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An ichthyosaur fragment from the Cretaceous of Northland, New Zealand

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Abstract The rostrum fragment of an ichthyosaur from Northland in New Zealand is described. The specimen appears to belong to the genus *Platypterygiu*s. It is the first Mesozoic marine vertebrate fossil reported from Northland and the first cranial element of a Cretaceous ichthyosaur from New Zealand. The fragment is, unfortunately, of uncertain provenance and could have come from the widespread Northland Allochthon (Early Cretaceous–Oligocene) or the allochthonous Houhora Complex (late Early Cretaceous) or Whatuwhiwhi Formation (latest Early to Late Cretaceous), perhaps by way of initial derivation from the Early Miocene Omapere Conglomerate.

Keywords Ichthyosauria; *Platypterygius*; Cretaceous; Northland; North Island; New Zealand

INTRODUCTION

In 1974 a farmer, H. R. Watkins, from near Dargaville in Northland, brought a specimen to one of us (JAG-M) for identification. His wife had picked it up as a river cobble that looked unusual and interesting. Examination showed it to be a water-worn and rounded ichthyosaur jaw fragment with teeth and the first find of this group in Northland.

The site from which the fragment was collected (Fig. 1) is some 30 km north-north-west of Dargaville, beside Waiotekumurau Road, Waimatenui, 1600 m south of its junction with Waimatenui East Road. The fossil was found on the true right bank of Waiokumurau Stream on the farm of Bruce J. Morris of Tutamoe, and constitutes fossil locality P06/f1 in the archival Fossil Record File of the Geological Society of New Zealand (in which localities are listed numerically within the appropriate sheet (in this case, P06) of the 1:50 000 map series NZMS 260).

Waiokumurau Stream rises on the eastern edge of Tutamoe Plateau in mid-Tertiary Waipoua Basalt and flows north-east and north, mostly through Early Cretaceous–Paleocene Tangihua Volcanics, before joining Mangakahia River (Hay 1960; Wright 1977). Between the Waipoua Basalt and Tangihua Volcanics occur lenses of Early Miocene Omapere Conglomerate in the northern and central part of the Waiokumurau catchment (Wright 1977). Two south-eastern tributaries, Waiowhata and Pakotai Streams, join Waiokumurau Stream south, i.e., upstream, of the fossil locality. These streams cut across a small area of Late Cretaceous sediments (Hay 1960; Wright 1977) included with the Tangihua Volcanics in the Cretaceous–Oligocene Northland Allochthon (Ballance & Spörli 1979; Isaac et al. 1994). The only other rocks known in the catchment are modern alluvial deposits.

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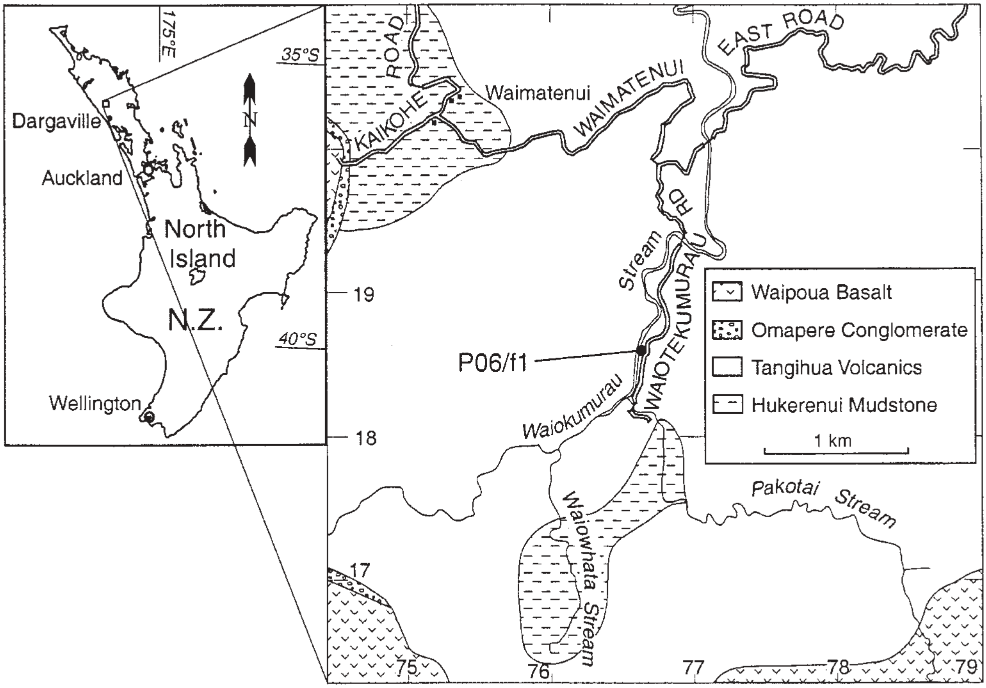

