An istiodactylid pterosaur from the Upper Cretaceous Nanaimo Group, Hornby Island, British Columbia, Canada

Victoria M. Arbour and Philip J. Currie

Abstract: An unusual jaw found in a calcite nodule from Collishaw Point, Hornby Island, British Columbia (off the east coast of Vancouver Island) represents the first definitive pterosaur found in British Columbia, and the first istiodactylid from Canada. The nodule was derived from the Northumberland Formation (Nanaimo Group), a fossiliferous formation known for producing numerous plants, invertebrates, sharks, and mosasaurs. The pterosaur is represented by the anterior portion of the rostrum, including the anterior edge of the nasoantorbital fenestra, and numerous small, triangular teeth lacking denticles. These teeth are similar in overall morphology to the teeth of istiodactylids, but are smaller, more numerous, more tightly packed, and have proportionately smaller crowns. Although fragmentary, this specimen is diagnostic and represents a new genus of istiodactylid pterosaur. Its presence in the upper Campanian Northumberland Formation makes this the latest occurring istiodactylid and extends the stratigraphic and geographic range of this enigmatic group of pterosaurs.

Résumé: Une mandible inhabituelle trouvée dans un nodule de calcite provenant de Collishaw Point, sur l’île Hornby, en Colombie-Britannique (côte est de l’île de Vancouver) représente le premier exemple définitif de pterosaurus de cette province et le premier istiodactylidé du Canada. Le nodule est dérivé de la Formation de Northumberland (Groupe de Nanaimo), une formation fossilifère connue pour ses nombreux fossiles de plantes, d’invertébrés, de requins et de mosasaures. Le pterosaurus est représenté par la partie antérieure du rostre, dont la bordure antérieure de la fenêtre nasoantorbitale, et de nombreuses petites dents triangulaires exemptes de denticules. Ces dents présentent une morphologie globale semblable à celles des dents d’istiodactylidés, bien qu’elles soient plus petites, plus nombreuses et de disposition plus compacte, et que leurs couronnes soient proportionnellement plus petites. Bien que fragmentaire, ce spécimen est diagnostique et représente un nouveau genre de pterosaures istiodactylidés. Sa présence dans la Formation de Northumberland du Campanien supérieur en fait le plus récent des istiodactylidés et repousse les limites des distributions stratigraphique et géographique de cet énigmatique groupe de pterosaures.

Introduction

VIPM 1513 (Vancouver Island Palaeontological Museum), a calcite nodule containing a fragmentary jaw from an istiodactylid pterosaur, was surface collected from Collishaw Point, Hornby Island, British Columbia (Fig. 1), where the upper Campanian Northumberland Formation of the Nanaimo Group crops out (Katnick and Mustard 2003). The Northumberland Formation is composed primarily of dark grey silty mudstones with thin-bedded sandstone turbidites, which Katnick and Mustard (2003) interpret as a deepwater environment at the edges of a submarine fan. This formation is notable for its high concentration of fossiliferous carbonate nodules, and Collishaw Point is one of the most fossiliferous localities, having produced numerous invertebrates, teleosts, sharks, mosasaurs, plants (Ludvigsen and Beard 1997), and most recently, ornithurine and enantiornithine birds (Morrison et al. 2005). Although pterosaur fossils have been recovered from Alberta (Godfrey and Currie 2005), VIPM 1513 represents the first record of a pterosaur from British Columbia, and the first pterosaur cranial material in Canada. Although fragmentary, the preserved remains are distinct from all other known istiodactylid pterosaurs and are herein assigned to a new genus and species.

Vancouver Island and the surrounding islands (including Hornby Island) represent an amalgamation of terranes known as the Insular Superterrane. Two competing hypotheses for the palaeolatitude of the Insular Superterrane during the Cretaceous are (1) that the Insular Superterrane was located north of the Franciscan–Sierran plate boundary in California during much of the Cretaceous, and (2) the “Baja British Columbia” hypothesis, which suggests that the superterrane was located at least 2400 km south of its present-day location, at approximately the modern-day location of Baja California (Ward et al. 1997). The Northumberland Formation may have been deposited 1600–3500 km south of its present location (Ward et al. 1997; Krijgsman and Tauxe 2006; Miller et al. 2006), and as such, it may preserve a very different vertebrate fauna from that of the well-known coeval faunas of Alberta.

Systematic palaeontology

Pterosauria Kaup, 1834
Pterodactyloidea Plieninger, 1901
Ornithocheiroidea Seeley, 1891 (sensu Unwin, 2003)
Istiodactylidae Howse, Milner, & Martill, 2001

Gwawinapterus gen. nov

ETYMOLOGY: Gwa’wina Kwakwala for raven, and from pteron (Greek) for winged. Kwakwala is spoken by the Kwakwa’ka’wakw people of Vancouver Island.

DIAGNOSIS: As for type and only species.

Gwawinapterus beardi gen. et sp. nov

ETYMOLOGY: After Graham Beard, who discovered the specimen, and for his contributions to the study of palaeontology on Vancouver Island.

HOLOTYPE: VIPM 1513a and VIPM 1513b, part and counterpart of a single nodule.

TYPE LOCALITY: Upper Campanian Northumberland Formation, Nanaimo Group, from Collishaw Point, Hornby Island, British Columbia.

DIAGNOSIS: An istiodactylid pterosaur differing from all other known istiodactylids in having more than 25 teeth on the premaxilla–maxilla, and in having the tooth root more than twice the height of the crown.

