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Arthrodire predation by *Onychodus* (Pisces, Crossopterygii) from the Late Devonian Gogo Formation, Western Australia

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During late September - early October 1990 a joint expedition by the Australian National University Geology Department and the Western Australian Museum collected a large number of well-preserved fossil fishes from the Gogo Formation, outcropping approximately 100km east of Fitzroy Crossing. Amongst the new finds is a well-preserved example of the predatory crossopterygian fish *Onychodus* sp. The specimen (WAM 90.11.1; Figure 1) is of special interest though because the bones of an arthrodire (Pisces, Placodermi) were found enclosed within the cranial bones of the *Onychodus* showing the first direct evidence of active predation on arthrodires by *Onychodus*. The nature of fossilisation of the fish remains in the Gogo Formation is such that, after death, the onset of concretion formation was rapid, preventing damage to many of the delicate perichondral cartilage bones of the gill-aches (Long 1988). Because the skull bones and most of the body of the *Onychodus* were not all present in the concretion, it is concluded that the specimen was partially disrupted after its death. This is not unusual because the skull roof bones of this specimen were only loosely connected, and none were in articulated position. It appears that the *Onychodus* choked on the placoderm and fell to the bottom where it was either partly scavenged or decomposed before a larger section of the head, including the gullet with the placoderm remains, was quickly buried in the sediment.

The placoderm plates were oriented with the anterior of the animal facing the same direction as the anterior of the *Onychodus* specimen. This indicates that the prey was captured by the tail, and then dragged back into the mouth by the large stabbing tooth whorl at the front of the mouth. The placoderm plates lack any markings indicative of a bite by the stabbing symphysial teeth, suggesting that *Onychodus* lunged at the soft fleshy tail of the placoderm rather than grabbing it anteriorly by the dermal armour. Furthermore the placoderm plates, although slightly displaced from their life position, had not been damaged by crushing from the powerful jaws of the *Onychodus*, indicating that the prey item was probably swallowed whole. The *Onychodus* has a lower jaw length of 105mm, suggesting an overall fish length of at least 600mm by comparison with estimates based on other complete *Onychodus* specimens from Gogo. The placoderm is one of the several undescribed new eubrachythoracid arthordires currently under study by workers at the British Museum of Natural History. It is represented by both posterior and anterior ventrolateral plates, a spinal plate and some indeterminate bone fragments. It has a ventral trunkshield about 85mm long, indicating a total fish length of about

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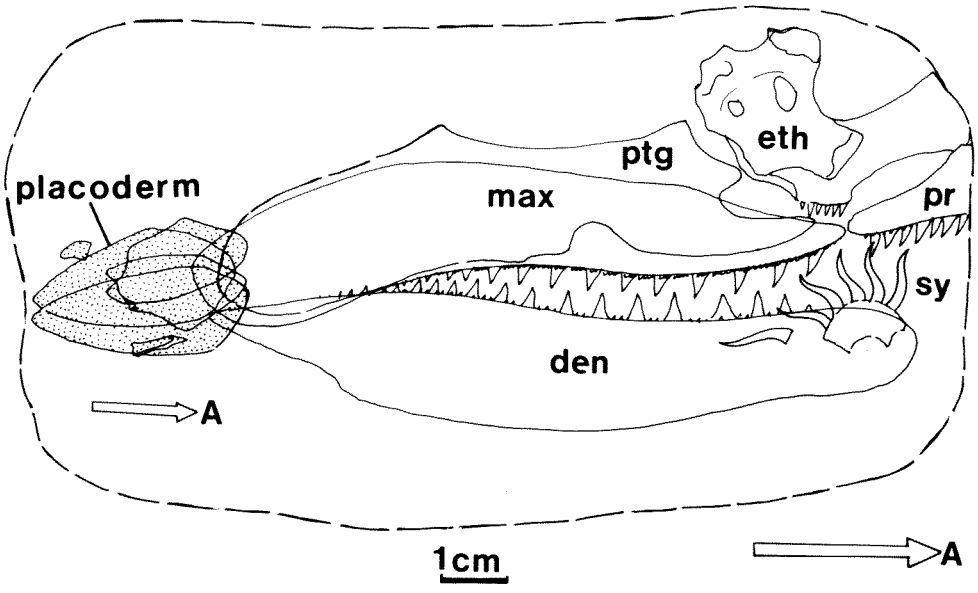

Figure 1. Sketch showing the orientation of some of the large *Onychodus* skull bones and predated arthrodire plates within the shape of the original concretion. Arrows indicate the anterior direction of both specimens.

