

EARLY ORDOVICIAN GASTROPODS OF THE BARBACE COVE MEMBER (BOAT HARBOUR FORMATION) AND CATOCHE FORMATION, WESTERN NEWFOUNDLAND

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ABSTRACT

Fossil gastropods and their stratigraphic ranges within the Upper Canadian carbonates of the Barbace Cove Member (Boat Harbour Formation) and the Catoche Formation of western Newfoundland are documented. *Ceratopea* sp. cf. *C. capuliformis* Oder, 1932 and *Euconia etna* (Billings, 1865) occur in the Barbace Cove Member. *Maclurites* spp. (and their opercula including "Billings second operculum"), *Plethospira*, *Ectomaria adelina* (Billings, 1865), *Polhemia*, *Euconia etna* (Billings, 1865) and *Lytospira*? occur throughout the Catoche Formation. *Ceratopea* spp. and *Turritoma* sp. have limited ranges at the base of the formation, and *Malayaspira* sp. appears to occur only in the upper part of the Catoche Formation. Several species have paleogeographic ranges restricted to eastern North America and Greenland. A silicified fossil from the upper part of the formation resembling a large horn-shaped operculum is tentatively identified as a cephalopod.

INTRODUCTION

Lower Ordovician platform carbonate rocks are widely exposed in western Newfoundland (Figure 1), where they are collected together in the St. George Group (Figure 2), a 500-m-thick succession of subtidal and peritidal limestone and dolostone. The group is divided into the Watts Bight, Boat Harbour, Catoche, and Aguathuna formations (Knight and James, 1987, 1988). An unconformity-bounded Arenig/late Canadian to Whiterockian sequence (consisting of the Barbace Cove Member of the Boat Harbour Formation, the Catoche Formation and the Aguathuna Formation) has been systematically sampled for gastropods (including opercula) in a number of sections on the Northern Peninsula and the Port au Port Peninsula (Figure 1). The sequence on the Northern Peninsula hosts six distinct trilobite zones (Boyce, 1989, 1997; Boyce and Stouge, 1997 - see Figure 2). Graptolites recovered from the Catoche and Aguathuna formations allow correlation of much of the upper sequence with the *Tetragraptus approximatus*, *Didymograptus* (*Expansograptus*) *nitidus* and *Didymograptus* (*Didymograptellus*) *bifidus* zones (James *et al.*, 1988; Williams *et al.*, 1987, 2000).

Molluscs are the most obvious macrofossils in the Catoche Formation, and gastropods are present in most of

the beds. Many of these gastropods were first illustrated by Billings (1865), but because fossil collecting during those early years was not pursued in any systematic fashion (Knight and James, 1988), the stratigraphic ranges of many genera are poorly known. Since Billings' (1865) work on the gastropods from, what is now, the Catoche Formation, only *Ceratopea billingsi* Yochelson, 1964 and "Billings second operculum" (Yochelson, 1964, 1990) have received any attention. The current study – a continuation of Boyce *et al.* (2000), Rohr *et al.* (2000) and Williams *et al.* (2000) – has resampled many of Billings' (1865) localities with the goal of determining the age ranges of the gastropods using established trilobite, conodont and graptolite biostratigraphy (Boyce, 1989, 1997; Boyce and Stouge, 1997; Stouge, 1982; Williams and Stevens, 1988; Williams *et al.*, 1987) within the detailed lithostratigraphic framework (see Figure 2) established by Knight (*op. cit.*) and others in the Port au Port Peninsula and Port au Choix areas (Knight and James, 1987, 1988; Knight, 1991; I. Knight, unpublished data).

Sections of the Barbace Cove Member and the Catoche Formation were examined on the western Port au Port Peninsula (Figure 3) east of the Cape St. George–Mainland road (Route 463), on the Port au Choix Peninsula (Figure 4) between Barbace Cove and Laignet Point (the Catoche Formation Reference Section, section 9, Knight, 1991), east of