Description

The specimen (Fig. 2) is embedded in a hard nodule and has been split in half. Most edges of the bone are broken, except for the dorsal and anterior edges. The bone surface is preserved on much of the central portion of the specimen, as the true surface on one side and an imprint in the surrounding matrix on the other (Fig. 3). The remainder of the bone is broken in cross-section, showing the alveoli for the teeth, the tooth roots, and replacement teeth.

The anterior edge of the bone is rounded and dorsoventrally deep (95 mm). The bone bifurcates posteriorly, with the dorsal portion and the ventral, tooth-bearing portion only 21 mm in height. This bone most likely represents part of the premaxilla (and possibly part of the maxilla), with the fenestra nested within the bifurcation representing the nasoantorbital fenestra. The length of the premaxilla–maxilla anterior to the nasoantorbital fenestra is 65 mm.

Alveoli for at least 26 teeth are preserved on each side of the nodule, although five alveoli in the middle of the series are more difficult to discern because of breakage. Teeth may be present anterior to the first identifiable alveolus, but the bone is partially broken and obscured by infilled matrix, so this is difficult to verify. Eleven or 12 of these alveoli are present below the nasoantorbital fenestra. The teeth are single-rooted and have triangular, labiolingually compressed crowns (Fig. 4). Some are broken and visible in sagittal section. Tooth crowns are approximately 4 mm tall, and the tooth height including the root is 14–16 mm. The crown height to mesiodistal width ratio is approximately 1.45. The labiolingual width of the teeth cannot be measured. The teeth are straight and show no posterior or lingual curvature. No denticles are present. The tooth crowns are so closely spaced that most are touching each other along the edges.

Discussion

During the Late Cretaceous, teeth lacking denticles could be found in some non-avian theropods, birds, pterosaurs, crocodilians, mosasaurs, and plesiosaurs. Mosasaurs, plesiosaurs, and crocodilians typically have large, pointed, conical teeth that are widely spaced from each other. Most small theropod teeth have denticles and are recurved (e.g., Larson 2008; Sankey 2008). Spinosaurid teeth lack denticles, but the teeth are conical and have distinct carinae, and are typically much larger than those in VIPM 1513 (Sues et al. 2002; Dal Sasso et al. 2005). Paronychodon teeth lack den-
Fig. 2. VIPM 1513 part and counterpart. Anterior is to the right in the top photograph, and to the left in the bottom photograph. Scale bar = 10 cm.

Fig. 3. VIPM 1513 part and counterpart interpretive drawings (A and B, respectively), showing distribution of teeth, bone surface, bone cross-section, and bone imprint on the two halves. Scale bar = 10 cm. (C) Generalized istiodactylid skull showing preserved portion of Gwawinapterus.
Table 1. Comparison of proportions in *Istiodactylus sinensis*, *Nurhachius*, and *Gwawinapterus*.

<table>
<thead>
<tr>
<th>Taxon</th>
<th>Height of maxilla–premaxilla ventral to nasoantorbital fenestra</th>
<th>Length anterior to nasoantorbital fenestra</th>
<th>Height:length ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Istiodactylus sinensis</em></td>
<td>15</td>
<td>85</td>
<td>0.17</td>
</tr>
<tr>
<td><em>Nurhachius</em></td>
<td>8.5</td>
<td>91</td>
<td>0.09</td>
</tr>
<tr>
<td><em>Gwawinapterus</em></td>
<td>21</td>
<td>65</td>
<td>0.32</td>
</tr>
</tbody>
</table>

Note: Measurements are in mm.

Fig. 4. Tooth morphology of *Gwawinapterus beardi*. (A) Specimen drawing of the first four preserved teeth in VPIM 1513. The tip of the second tooth (from right) is restored. Cross-hatching represents area where the dentine of the root is broken and lost. Boxes A, B, C, and D correspond to the labeled drawing and photos.
Fig. 5. Gwawinapterus (C) compared with (A) Istiodactylus sinensis and (B) Longchengpterus (= Nurhachius). Gwawinapterus has a comparatively deeper rostrum and smaller, more closely packed teeth. Specimens are scaled to the same length from the anterior edge of the nasoantorbital fenestra to the anterior edge of the rostrum. *I. sinensis* modified from Andres and Ji (2006), and *Longchengpterus* modified from Lü et al. (2008).

Gwawinapterus (C) represents the latest known istiodactylid, as it is from the upper Campanian. Most istiodactylids (*Hongshanopterus*, *Istiodactylus*, *Liaoxipterus*, and *Nurhachius*) are from the Jehol Group of China, which is Aptian in age (Wang and Lü 2001; Wang et al. 2005, 2006, 2008; Andres and Ji 2006; Lü et al. 2008). *I. latidens* and isolated istiodactylid teeth from Las Hoyas and Galve, Spain, are Barremian in age (Howse et al. 2001; Sánchez-Hernández et al. 2007; Vullo et al. 2009), and isolated istiodactylid teeth have been identified from the Jurassic Morrison Formation in the USA (Bakker 1998). The presence of *Gwawinapterus* in the Upper Cretaceous of British Columbia extends the stratigraphic range of the Istiodactyliidae by almost 40 million years (Fig. 6). Dyke et al. (2009) considered the mid to Late Cretaceous pterosaur record to be relatively complete; however, the large stratigraphic range extension of the Istiodactyliidae into the Late Cretaceous suggests that the pterosaur record is far from complete. In addition, *Gwawinapterus* is the latest occurring toothed pterosaur, which suggests that the mid and Late Cretaceous were not completely dominated by edentulous taxa, as suggested by Unwin (2005).

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References