Fig. 1 Geological sketch map of fossil site P06/f1 (after Wright 1977). Omitted is a narrow strip of Holocene alluvium along Waiokumurau Stream. Grid squares are 1 km on each side.

The bone retains some original matrix within the jaw cavities and this is a very hard lithology consisting of clear subangular medium quartz sand supported in dark red-brown mudstone.

The Ichthyosauria are a well-documented group of fossil marine reptiles. From New Zealand only few ichthyosaur remains are known. Hector (1874) described a vertebral centrum from Triassic beds at Mt Potts, Canterbury, and erected the taxon *Ichthyosaurus australis* (later re-named *Ichthyosaurus pottsi* Hector, 1886 and *Ichthyosaurus hectori* Lydekker, 1889) on the basis of this same specimen. Strata at Mt Potts later yielded further remains, mainly vertebrae (for an historical overview see Fleming et al. 1971), but this taxon remains indeterminable. Other Triassic ichthyosaur material, including a well-preserved rostrum fragment with teeth, was reported by Campbell (1965) from Otamita Stream, Southland. Three North Island Lower Cretaceous ichthyosaur specimens (consisting of vertebral centra) were described by Fleming et al. (1971) from Gentle Annie, Mangapurupuru, and Whakarora Streams, all in the Tinui district, eastern Wellington.

Previously unpublished records include a large partial humerus, partial ribs, and other fragmentary bones of Oretian age (latest Carnian to Early Norian, Late Triassic) from the Kiritehere coast, south-west Auckland, and an isolated centrum 98 mm in diam., the only known New Zealand Jurassic ichthyosaur, from the type Aratauran sequence (Hettangian-Sinemurian) of Kawhia. These are held in collections of the Department of Geology, University of Auckland, and were collected by JAG-M and colleagues.

Globally, ichthyosaurs were taxonomically diverse during the Jurassic and are only represented by one genus, *Platypterygius*, in the Cretaceous (McGowan 1972; Maisch & Matzke 2001). During the Early Cretaceous *Platypterygius* had a wide geographic distribution and is known, e.g., from Europe (Kiprijanoff 1881; Broili 1907; Kuhn 1946; Bardet et al.

