are no toilet facilities at the site.

Industrial history of Achanarras Quarry SSSI

The Achanarras Quarry started as a small farm quarry in 1870. Later it was worked by the Thurso Flagstone Quarry, and by 1891 the fish bed was exposed. The quarry fell into disuse in the early 20<sup>th</sup> Century, but was worked for roofing slates in 1959-61. In the early 1970s there was minor quarrying activity. Wheeled wagons on rails, called bogies, were used to take the waste from the quarry to the outer tip. During working the water was drained from the quarry by means of a siphon. It took about 10 days to empty. The last time it was drained was in 1980 for a scientific study of fossil distribution through the fish bed.



For the next 20 years collectors scoured the tips for fossils and it became increasingly difficult to find new specimens.

Contact details

Please let SNH know if any rare or particularly fine fossils are found.

Scottish Natural Heritage  
North Highland Area Office  
The Links, Golspie Business Park, Golspie, KW10 6UB  
T: 01408 634063 E: north.hIGHLAND@snh.gov.uk

www.snh.org.uk

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All of nature for all of Scotland

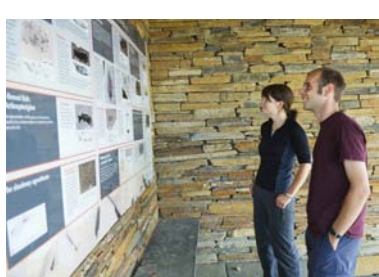
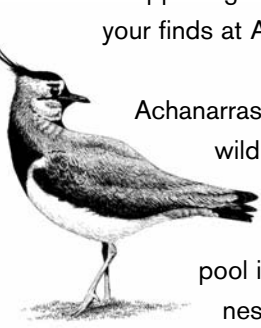
Modern Achanarras

Now, parts of the tips are turned over regularly using a mechanical excavator. This action provides more material for collectors to search for fossils, and ensures that this internationally important locality does not become overgrown. These activities have resulted in several new species being found and described.



Digger turning over quarry material

The facilities at Achanarras were upgraded in 2008. You can now discover more about the fish, walk a geological 'timeline', search for fossils, find out what has been happening in the fossil world and record your finds at Achanarras.



Achanarras Quarry is also located in a wild area with interesting plants and animals. Watch out for frogs by the quarry pool in the early spring, and nesting birds such as oystercatcher, curlew, lapwing and skylark. You may even be lucky enough to spot a hen harrier hunting over the heather moorland.

Other Fossil Sites in Caithness

Fossils can be found at many other sites in Caithness. These often contain fish beds of different ages from that at Achanarras. By comparing the species found at each site the history of Lake Orcadie, and which fish species lived at particular times, can be revealed. Most of the other sites are on private land where you will need the owner's permission to collect fossils. The most important areas are also protected as Sites of Special Scientific Interest (SSSIs). There is the opportunity to see some preserved fossils at the Caithness Horizons museum in Thurso.

Further Information

For further information on local geology and fossils see *Excursion guide to the Geology of East Sutherland and Caithness*. N H Trewin and A Hurst (eds) Dunedin Academic Press. 2009

For imaginative time-travel stories of excursions to famous Scottish fossil localities (including Caithness fish, and the Jurassic of Helmsdale and Skye) see *Fossils Alive!* by N H Trewin (Dunedin Academic Press, 2008)

For more information on the geology and landscape of Scotland please visit the SNH website to view the online publication: *Scotland: The Creation of its Natural Landscape*, and other regional publications in the series *A Landscape Fashioned by Geology*.

Acknowledgements

Majority of text, photographs and sketches by Professor Nigel H. Trewin, University of Aberdeen.

The Scottish Fossil Code

At Achanarras Quarry, the Scottish Fossil Code has replaced the fossil collecting permit system that was previously in operation there. Searching for and collecting fossils is permitted subject to visitors following the Fossil Code. You can download a copy of the Scottish Fossil Code from the SNH website ([www.snh.org.uk/fossilcode/](http://www.snh.org.uk/fossilcode/)). Please read the information about fossil collection at Achanarras Quarry SSSI on arrival to the car park.



Scottish Outdoor Access Code

The Scottish Outdoor Access Code applies to all land in Scotland. The access track to Achanarras Quarry is through private land and the Access Code should therefore be followed at all times. Please read the safety notice on arrival to the quarry car park.