¹ Regional Geology Section

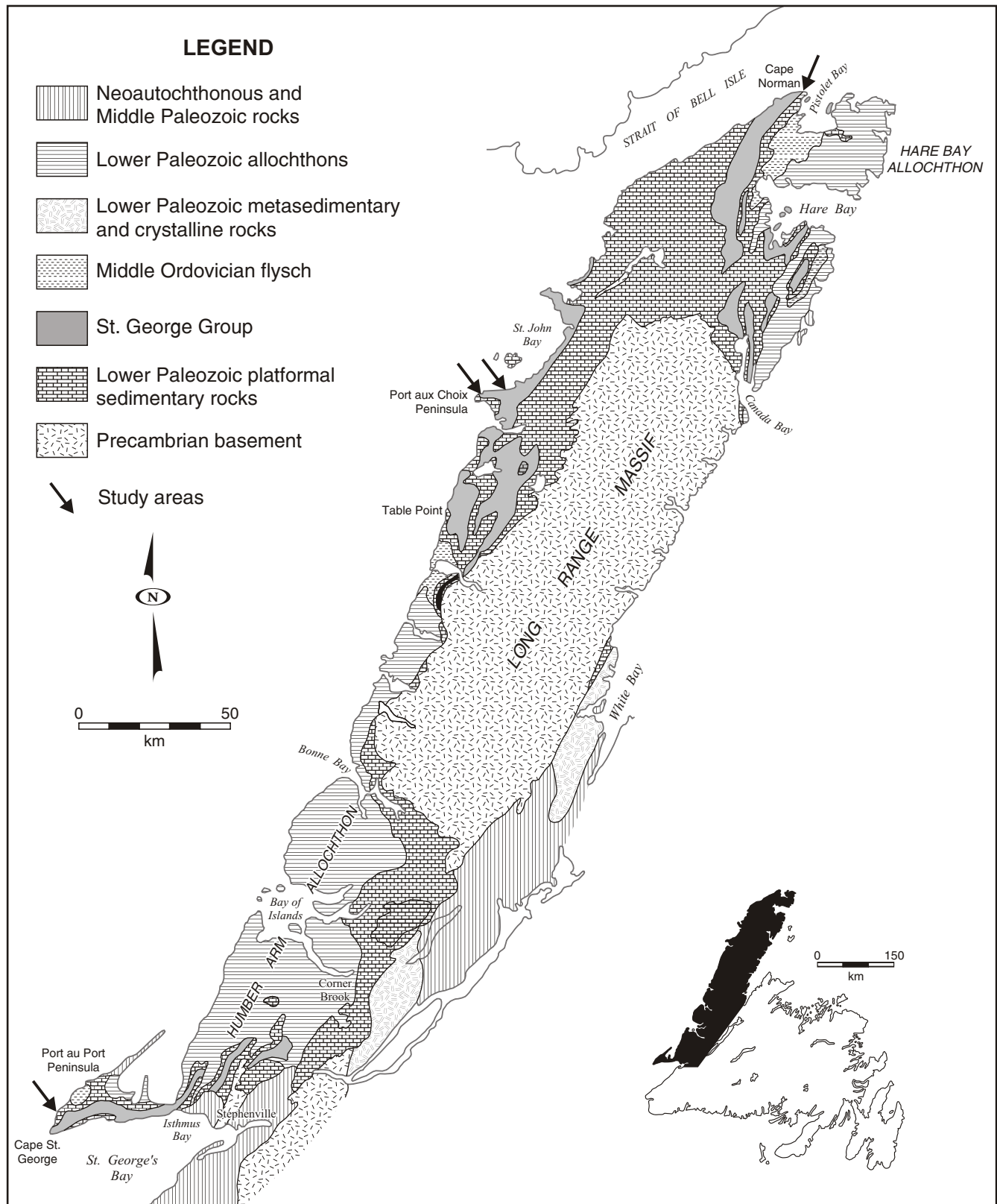


Figure 1. Geological terranes and outcrop distribution of the St. George Group in western Newfoundland (based on Knight and James, 1988). Arrows indicate areas studied for gastropods.

CHRONO-STRATIGRAPHY					LITHOSTRATIGRAPHY		BIOSTRATIGRAPHY			GASTRO-PODS	
					Knight and James, 1987, 1988; Stenzel et. al., 1990	Logan et al. 1863	TRILOBITES	CONODONTS	GRAPTOLITES		Williams et. al., 1997, 2000
							Boyce and Stouge, 1997				
ORDOVICIAN	MIDDLE	LOWER	LLANVIRN	WHITEROCKIAN	Table Head Group	Table Point Fm.	K/L	M	Histodella tableheadensis	Diplograptus decoratus	
					Table Point Fm.	Table Point Fm.					
	ARENIG				St. George Group	Aguaithuna Fm.	I	?	P. fruticoscis		
					Aguaithuna Fm.	Aguaithuna Fm.					
		CANADIAN/IBEXIAN	CASSINIAN			Costa Bay Mbr.	H	J	C. speciosa G. rarus	T. akzharensis	
						Laignet Point					Laignet Point
		JEFFER-SONIAN				Boat Hr. Fm.	Barbace Cove Member	G	G ₂	Strigigenalis brevicaudata	Oepikodus communis
						Boat Hr. Fm.	Boat Hr. Fm.				
						Boat Hr. Fm.	Boat Hr. Fm.				
						Boat Hr. Fm.	Boat Hr. Fm.				

Figure 2. Lithostratigraphic, chronostratigraphic and biostratigraphic nomenclature, ranges and zonation associated with the upper St. George Group carbonates studied for gastropod faunas. The Laignet Point member is an informal unit (Knight, 1977a,b; Stouge, 1982).

Barbace Cove (Figure 4) (section 6, Knight, 1991) and between Hunters Point and Back Arm (sections 4 and 8, Knight, 1991, Figure 4), St. John Bay (the Catoche Formation Type Section).

TAXA PRESENT

Gastropod shells and opercula occur in the Barbace Cove Member of the Boat Harbour Formation and the Catoche Formation, and with a few exceptions, they are long-ranging. Taxa found throughout the Catoche Formation include *Maclurites* sp. 1 and its probable operculum, *Maclurites* sp. 2 and its probable operculum ("Billings second operculum"), the shell of *Ceratopea* sp., *Plethospira* sp., *Hormotoma* sp., *Polhemia* sp., "*Lytospira*" sp., and *Euconia etna* (Billings, 1865). *Euconia etna* also occurs in the Barbace Cove Member of the Boat Harbour Formation.

A few gastropod taxa have shorter ranges. *Ceratopea* sp. cf. *C. capuliformis* Oder, 1932, is present in the Barbace Cove Member at Hunters Point and in the lowest part of the Catoche Formation at Barbace Cove. *Turritoma acrea* (Billings, 1865) and *Ceratopea billingsi* Yochelson, 1964 are restricted to the lower part of the Catoche Formation. *Malayaspira* and indet. cephalopod? were found only in the upper part of the Catoche Formation.

Specimen numbers used herein are those of the Newfoundland Museum, repository for the specimens.