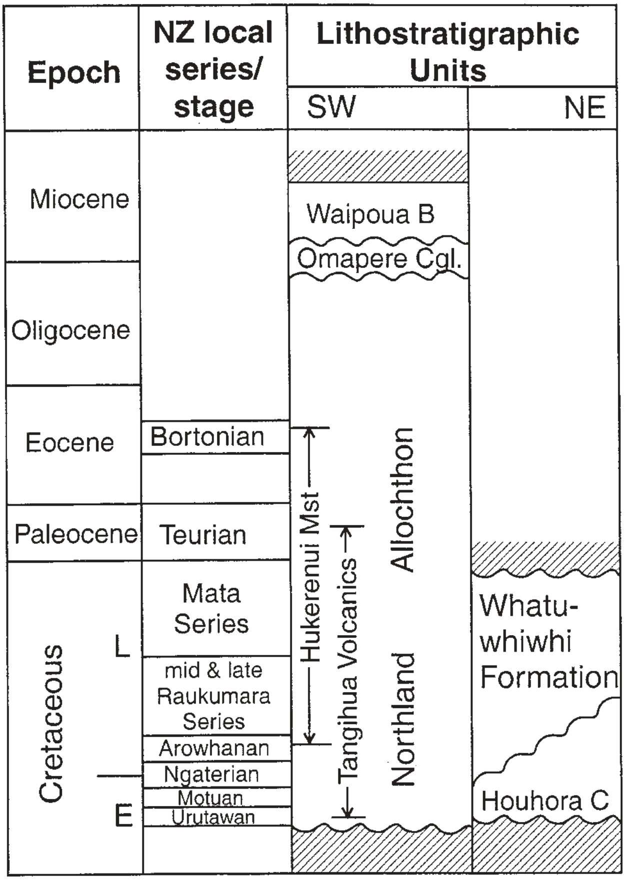

Fig. 2 Cretaceous–Miocene lithostratigraphic units of Northland discussed in the text, and their correlation. Wavy lines show unconformable contacts; names in the series/stage column are stages unless otherwise stated. B, Basalt; C, Complex; Cgl, Conglomerate; E, Early; L, Late; NE, north-east; SW, south-west (i.e., Dargaville area).

1994), America (Romer 1968; McGowan 1972; Páramo 1996), and Australia (Wade 1984, 1990; Murray 1985).

The youngest ichthyosaur described so far came from the Upper Cenomanian of Bavaria (South Germany; Bardet et al. 1994). Other Cenomanian specimens have been described, e.g., by Bardet (1989) and Wittler & Roth (2000). A coracoid from the Maastrichtian was regarded as that of an ichthyosaur by McGowan (1978), but has since been identified as a plesiosaurian bone by Baird (1984). Hence, there is a universal agreement that ichthyosaurs became extinct at the Cenomanian-Turonian boundary (e.g., Bardet et al. 1994; Sander 2000).

Institutional abbreviations: AU, Department of Geology, University of Auckland, Auckland, New Zealand; QM, Queensland Museum, Brisbane, Australia.

PROVENANCE

Fig. 2

Northland Allochthon

The Cretaceous sediments within the Waiokumurau catchment were included by Hay (1960) within his Titoki Shale, of grey, green, and chocolate shale, now included in Hukerenui Mudstone of Isaac et al. (1994). This unit is dated as ?Arowhanan to ?Bortonian (?Cenomanian–Turonian to Late Eocene). Derivation of the ichthyosaur from this unit is unlikely because of the coarser nature of the included matrix, but not impossible, because of the melange nature of the Northland Allochthon.

Omapere Conglomerate

Derivation from the Omapere Conglomerate is another possibility. Clasts in this formation are heterogenetic and dominantly igneous, of Tangihua origin, but include also greywacke, tuff, argillaceous limestone, and calcareous mudstone (Isaac et al. 1994), some of which originate from the Northland Allochthon. The Omapere Conglomerate is up to 450 m thick to the north-west at Omapere itself, but thins rapidly to the south and east; Wright (1977) showed it to be < 5 m thick adjacent to the Waiokumurau valley.

If the ichthyosaur clast came from the Omapere Conglomerate, it could have been incorporated into that unit after erosion from nearby Northland Allochthon, but an alternative that cannot be ignored is derivation from autochthonous Cretaceous strata.

Autochthonous Cretaceous

The Houhora Complex and Whatuwhiwhi Formation (Hay 1975; Isaac et al. 1988, 1994) are the only such units now exposed in Northland. The Houhora Complex includes quartzofeldspathic sandstones and mudstones, mostly of turbidity current and high density gravity flow origins, of Early Cretaceous (Urutawan–Motuan, i.e., Albian) age. The Whatuwhiwhi Formation consists of up to 270 m of upwards-fining conglomerate, sandstone, and mudstone of possibly Early Cretaceous, more probably Late Cretaceous (?Clarence Series, Raukumara–Mata Series) age. The presence of these units, even though at considerable distance to the north-east, reinforces the possibility of marine beds from which the ichthyosaur fragment could have been derived having been present further south, nearer the Waiokumurau valley.