Fossil Fish of Caithness

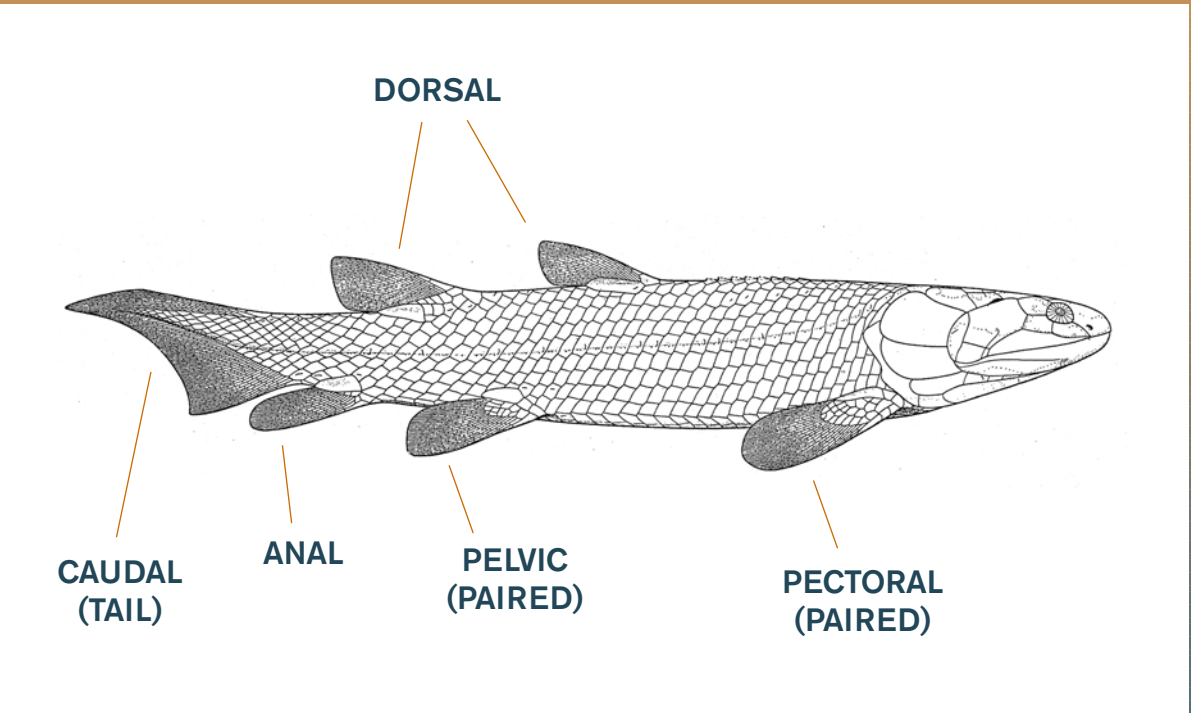
THE 385 MILLION YEAR OLD STORY OF 'ACHANARRAS' QUARRY





# A Guide to Achanarras Fossils

## Fish fins



## Lobe-finned fish, Dipnoans and Crossopterygians

These fish have leaf-shaped paired pectoral and pelvic fins. The lobe-finned fish gave rise to amphibians and later land-dwelling vertebrates. Many representatives of these groups are found in Caithness, including Thursius, Gyroptichius and Tristichopterus. Three representatives are found at Achanarras.

### Dipterus

This primitive lung fish (Dipnoan) is the most common of the larger fishes in the quarry. It has lobed pectoral and pelvic fins and rounded scales. Its maximum length is about 40cm, but most found are around 15 cm long. Flat tooth plates indicate that it had a varied diet of plants and small aquatic animals. It was probably capable of living in water with a low oxygen content and was able to gulp air. It is related to modern lung-fishes that inhabit rivers in

Australia, Africa and South America.

### Osteolepis

This crossopterygian lobe-finned fish has enamelled rhomboid scales. It is scarce at Achanarras, but common in Orkney. The teeth were small but sharp and numerous. It probably preyed on small fish and other animals in the lake. Specimens found are generally about 15cm long.

### Glyptolepis

This large lobe-finned fish grew to over 50cm and had strong sharp teeth. It was the top predator at Achanarras, and specimens have been found showing the tail of a prey item sticking out of its mouth. It was a lurking predator like the (unrelated) modern pike. Individual scales are up to 2cm in diameter with a distinctive pattern; the name means 'carved scale'.

## Ray-finned fish, an Actinopterygian

The sole representative of this group at Achanarras is considered to be a distant relation of modern bony fishes (e.g. trout and cod).

### Cheirolepis

This fish is rare and grew to 30cm long. It is covered in tiny scales less than a millimetre in size. The sharp teeth indicate that it was a predator.

## Armoured Fish - the Placoderms

Coccosteus, Rhamphodopsis, Homosteus, Actinolepis and Pterichthyodes are representatives of the extinct group of armoured placoderm fish. The head and part of the body is covered with bony plates. All except Pterichthyodes lacked scales on the rest of the body, so internal features can be seen in fossil specimens.