Ceratopea Ulrich, 1911

Several species of *Ceratopea* are present in the St. George Group, including the operculum *Ceratopea* sp. cf. *C. capuliformis* Oder, 1932, the operculum *Ceratopea billingsi*

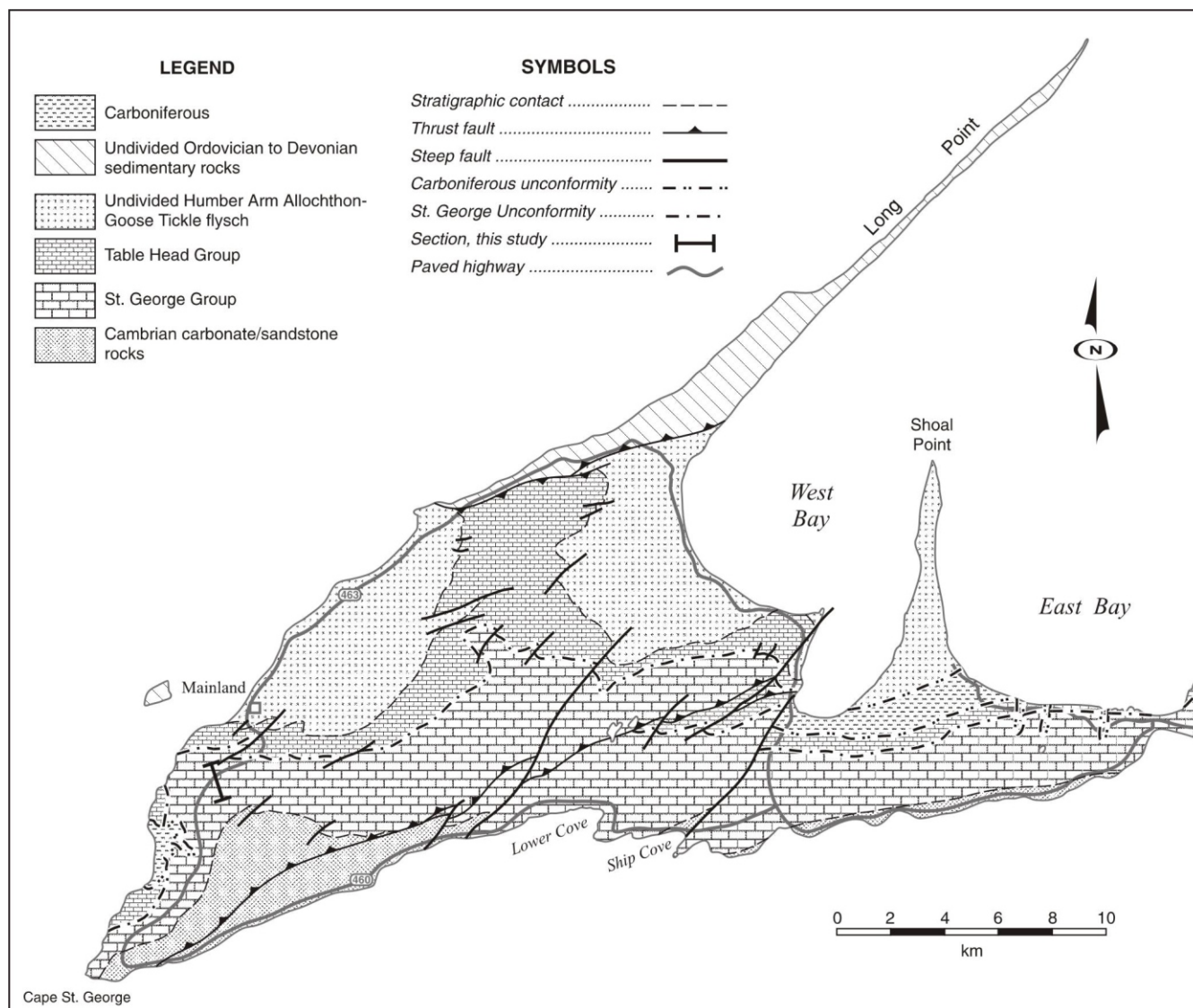


Figure 3. Geological map of the Port au Port Peninsula (after Stockmal and Waldron, 1993) showing the location of the St. George Group section at the western end of the peninsula studied for gastropods.

Yochelson, 1964, and the shell of *Ceratopea*. The poorly preserved shells of *Ceratopea* occur throughout the Catoche Formation, some of which may belong to *Ceratopea canadensis* (Billings, 1865), which is not discussed further.

***Ceratopea* sp. cf. *C. capuliformis* Oder, 1932**

Figure 5

Ceratopea sp. cf. *C. capuliformis* Oder, 1932 is present in the Barbace Cove Member of the Boat Harbour Formation (*Strigigenalis brevicaudata* trilobite zone), near Hunters Point, St. John Bay (Figure 4). This species indicates the lowest part of the *Ceratopea* Zone (Yochelson and Bridge, 1957). None of the silicified specimens from either area preserve the inner surface of the operculum, and it is

not known if the operculum had a muscle attachment process like *Ceratopea billingsi* Yochelson, 1964 (see below).

***Ceratopea billingsi* Yochelson, 1964**

Figure 6

Three specimens of the operculum now called *Ceratopea billingsi* Yochelson, 1964 were first described as an unnamed operculum by Billings (1865, page 243, Fig. 228). It was later established as a species of *Ceratopea* and re-illustrated by Yochelson (1964), who also included specimens from eastern Greenland and Scotland. The holotype (GSC 7459) is from Cape Norman and was designated by Yochelson (1964). T. Bolton (*in* Yochelson, 1964) observed

