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FIRST RECORD OF FOSSIL *MERLANGIUS* (PISCES, GADIFORMES) FROM ARCTIC ALASKA AND CHRONOSTRATIGRAPHIC IMPLICATIONS

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An otolith of a new species of *Merlangius* Geoffroy St. Hillaire, 1767, *Merlangius arcticus*, collected from the Nuwok Member of the Sagavanirktok Formation of northeastern Alaska, is the first occurrence of this genus as a fossil in the Arctic Ocean. The age range of this well-known genus, early Miocene to Recent, is consistent with an inferred late Neogene age for the Nuwok strata based on molluscs, ostracods and palynomorphs.

Key words — Pisces, Osteichthyes, Neogene, Arctic, Alaska, USA, new taxon.

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INTRODUCTION

The Nuwok Member of the Sagavanirktok Formation occurs principally as subsurface strata beneath the arctic coastal plain of northeastern Alaska (Fig. 1). In its stratigraphic type section at Carter Creek, this unit comprises 132 m of interbedded marine sandstone and siltstone (Fig. 2; T.D. Fouch, pers. comm. 1993). Thinner and less extensive outcrops occur at Barter Island and Manning Point, about 40 km to the east (Brouwers & Marincovich, 1988). The type Nuwok strata are the uppermost portion of a Cainozoic sequence that may be as thick as 1,800 m and possibly ranges in age from Palaeocene to Pliocene (Detterman *et al.*, 1975). Strata at Carter Creek were previously cited as having a thickness of either 210 feet (64 m) (Dall, 1920) or 266 feet (81 m) (Morris, 1954; MacNeil, 1957). Remeasurement of this Nuwok Member type section in 1988 by T.D. Fouch yielded a thickness of 132 m, which is used herein.

Marine molluscs, ostracods, benthic foraminifera and palynomorphs occur abundantly throughout the Nuwok strata at Carter Creek. The molluscs and ostracods are biogeographically related to North Atlantic faunas, with several still-extant Atlantic species of each group present in the Nuwok fauna (Brouwers & Marincovich, 1988; Marincovich *et al.*, 1990). Two faunal zones were defined for the molluscs by MacNeil (1957): a lower Chlamys nuwokensis Zone and an upper Arctica

carteriana Zone (Fig. 2). In addition, Brouwers (*in* Brouwers & Marincovich, 1988) noted the presence in the same strata of three stratigraphically distinct ostracod assemblages, the lower two of which correspond to the two molluscan zones mentioned above (Fig. 2).

Molluscs and ostracods from the type Nuwok strata suggest that this section might span the Miocene-Pliocene boundary. The absence of any Pacific taxa clearly implies an age prior to the connection of the Arctic and Pacific Oceans through Bering Strait at about 4.0-3.0 Ma (Marincovich *et al.*, 1990; Gladenkov *et al.*, 1991).

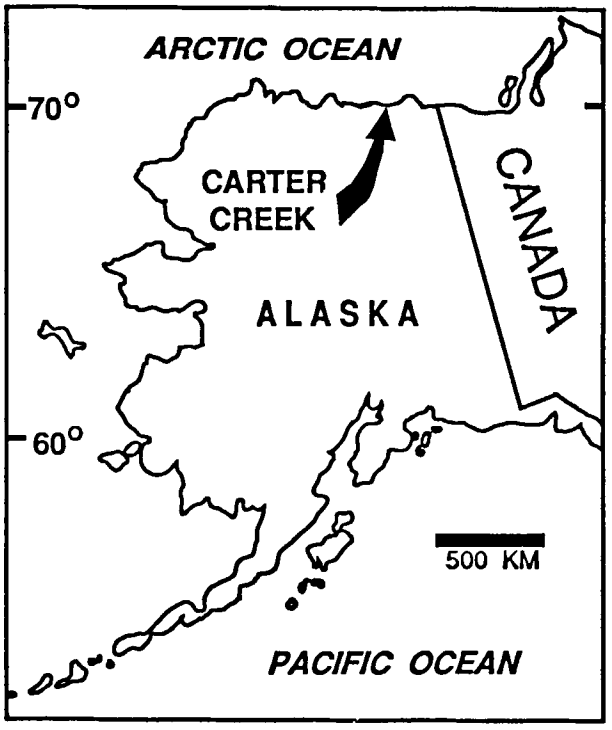

Fig. 1. Location of Carter Creek, northeastern Alaska, where the type section of the Nuwok Member of the Sagavanirktok Formation outcrops.

Until recently, the greatest age inferred for the Carter Creek Nuwok strata was middle Miocene. Molluscs from the lower part of the type Nuwok strata were thought to be of late Pliocene age (Dall, 1920). The entire Carter Creek sequence was tentatively assigned a late Miocene or early Pliocene date by Todd (1957), based on benthic foraminifera. The Carter Creek strata were recently assigned a late Oligocene age based on the presence of a single benthic foraminiferal species that ranges to the end of the Oligocene, the absence of pre-late Oligocene benthic foraminifera, and strontium isotope measurements of foraminifera tests (McNeil & Miller, 1990, 1991).