### Coccosteus

In this common 30cm long Achanarras fish, the head and part of the body are covered in bony plates with an ornament of small bumps. The rest of the body had no scales so the internal skeleton can be seen in fossils. The jaws had sharp-edged plates that acted like shears; probably used to take bites from prey. Analysis of stomach contents shows that *Dipterus* and acanthodians were on the menu.

### Homosteus

A large fish with an armoured body up to 40cm long. The tail has not been found yet! Isolated thick bony armour plates are sometimes found in the quarry. The flattened shape of the fish indicates a bottom-dwelling habit, possibly a large scavenger.

### Rhamphodopsis

This small (up to 15cm) and scarce fish had a partly armoured head and a naked body as in *Coccosteus*; hence the internal backbone can be seen in the fossil. There is a long whiplash tail, and the fish probably swam rather like an eel.

### Pterichthyodes

This curious fish was first discovered by Hugh Miller at Cromarty in the 19<sup>th</sup> Century. The pectoral fins are represented by paddles that move with the box-like body armour by ball and socket joints. The jaws were weak and situated on the underside of the animal. This bottom-dwelling fish found its food by grubbing in the mud of the lake shallows.

### Actinolepis

The first recorded Scottish specimen of this fish was found at Achanarras in 1998. It is very similar to forms from the Baltic area and strengthens ideas that there was a connection between these areas in the Devonian. It has bony plates that could easily be mistaken for *Coccosteus*, but has two distinctive pointed plates bearing a row of spines.

## The shadowy agnathans

Achanarella and Cornovichthys are recently described animals remotely related to the modern lamprey. They both lacked jaws and a backbone and are preserved as no more than a black stain on the rock. Achanarella is not rare, but Cornovichthys is only known from two specimens.

### Achanarella

Has a distinctive black blunt arrowhead-shaped head, sometimes showing a hole representing the mouth. The body is seldom more than a grey smear. It is common on a few bedding surfaces.

### Cornovichthys

Shows big eyespots, and a dark mass within the body representing internal organs. The tail is unusual with the fin on the top side of the body, like an inverted shark tail.

## Spiny-finned fish, the Acanthodians

Various species of Diplacanthus, Cheiracanthus and Mesacanthus occur at Achanarras. They are all characterised by spines supporting the fins, and a covering of tiny scales. They are frequently poorly preserved with a tendency for the head to be fragmented.

### Mesacanthus

This small fish is common and is seldom larger than 5cm. Several may be found on a single slab of rock. It was probably a shoal fish feeding on microorganisms (tiny, microscopic plants and animals) in the lake water. This fish was probably a snack for the predator fish.

### Diplacanthus

This fish is characterised by two dorsal fins with supporting spines, and strong pectoral fin spines. Specimens more than 10cm long are rare. Two species are present at Achanarras.

### Cheiracanthus

This fish only has a single dorsal fin on the top of its body, and the spines are more delicate than those of *Diplacanthus*.

## Palaeospondylus – a zoological enigma

Despite recent suggestions that Palaeospondylus is a larval (young) lungfish but nobody really knows where this species fits in to the evolution of vertebrates. It is common at Achanarras, but very rare elsewhere in Caithness and Orkney. It is not known from anywhere else in the world.

It has a well-developed skull, back bone, and tail fin. It lacked scales, but a faint skin outline can sometimes be seen. Most specimens are preserved in a curved tadpole shape.

## Coprolites, fish excrement

Elongated solid black masses up to 5cm long, sometimes with a lumpy or rough surface texture are fish coprolites (excrement). They have been found within *Coccosteus*, and sometimes contain fish scales.

## Other fossils from Achanarras

There are few fossils apart from fish found in the quarry. Only a single arthropod and some plants have been found so far.

### Arthropods

An arthropod is an animal with a hard, segmented outer skeleton such as a spiders, scorpion, crabs and insects. The only other animal, apart from fish, known from Achanarras is a single shadowy specimen of an arthropod called *Achanarraspis*. It is probable that there were lots of small arthropods in the lake, but they were seldom preserved.

### Fossil plants

Fragments of plant stems are found in the fish bed and in the rocks above the fish bed. They floated out from the shore, became waterlogged and sank to the lake floor where they were buried by mud.

Please let SNH know if you find any fossils not on this sheet, (email: [north.highland@snh.gov.uk](mailto:north.highland@snh.gov.uk)) and take your find to an appropriate museum for identification (see guidance in the Scottish Fossil Code, [www.snh.org.uk/fossilcode/](http://www.snh.org.uk/fossilcode/))