310mm by comparison with the well-known placoderm *Coccosteus cuspidatus* (Miles & Westoll 1968). This suggests that *Onychodus* was an effective predator capable of attacking and swallowing whole prey items of a size nearly more than half its own body length, unless of course, this case is an exception which resulted in the death of the predator. Figure 2 shows a reconstruction of *Onychodus* catching an arthrodire by its tail.

A description of the Gogo *Onychodus* is currently being prepared by Dr S. M. Andrews (Royal Scottish Museum), and until this work is published the anatomical features of the feeding mechanism cannot be discussed in detail. However, it can be seen from the new specimen, which shows the anterior ossification of the braincase intact, that the skull was highly kinetic and the snout could be raised independently of the largely unossified posterior neurocranial component (the oto-occipital). The cavities within the snout for housing the large symphysial toothwhorls indicate that when *Onychodus* closed its mouth the stabbing teeth would have almost touched the top of the skull roof. The presence of a ligament attachment area on the posterior face of the symphysial tooth whorl suggests that *Onychodus* may have been able to rotate the symphysial tooth-whorls. Thus it was able to lunge out, catch prey and then retract the tooth-whorl to drag the prey back into the buccal cavity.

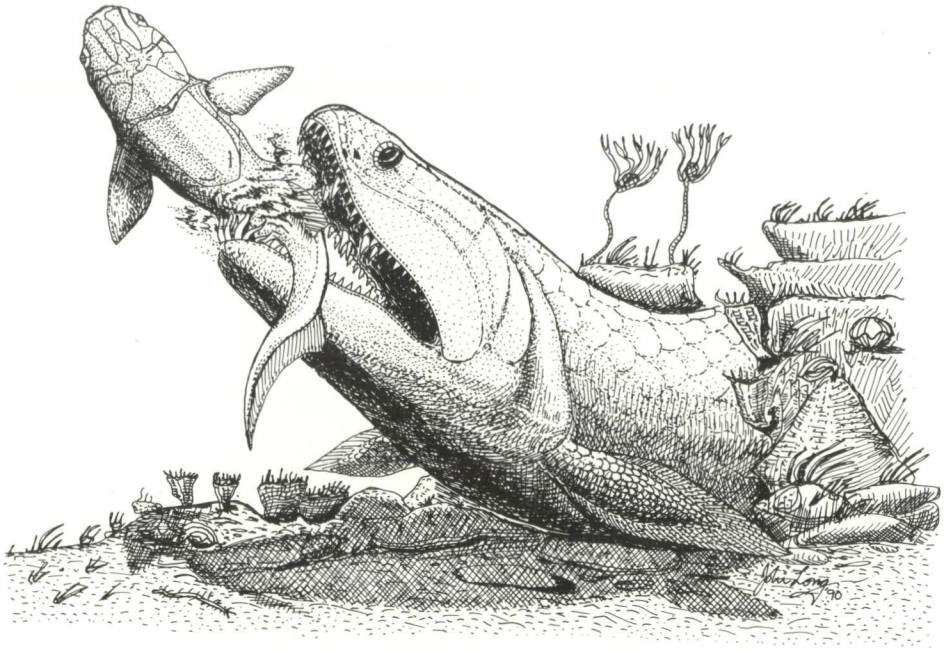

Figure 2. Restoration of an *Onychodus* catching a placoderm fish by the tail using its symphysial tooth whorls and full kinesis of the braincase.

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