Marincovich & Powell (1991) described evidence for diagenesis of shell carbonate, including abundant recrystallised molluscan shells, as well as numerous horizons with calcareous concretions, throughout the Carter Creek stratotype section. This evidence of pervasive diagenesis strongly casts doubt on the validity of strontium isotopic ages derived from calcareous foraminifera of this section. An Oligocene age is further challenged by the presence of Neogene to Recent molluscs, ostracods and palynomorphs, noted above. This Neogene age inference is bolstered by the presence of the genus *Merlangius*, as discussed below.

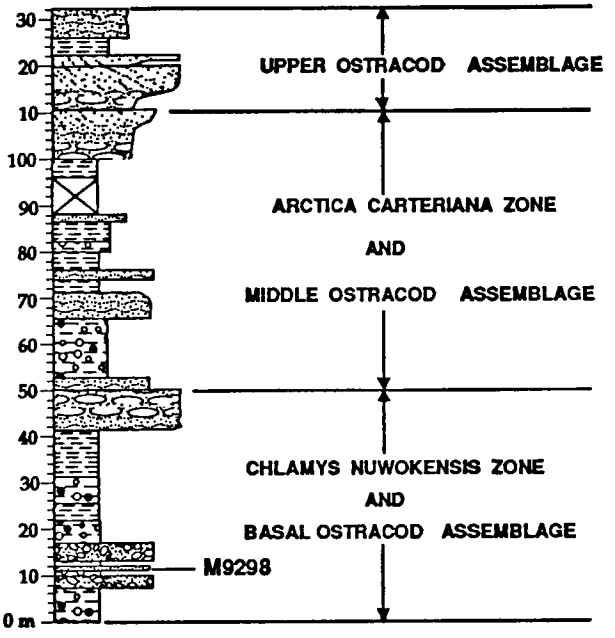

Fig. 2. Location of U.S. Geological Survey (Menlo Park, California) Cainozoic locality M9298 in the type section of the Nuwok Member of the Sagavanirktok Formation at Carter Creek. Molluscan zones are those of MacNeil (1957) and ostracod assemblages those of Brouwers (*in* Brouwers & Marincovich, 1988).

LOCALITY DATA

The single otolith was collected from poorly indurated siltstone, 11 m above the base of the type section of the Nuwok Member of the Sagavanirktok Formation, Carter Creek, northeastern Alaska. This locality is designated

U.S. Geological Survey (Menlo Park, California) Cainozoic locality M9298 (Fig. 2). Latitude 69°56.6'N, longitude 144°39'W, U.S. Geological Survey Mt. Michelson (D-2) quadrangle (scale 1:63,360). Collected by L. Marincovich Jr., July 1988, at the surface of the outcrop; intensive search at the same spot did not yield any additional otolith specimens.

DESCRIPTION

Merlangius arcticus n. sp.
Figs 3b, 4

Material — A left saccular otolith (Figs 3b, 4) is the holotype and sole specimen known (USNM 482398).
Dimensions — Length 17.0 mm, height 4.0 mm, thickness 1.7 mm.
Stratum typicum — Nuwok Member of the Sagavanirktok Formation.
Locus typicus — Carter Creek, northeastern Alaska, USA.
Derivatio nominis — Alluding to the geographic location of the taxon.
Diagnosis — A robust, elongate otolith with a blunt anterior portion and a spinous posterior end. The outer face is roughly tuberculated, nearly flat in antero-posterior direction and slightly convex in dorso-ventral direction. The greatest thickness is located in the ventral portion. In a transverse section, both the dorsal and ventral rims are smooth.

The inner face is markedly convex. The sulcus is rather narrow and shows a clear division in ostial and caudal portions, the latter being slightly longer, and open on the postero-dorsal rim. Both ostium and cauda are provided with colliculum. These collicular formations are irregular, but relatively flat. The antero-ventral portion is well developed, and its anterior part is more or less salient, forming a pseudorostrum. There is a clear ventral furrow.
Affinities — The otolith of *M. arcticus* is most similar to that of the Recent species *Merlangius merlangus* (Linnaeus, 1758) (Fig. 3a), an eastern Atlantic species that ranges from Portugal to the Barents Sea and Iceland. Otoliths of *M. merlangus* are much thinner, more slender and elongate than that of *M. arcticus*. The Recent fishes probably attain a much greater size than the fossil species described here. The smooth tuberculation of the external face of the holotype of *M. arcticus* is an adult feature. In *M. merlangus*, however, otoliths of comparable size are from juveniles, as indicated by their strongly tuberculate outer faces and lobate rims. In older adult specimens of *M. merlangus* (see Nolf, 1977, pl. 5; Nolf & Steurbaut, 1989, figs 8a-c for a complete growth series), the tuberculation of the outer face becomes obsolete, and a pseudorostral expansion appears.