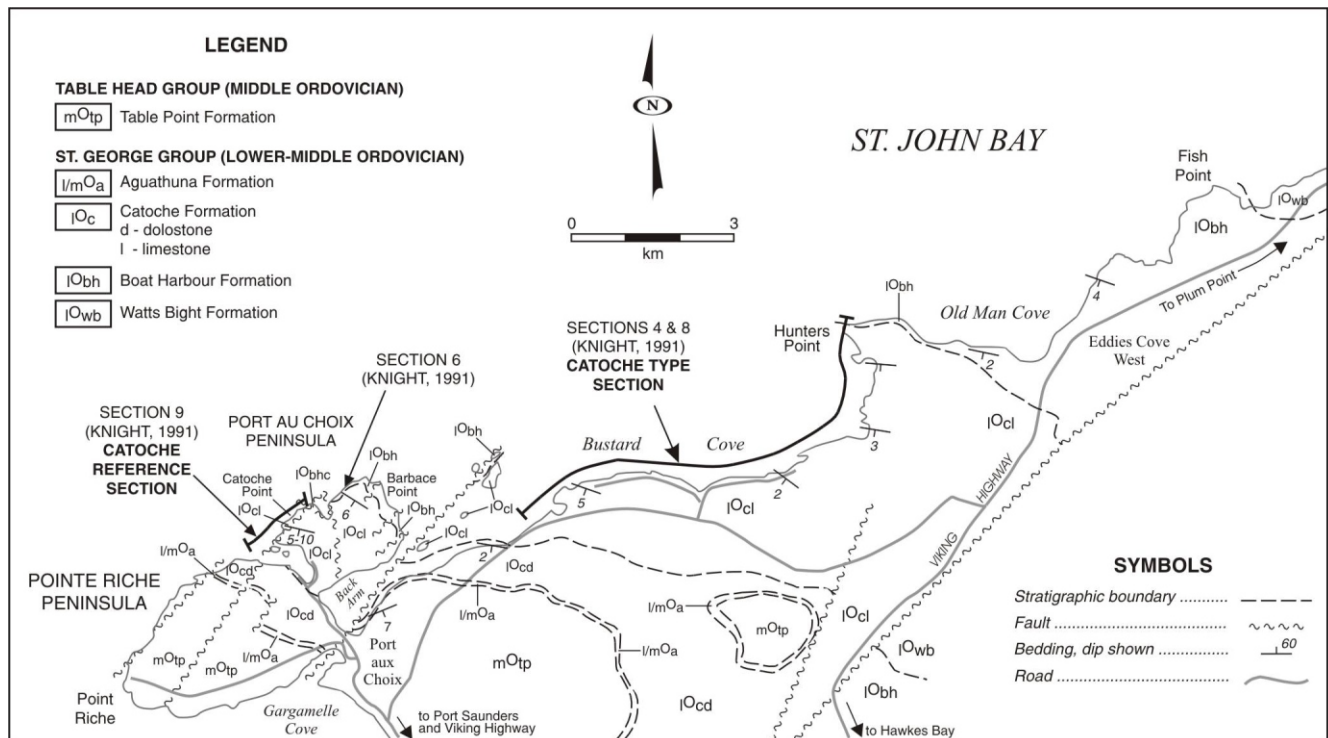


Figure 4. Detailed geology and locations of sections studied in the upper St. George Group from Eddies Cove West to Port au Choix (map modified from Knight and James, 1988). Sections are described in detail in Knight (1991).

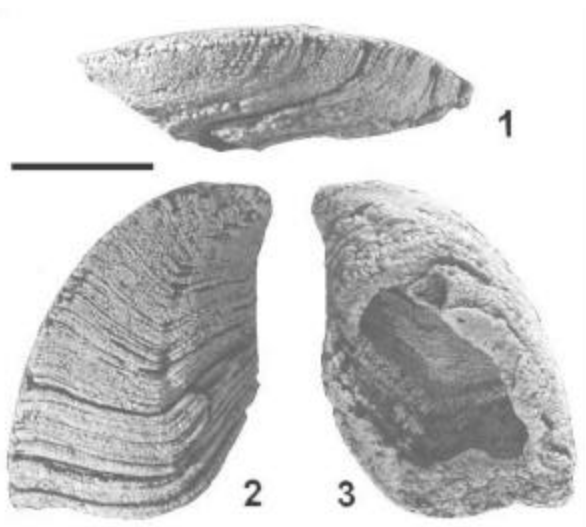


Figure 5. *Ceratopea* sp. cf. *C. capuliformis* Oder, 1932. 1-3, side, exterior and interior views. Rohr 98R017=Boyce 99F090=ECW-033 of Boyce and Stouge (1997). Black bar is 1 cm. Specimen number NFM F-401.

that virtually nothing was known of the stratigraphic placement of Billings' (1865) material from Newfoundland.

In his original description based on the three specimens from Cape Norman, Billings (1865, page 243) described the

operculum as lacking a muscle process on the interior surface. Yochelson (1964) later stated that while the attachment surface of the holotype is not preserved, an irregular boss is present on paratypes from Newfoundland and from Scotland, but he could not determine from the material available if this is a natural feature or a secondary growth of silica. As predicted by Yochelson (1964), additional specimens have clarified that the boss is a muscle process (Figure 7-1).

Yochelson (1964, page 7) assigned the species to *Ceratopea* because of its similarity to the group of *Ceratopea capuliformis* Oder, 1932 and concluded, "...it is most like *C. germana* Yochelson and Bridge, 1957, the least typical member of the group. It may be that these two species may constitute yet another species group". Although the shapes of the exteriors of all three species are similar, the presence of a muscle process on the interior surface of *Ceratopea billingsi* easily distinguishes it from *C. capuliformis* and *C. germana*.

Specimens of *Ceratopea billingsi* Yochelson, 1964, were found in the lower part of the Catoche Formation at Port au Port Peninsula and north of Port au Choix. Yochelson (1964) reported the species from the "St. George Group" at Cape Norman and the Durness Group of Scotland.