SYSTEMATIC PALEONTOLOGY

Ichthyosauria de Blainville, 1835
Euichthyosauria Motani, 1999
Thunnosauria Motani, 1999
Ophthalmosauridae Baur, 1887

Platypterygius von Huene, 1922

cf. *Platypterygius* sp. Fig. 3

MATERIAL: V345, rostrum fragment, formed by the premaxillae and nasals; collection catalogue number AU 5648, Paleontology Collection, Department of Geology, University of Auckland, New Zealand.

LOCALITY: P06/f1; grid reference P06/766186 approximately; 173°43′44″E, 35°38′04″S; Waiokumurau valley, Waimatenui.

AGE: Given the uncertainty of the source of the bone, its age must also be unclear. If derived from the Houhora Group it is of Early Cretaceous age; if from the Whatuwhiwhi Formation it is more likely Late Cretaceous; and if from the Northland Allochthon it would also be of late Early or Late Cretaceous age. In the absence of a clear lithologic match with a unit of known age, the specimen can only be dated as Cretaceous.

DESCRIPTION: The specimen represents a part of the rostrum and consists of portions of both premaxillae and nasals. Dorsal and ventral sutures are clearly visible separating the left and right premaxilla, which have suffered slight post-mortem relative displacement of c. 3 mm. In lateral view, there is a long, straight, moderately deep, 4–5-mm-wide longitudinal groove