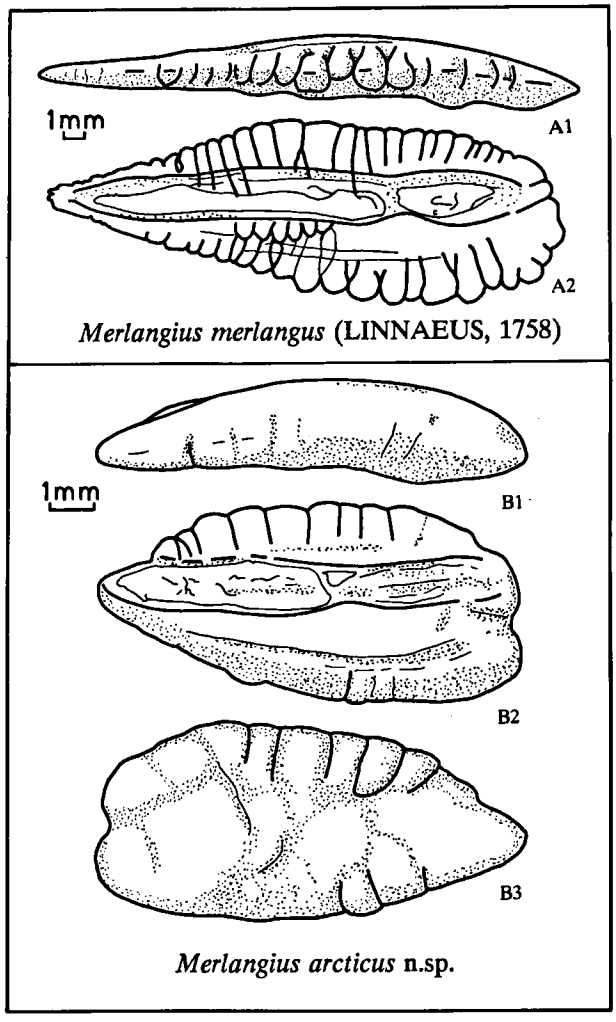

Fig. 3. Comparison of the otoliths of the Recent *Merlangius merlangus* (A) and *M. arcticus* n. sp. from the Nuwok Member of the Sagavanirktok Formation, northeastern Alaska (B).

Merlangius merlangus is the only Recent species in the genus, although three other fossil species are known from the North Sea Basin (see Gaemers, 1973; Nolf, 1985; Nolf & Steurbaut, 1989). The oldest record of *Merlangius*, *M. bifurcatus* Gaemers, 1973, is from the Edegem Sands of Belgium, of early Miocene age (see Gaemers, 1973, pl. 1, fig. 1); this is a rare, poorly known species in early and middle Miocene faunas. *Merlangius tenuis* Weiler, 1942 is a rare species known in late Miocene faunas; its otoliths are extremely thin and slender (Weiler, 1942, pl. 5, fig. 30), which precludes

confusion with *M. arcticus*, and lack a spiniform posterior end as seen in *M. merlangus*. *Merlangius pseudaeglefinus* (Newton, 1891) (see Nolf, 1978, pl. 3 for a complete growth series) is a common Pliocene species with a rather high, non-spiniform posterior end.

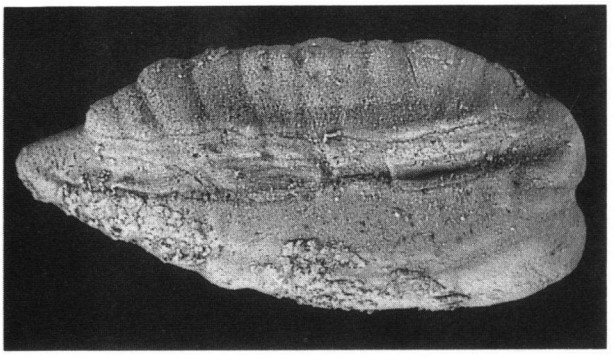

Fig. 4. Holotype of *Merlangius arcticus* n. sp. (United States National Museum Collections, no. USNM 482398) from the Nuwok Member of the Sagavanirktok Formation, northeastern Alaska.

CONCLUSIONS

Merlangius merlangus is a bottom fish, ranging in depth from 10 to 200 metres, but is found mainly between 30 and 100 m (Cohen *et al.*, 1990). The three previously described fossil species, from Neogene faunas of the North Sea Basin, are also known only from neritic deposits. Therefore, it seems reasonable to conclude that the presence of *Merlangius* indicates a neritic environment, probably shallower than 100 m, for the lower part of the Nuwok Member.

As indicated, the oldest occurrence of *Merlangius* is in the early Miocene Edegem Sands of Belgium. However, its plesiomorph sister taxon *Micromesistius* Gill, 1864 is in faunas as old as late Oligocene: *M. decorus* (Gaemers, 1973) (see Gaemers, 1973; Nolf, 1985; Nolf & Steurbaut, 1989 for data on the fossil record of these two genera). Both genera are thought to have a common origin, so the absence of *Merlangius* from pre-Miocene faunas may not be an absolute biostratigraphic criterion. However, the known stratigraphic range of the genus suggests a Neogene age for the lower part of the Nuwok Member of the Sagavanirktok Formation. This is in agreement with the inferred Neogene age of molluscs, ostracods and palynomorphs and especially with the presence of Recent species among these groups.

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