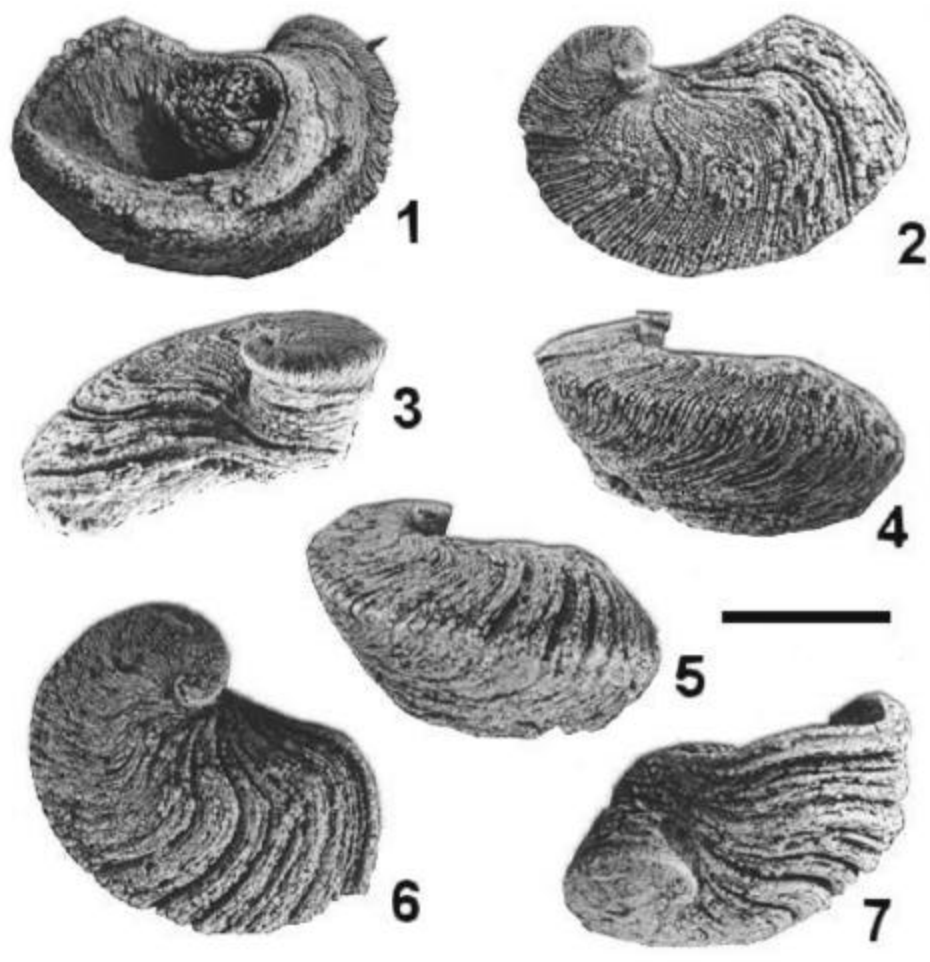


Figure 6. *Ceratopea billingsi* Yochelson, 1964 operculum.

1-4, interior showing muscle process, exterior, and side views. Black bar is 1 cm. Specimen number NFM F-402.
5-7, side, exterior and side views. Rohr 96R017=Boyce 96F011. Black bar is 1 cm. Specimen number NFM F-403.

***Maclurites* sp. 1 and 2**

Figures 7 and 8

At least two species of *Maclurites* Lesueur, 1818 occur throughout the Catoche Formation and they represent the oldest occurrence of this genus. The species are distinguished by their base, width of the umbilicus and relative size.

Maclurites sp. 1 has a narrow umbilicus (about 25 percent of the width of the whole shell) and a planar base having a shallow suture. Generally, it is smaller than the other species; its diameter does not exceed 5.5 cm. Billings (1865) describes his *Maclurea oceana* as having a wider umbilicus. The shape of *Maclurites* sp. 1 is similar to *Monitorella crenulata* (Billings, 1865) from the Table Point Formation, but that taxon is smaller and is interpreted to have a different operculum (Rohr and Measures, *in press*).

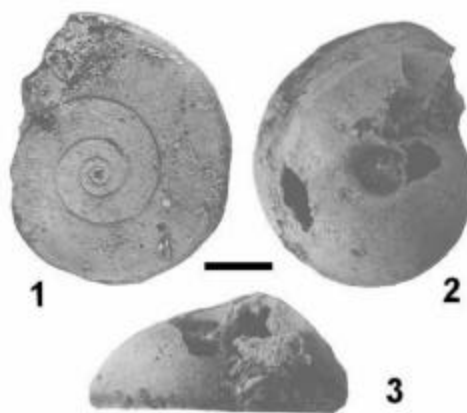


Figure 7. *Maclurites* sp. 1.

1-3, basal, umbilical and apertural views of same specimen. Note the narrow umbilicus compared to the shell in Figure 4. Rohr 99R004=Boyce 99F086. Black bar is 1 cm. Specimen number NFM F-404.



Figure 8. *Maclurites* sp. 2.

1-3, basal, umbilical and apertural views of shell. Rohr 99R004=Boyce 99F086. Black bar is 1 cm. Specimen number NFM F-405.

Maclurites sp. 2 attains a larger size and has a wider umbilicus exposing the previous whorls. Bases of large shells are relatively common on some bedding planes. The base is planar, although the base of individual whorls are slightly convex. The rate of expansion of the width of the early whorls is about 1.7 times per revolution. On larger (7 or 8 cm in diameter) specimens, the rate of increase of the width is about 5 times, possibly indicating a mature stage of growth.

"Billings second operculum"

Figure 9

"Billings second operculum" was first illustrated by Billings (1865), and it was informally named and discussed



Figure 9. "Billings second operculum".

1-3, exterior, side and interior views. Rohr 96R017=Boyce 96F011. Black bar is 1 cm. Specimen number NFM F-406.

in detail by Yochelson (1990). Yochelson (*op. cit.*) thought the distinctive operculum most likely belongs to *Maclurites*, but he did not give it a formal name because the corresponding shell was not known.

In the past, species of *Maclurites* have been based on the shell, while *Ceratopea* species have, in most instances, been based on the operculum. No specimens of "Billings second operculum" were found in life position in a shell, but they are found together in the same beds with *Maclurites* sp. 2, which has an appropriately large shell.

Yochelson (1990) concluded that the operculum illustrated by Billings (1865, page 243, Fig. 229) is from the St. George Group and probably from the Catoche Formation. There is no reason to refute this because in western Newfoundland "Billings second operculum" is restricted to the Catoche Formation.