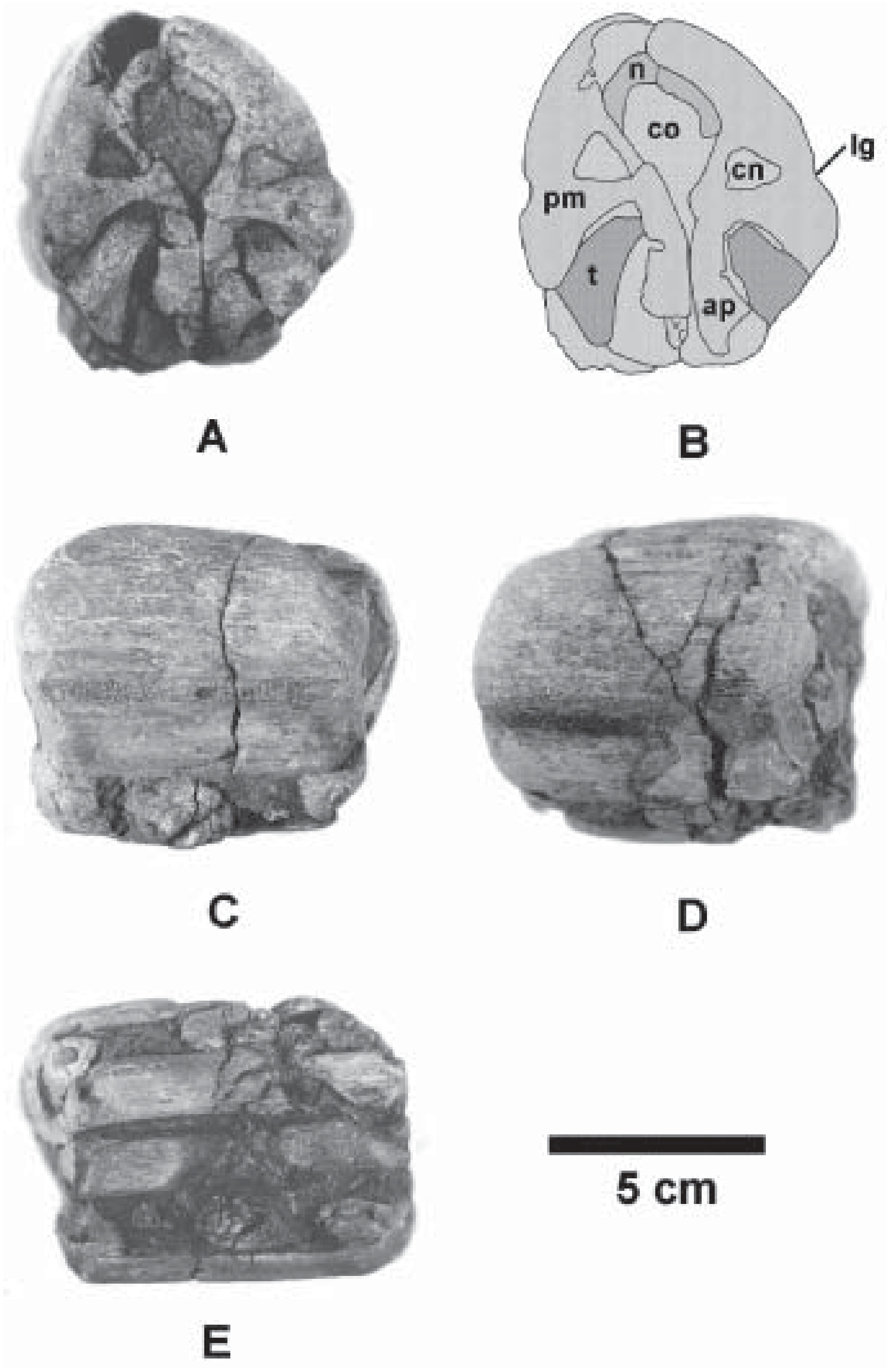

Fig. 3 cf. *Platypterygius* sp. Rostrum fragment from Dargaville. **A**, Anterior view; **B**, explanation of the structures visible in A (ap, alveolar process; cn, cavity for nutritive vessel; co, central opening; lg, longitudinal groove; n, nasal; pm, premaxilla; t, tooth); **C**, right lateral view; **D**, left lateral view; **E**, ventral view, showing the abraded stumps of three adult teeth in each alveolar groove; one juvenile tooth lies in the right (lower) groove in each of the gaps between the adult teeth.

running anteroposteriorly along the fragment (Fig. 3C,D). In anterior and posterior view, a cross-section through the rostrum is present, in which only the anterior side is well preserved (Fig. 3A,B). Here, three cranial openings are visible. In the centre, there is a large opening, which is somewhat pyriform in outline, with a narrow ventrally directed tip. The nasals are situated in the dorsal half of this opening. They are rather thin compared with the massive premaxillary roof that covers them and follow the curvature of the central opening. Lateral of the latter, a smaller, triangular cavity is present on each side. These cavities are clearly separated from the central opening by a bony wall and are situated at about the level of the longitudinal groove. According to Sollas (1916, p. 118) the cavities probably represent canals for nutritive vessels and nerves. The tooth-bearing parts of both premaxillae are well developed and fragments of three relatively large teeth are present in each (Fig. 2A–C,E). In the right premaxilla there are also two replacement teeth, one of which shows the enamel on the labial side; the other shows the conical form of the crown. The enamel bears numerous closely set fine apicobasal striations. The adult teeth are badly abraded but can be seen to be anteroposteriorly oval in section, with rounded oval root ends (Fig. 2A,B, lower left). Two crowns show indications of a weakly developed longitudinal flange on their distal sides. Teeth are set in two longitudinal alveolar grooves in the premaxillae, showing the aulacodont condition typical for post-Triassic ichthyosaurs (*sensu* Mazin 1983; Maisch & Matzke 2001). These grooves have rounded bottoms and divergent sides which become 13–15 mm apart at the surface; they are 30 mm deep on the lingual side and 25 mm deep labially. Massive, long, alveolar processes form the medial border.

MEASUREMENTS: Length anteroposteriorly c. 95 mm, greatest height of the rostrum c. 70 mm, greatest diameter anteriorly c. 63 mm, greatest diameter posteriorly c. 65 mm.