Maclurites operculum Type 1

Figure 10

Another *Maclurites* operculum besides "Billings second operculum" occurs in the Catoche Formation. It is a distinctive, plate-like form having concentric growth lines, but does not have the muscle process on the interior surface exhibited by many other species of the genus. The operculum has not been observed in life position in a shell, but it occurs in the same beds as *Maclurites* sp. 1, whose whorl profile corresponds to the shape of the operculum; the profile is narrow, but not unusually tall.

Lytospira? sp.

Not Figured

Uncoiled and slowly expanding gastropods occur throughout the Catoche Formation, and are commonly observed only in cross section in the rock. As cross sections, *Lytospira* cannot be distinguished from other uncoiled genera such as *Ecculiomphalus*.

Malayaspira sp. aff. *M. speciosa* (Billings, 1865)

Figure 11

Maclurea speciosa Billings, 1865 was established by Billings (1865, pages 240-241, Fig. 226) for a shell, about 5 cm in diameter, which he observed in his

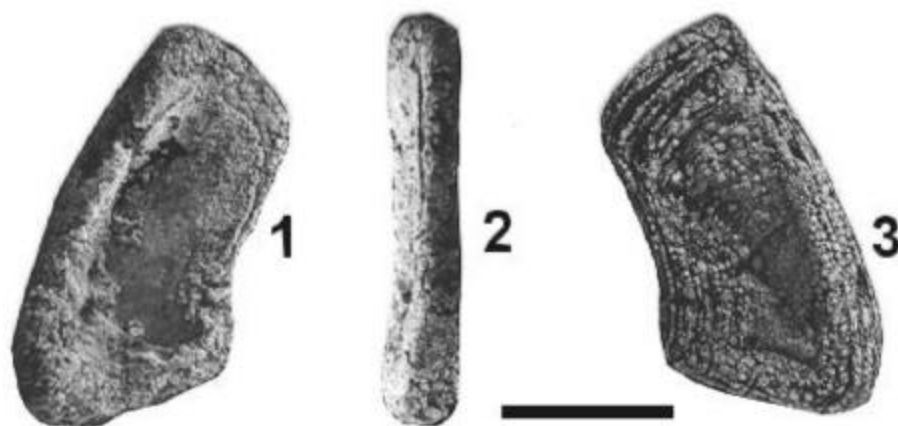


Figure 10. *Maclurites* operculum type 1.

1, concave interior lacking a muscle process; 2, side view; 3, concentric ornamentation on exterior. Rohr 96R019=?Boyce 96F018. Black bar is 1 cm. Specimen number NFM F-407.

units G through M at several locations on the Northern Peninsula. This flat-based shell occurs in the upper part of the Catoche Formation. It first occurs in bed 6e of Knight (1991, page 125) in the Bustard Cove section, 30 m above the base of the formation, and continues through the formation at both Bustard Cove and Port au Choix. At Port au Port Peninsula it appears at approximately 35 m above the base of the formation. This shell closely resembles *M. speciosa*, but the former has spiral ornament on the side of the whorl. It superficially resembles *Maclurites* but has a more rectangular whorl profile and bears ornamentation.



Two well-preserved silicified species of *Malayaspira* (without the spiral ornament) occur in the Table Point Formation (Rohr and Measures, *in press*).

***Polhemia* sp.**

Not Figured

Polhemia sp. is a distinctive shell not previously reported from Newfoundland or the northern Appalachians. The type species of *Polhemia*, *Polhemia taneyensis* Cullison, 1944, occurs in the Theodosia Formation (late Jeffersonian) of the Ozark Uplift (Missouri, Arkansas). *Polhemia* is found throughout the Catoche Formation.

***Ectomaria adelina* (Billings, 1865)**

Figure 12

Ectomaria (=Murchisonia) *adelina* (Billings, 1865) occurs throughout the Catoche Formation in all of the sections examined and was illustrated originally by Billings (1865, page 231, Fig. 217) from Cape Norman. It is a rel-

Figure 11. *Malayaspira* sp. aff. *M. speciosa* (Billings, 1865).

1-3, top, oblique apertural, and side views of a naturally weathered shell. Rohr 99RB6E. Black bar is 1 cm. Specimen number NFM F-408.

4-6, basal, top and side views of silicified specimen with spiral ornament. Rohr 96R019=?Boyce 96F018. Black bar is 1 cm. Specimen number NFM F-409.

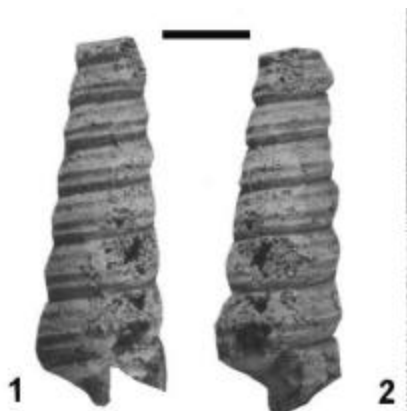


Figure 12. *Ectomaria* (=Murchisonia) *adelina* (Billings, 1865).

1-2, side views of same specimen. Rohr 99R005, Black bar is 1 cm. Specimen number NFM F-410.

atively large (up to 12 cm tall), high-spired shell with two strong spiral, cords. The species is known only from western Newfoundland and represents the oldest known occurrence of the genus.

***Plethospira* Ulrich in Ulrich and Scofield, 1897**

Figures 13-15

Plethospira is the largest gastropod seen in the Catoche Formation. It is turbate and anomphalous with an apical angle of about 90 degrees. *Plethospira* occurs abundantly as internal molds and cross sections particularly in intermound limestones of the lowest mound beds of the Catoche Formation at Hunters Point. It is less abundant throughout the rest of the Catoche sections, but it is locally abundant as silicified columella in the lower Catoche Formation on the Port au Port Peninsula (Figure 15).

The *Plethospira* from the Catoche Formation has a more obtuse apical angle than *Plethospira arenaria* (Billings, 1859), *P. cassina* (Whitfield, 1886), *P. floweri* Peel in Fortey and Peel (1990) *P. hyale* (Billings, 1865), *P.(?) caledoniensis* Longstaff, 1924 and *P. rotunda* Flower, 1968a. Of these species, a single un-illustrated specimen is known of *P. hyale* (Billings, 1865), but it is described as having ventricose whorls. The only species with an apical angle of about 90 degrees is *Plethospira bilineata* Flower, 1968a from the Fort Ann Formation. It is based on internal molds.

***Turritoma acrea* (Billings, 1865)**

Figure 16

The current study recovered only one specimen of this gastropod 2 m above the base of the Catoche Formation at

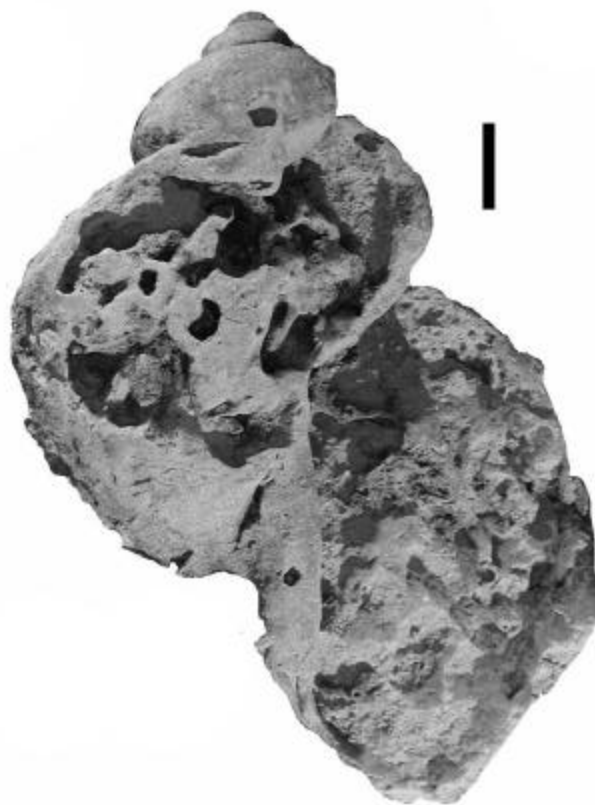


Figure 13. *Plethospira* sp.

Cross section of shell showing the large, thickened columellar lip. Rohr 99RB2=Boyce =ECW-037 of Boyce and Stouge (1997). Black bar is 1 cm. Specimen number NFM F-411.

Catoche Point. Neither the present specimen nor Billings' (1865) specimen preserves the surface ornament. Billings (1865, pages 231-232, Fig. 216) described this high-spired species from his unit G at Port au Choix.

***Euconia etna* (Billings, 1865)**

Figure 17

The distinctive, deeply umbilicate conical shell of *Euconia etna* is seen throughout the Barbace Cove Member of the Boat Harbour Formation and the Catoche Formation at Port au Choix. Billings' (1865, page 226-227, Fig. 210) illustrated specimens show better preservation than any of the present study.

Indet. cephalopod?

Figure 18

A large, horn-shaped fossil resembling an operculum is easily recognized in the upper half of the Catoche Formation. The object is commonly filled with calcite spar and has a silicified edge. The wide end has a conical pit like *Cer-*



Figure 14. *Plethospira* sp.

1-3, side views of internal mold of same specimen. Rohr 00R015. Black bar is 1 cm. Specimen number NFM F-412.



Figure 15. Silicified columella of *Plethospira* sp.

The columella is the thickest part of the shell and is more resistant to post-mortem destruction. They are locally abundant. Rohr 99R002. Scale is in cm. Specimen number NFM F-413.

atopea and *Teiichispira*, and the interior is structureless and lacks septation. According to Ellis Yochelson (2000, personal communication), "These are the siphuncular deposits of orthoconic cephalopods. I was confused between them and *Ceratopea* until Rousseau Flower set me straight. Apparently they can also have some biostratigraphic utility. My guess is that in some instances the shell does not silicify, but the deposits within the siphuncle do."

The fossil first occurs in bed 6 (Knight, 1991) at Bustard Cove and appears to continue to near the top of the section.



Figure 16. *Turritoma acrea* (Billings, 1865)

Side view of holotype GSC 585. Billings' (1865, page 231, Fig. 216) illustration of specimen from "Division G" at Port au Choix. Black bar is 1 cm.

PALEOBIOGEOGRAPHY

Ceratopea is known mostly from eastern North America (see Yochelson and Bridge, 1957) as well as from Greenland and Scotland. *Ceratopea capuliformis* Oder, 1932 occurs in the Kindblade Formation of Oklahoma (Yochelson, 1973) and the Rich Fountain Formation (Jefferson City Group) in Missouri (Cullison, 1944). Yochelson (1964) at the same time he reported *Ceratopea billingsi* Yochelson, 1964 from the "St. George Group" at Cape Norman

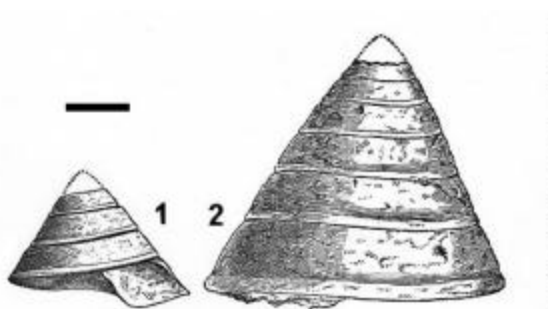


Figure 17. *Euconia etna* (Billings, 1865)

1. apertural view of holotype, specimen GSC 565. 2. side view of larger specimen, syntype GSC 565a(?). Billings' (1865, page 226, Fig. 210a, b) illustrations of specimens from either "Division G" at Cape Norman or "Division H at Table Point" (=Table Head). Black bar is 1 cm.

described it also from the Narwhale Sound Formation on Ella Ø (East Greenland) and the Durness Group of Scotland. Yochelson and Peel (1975) and Peel (1980) documented *C. billingsi* from the Wandel Valley Formation of eastern North Greenland.