DISCUSSION: The fragment AU V345 belonged to the anterior section of the rostrum. This is clear because neither the maxillae nor the vomers are present, the nasals are well covered by the premaxillae, and the longitudinal lateral groove is distinctly developed. An almost identical section of the skull of ichthyosaurus was described and figured by Sollas (1916, fig. 19).

A generic determination of the specimen is rather difficult. The aulacodont mode of tooth inseration is present in all post-Triassic ichthyosaurs (= Neoichthyosauria *sensu* Sander 2000) and, thus, of no taxonomic use. The teeth are ornamented with distinct apicobasal ridges, a condition present in all ophthalmosaurids and most neoichthyosaurs with the exception of the Leptonectidae and *Aegirosaurus* (see Maisch & Matzke 2001, character 3). The upper parts of roots of the teeth are elliptical in cross-section. In *Platypterygius* the teeth appear to be usually quadrangular in the lower part of the root, elliptical in the upper one and circular at the tip. This character was first described by Carter (1846) and later by Owen (1851) for *Platypterygius campylodon* (now a nomen dubium; see Bardet (1990)). Bardet (1990) discussed the feature and found that it could be diagnostic for *Platypterygius*. In Jurassic taxa the tooth morphology varies and can even be different in the jaws of the same specimen (Bardet 1990).

In its general appearances AU V345 matches well with the corresponding anterior section of the rostrum of *Platypterygius longmani* (QM F2453; SS pers. obs.; Fig. 4). Also, according to McGowan (1972), Bardet et al. (1994), Sander (2000), and Maisch & Matzke (2001), *Platypterygius* is the only ichthyosaur genus clearly defined in the Cretaceous. Therefore, despite the lack of positive anatomical evidence for generic allocation, the specimen here is ascribed tentatively to *Platypterygius* on the grounds of its stratigraphic position, its close similarity to the comparable portion of the type specimen of the Australian *P. longmani*, and the fact that this genus has already been recorded from the Australasian Cretaceous.

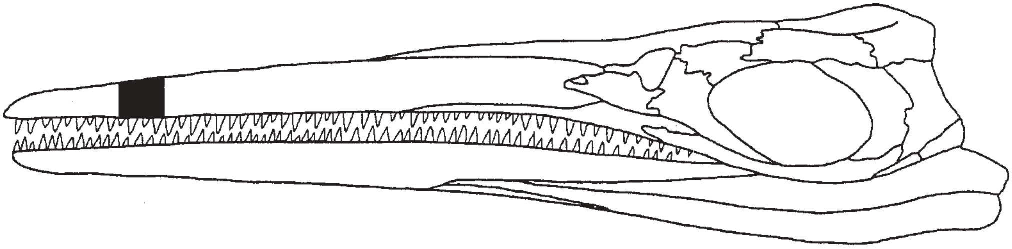

Fig. 4 Drawing of the skull of *Platypterygius longmani* (QM F2453), showing the possible position of AU V345 (modified from Maisch & Matzke 2001).

In addition, there are no anatomical features present in the specimen that deny the feasibility of this determination.

Nine species of *Platypterygius* are regarded as validly separable according to Bardet (1992), Maisch & Matzke (2001), and Páramo (1996): *P. americanus* (Nace, 1939, from Wyoming, USA), *P. bannovkensis* (Arkhangelsky, 1998, from Russia), *P. bedengensis* (Efimov, 1998, from Russia), *P. birjukovi* (Otschev & Efimov, 1985, from Russia), *P. hercynicus* (Kuhn, 1946, from Germany), *P. kiprijanoffi* (Romer, 1968, from Russia), *P. longmani* (Wade, 1990, from Australia), *P. platydactylus* (Broili, 1907, from Germany), and *P. sachicarum* (Páramo, 1996, from Colombia).

Although only a small fragment of the original skeleton, this specimen is an important record representing the first Mesozoic marine vertebrate reported from Northland and the first cranial element of a Cretaceous ichthyosaur in New Zealand.

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