Yochelson (1990) illustrated "Billings second operculum" from "the lowest member of the Eleanor River Formation" (Arenig) on Ellesmere Island, Canadian Arctic, and Yochelson (1979, 1990) mentions unillustrated specimens from the Isle of Skye, Scotland.

Malayaspira occurs in the lower Arenig of Malaysia and British Columbia, and the Whiterock of Nevada, Siberia, and Newfoundland. *Polhemia* is previously known only from the east-central United States.

Plethospira is known from the Fort Ann Formation (Demingian) of New York (Flower, 1968b), the Gorman Formation (Ellenburger Group) of Texas (Cloud and Barnes, 1948), the Scenic Drive Member (Cassinian) of the El Paso Group (Flower, 1968a), the "Ceratopea Zone of the Beekmantown" of Virginia (Butts, 1940, 1941), the Poulsen Cliff Formation of Washington Land, Greenland (Fortey and Peel, 1990), and possibly the Upper Ordovician of Scotland (Longstaff, 1924).

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Figure 18. Indet. cephalopod?

1-2, side views of operculum-like fossil. Boyce locality 99F022. Black bar is 1 cm. Specimen number NFM F-414.

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APPENDIX 1 -- Location of illustrated specimens

***Ceratopea billingsi* Yochelson, 1964 locality**

Garden Hill, western Port au Port Peninsula, Hunt–Pan Canadian Petroleum Port au Port No. 1 Well Head. Lower part of Catoche Formation. Beds east of well, dipping about 10°W. UTM Zone 21, 335490E, 5372856N. Rohr 96R017=Boyce 96F011. *Strigigenalis caudata* Zone.

***Ceratopea* sp. cf. *C. capuliformis* Oder, 1932 localities**

Hunters Point, St. John Bay. Barbace Cove Member of the Boat Harbour Formation. Top of Unit 119 of Knight (1991, page 107). UTM Zone 21, 484616E, 5622752N (NAD 83). Rohr 98R017=Boyce 99F090=ECW-033 of Boyce and Stouge (1997). *Strigigenalis brevicaudata* Zone.

Catoche Point, Port au Choix Peninsula. Bed 3, of Knight (1991, page 129). 2 m above the base of the Catoche Formation. UTM Zone 21, 474700E, 5619410N (NAD 27). Rohr 00R002. *Strigigenalis brevicaudata* Zone.

***Maclurites* sp. 1 locality.**

Western Port au Port Peninsula, east of Cape St. George–Mainland road (Route 463). Silicified sponge-thrombolite mound, 33 m above base of Catoche Formation. UTM Zone 21, 337330E, 5377725N (NAD 83). Rohr 99R004=Boyce 99F086. *Strigigenalis caudata* Zone.

***Maclurites* sp. 2 locality.**

Western Port au Port Peninsula, east of Cape St. George–Mainland road (Route 463). Silicified sponge-thrombolite mound, 33 m above base of Catoche Formation. UTM Zone 21, 337330E, 5377725N (NAD 83). Rohr 99R004=Boyce 99F086. *Strigigenalis caudata* Zone.

***Maclurites operculum* type 1 locality.**

Western Port au Port Peninsula, east of Cape St. George–Mainland road (Route 463). Approximately 35 m above base of Catoche Formation. UTM Zone 21, 337000E, 5377500N. Rohr 96R019=?Boyce 96F018. *Strigigenalis caudata* Zone?

"Billings second operculum" locality

Garden Hill, western Port au Port Peninsula, Hunt–Pan Canadian Petroleum Port au Port No. 1 Well Head. Lower part of Catoche Formation. Beds east of Hunt Well, dipping about 10°W. UTM Zone 21, 335490E, 5372856N. Rohr 96R017=Boyce 96F011. *Strigigenalis caudata* Zone.

***Malayaspira* sp. aff. *M. speciosa* (Billings, 1865) localities**

Bustard Cove, St. John Bay. Catoche Formation, Unit 6e of Knight (1991, page 125), 30 m above base of section. UTM Zone 21, 484588E, 5620927N (NAD 83). Rohr 99RB6E. *Strigigenalis caudata* Zone.

Western Port au Port Peninsula, east of Cape St. George–Mainland road (Route 463). Approximately 35 m above base of Catoche Formation. UTM Zone 21, 337000E, 5377500N. Rohr 96R019=?Boyce 96F018. *Strigigenalis caudata* Zone.

***Plethospira* sp. localities**

Hunters Point, St. John Bay. Unit 2 of Knight (1991). 3 m above base of Catoche Formation, in intermound beds. UTM Zone 21, 484227E, 5622664N (NAD 83). Rohr 99RB2=Boyce 99F088=ECW-037 of Boyce and Stouge (1997). *Strigigenalis brevicaudata* Zone.

Laignet Point, Port au Choix Peninsula. Upper part of Catoche Formation. UTM Zone 21, 473655E, 5618565N (NAD 27). Rohr 00R015. *Benthamaspis gibberula* Zone.

Western Port au Port Peninsula, east of Cape St. George–Mainland road (Route 463). 21 m above base of Catoche Formation, UTM Zone 21, 337336E, 5377594N (NAD 83). Rohr 99R002. *Strigigenalis caudata* Zone.

***Ectomaria adelina* (Billings, 1865) locality**

Western Port au Port Peninsula, east of Cape St. George–Mainland road (Route 463). Approximately 35 m above base of Catoche Formation. UTM Zone 21, 337188E, 5377948N (NAD 83). Rohr 99R005. *Strigigenalis caudata* Zone.

Indet cephalopod? locality

Port au Port Peninsula, Duck Pond. Catoche Formation. UTM Zone 21, 35317SE, 5379700 (NAD 27). Boyce 99F022