

Fishes Stranded During Extreme Low Tides in Minas Basin, Nova Scotia

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Abstract. Twenty-one species of fishes caught in Minas Basin during extreme low-water tides included five new records: *Enchelyopus cimbrius*, *Myoxocephalus scorpius*, *Cyclopterus lumpus*, *Liparis atlanticus*, and *Lophius americanus*. Thirty-six species have now been found in this area.

Introduction

The greatest tidal range in the world occurs in the Minas Basin, Nova Scotia, but it is usually the height of the tides that is emphasized in the literature. The extreme lows are equally spectacular, but are seldom observed by biologists, as the majority of such tides center around March and October when field work is minimized. Because of the gradual slope of the shore in the Minas Basin (Figures 1 and 2), the maximal Extreme Low Water Springs (E.L.W.S.) expose additional square miles of sublittoral habitat for periods of usually less than 30 minutes. These E.L.W.S. present the intrepid field biologist with the unique opportunity of an evening's stroll over the sea bed of Minas Basin. The majority of such tides in Minas Basin occur between the hours of 6 and 9, either in the morning or evening.

Collecting

During such occasional extreme tides between 1966 and 1972, 21 species of fishes (Table 1) were collected by hand from the floor of the Minas Basin off Kingsport, Kings County, at a site with high-water depths of approximately 48 feet. This area (E in Figure 3) is about 6/10 of a mile from strand line. Above the low-tide limits, the shore is a relatively smooth sloping expanse of sand and mud, with outcroppings of sandstone over the upper shore, and areas of scattered rocks common to the lower shore (Figure 3). The latter are carried

by ice movement from other parts of the Basin and from rock fill in the many derelict wharves (Figure 4).

The field technique consisted simply of arriving about one hour before low tide and following the receding tide, searching the pools as they become exposed. The fast-flowing ebb current is turbid and also creates ripples making it difficult to see, however once the tide has receded from the pools the surface becomes calm and suspended matter quickly settles out. On the flood tide, the pools were worked over again; by then they contained tracks and trails in the fresh silt revealing the presence of forms not otherwise visible or suspected.

Extreme Low Water Spring tides that are less than 1 foot above Datum on Tide and Current Tables for Saint John, New Brunswick, present the one possibility of studying this benthic community *in situ* (Bleakney 1972). It is not an area that can otherwise be examined visually because severe turbidity discounts the possibility of using SCUBA or underwater TV. It is unlikely that dredging would reveal the pattern of depressions and elevations which characterize this sublittoral region creating a peculiar landscape of innumerable pools and troughs mostly 3 to 6 feet long (Figure 2). Most pools are 1 to 4 inches deep with a bottom composition of fine silt. It would be difficult effectively to seine this habitat because each depression is surrounded by a jagged sand ridge of firmly cemented worm tubes constructed by the polychaete *Sabellaria*

TABLE 1. — Fishes of Minas Basin, Nova Scotia

Species		Huntsman (1922)	Bousfield & Leim (1960)	Leim & Scott (1966)	Other records†	Number of specimens, present study
Sea lamprey	<i>Petromyzon marinus</i>			+		
Thresher shark	<i>Alopias vulpinus</i>	+	+	+		
+White shark	<i>Carcharodon carcharias</i>				1	
Little skate	<i>Raja erinacea</i>	+	+			6
Barndoor skate	<i>Raja laevis</i>		+	+		
Winter skate	<i>Raja ocellata</i>		+			1
Atlantic sturgeon	<i>Acipenser oxyrhynchus</i>		+	+		
Gaspereau	<i>Alosa pseudoharengus</i>		+		1	
American shad	<i>Alosa sapidissima</i>	+	+	+		1
Atlantic menhaden	<i>Brevoortia tyrannus</i>				1	
Atlantic herring	<i>Clupea harengus</i>		+		1	
Atlantic salmon	<i>Salmo salar</i>	+	+			
Rainbow smelt	<i>Osmerus mordax</i>	+	+		1	1
American eel	<i>Anguilla rostrata</i>		+			
# Fourbeard rockling	<i>Enchelyopus cimbrius</i>					1
Atlantic cod	<i>Gadus morhua</i>	+	+			
Atlantic tomcod	<i>Microgadus tomcod</i>	+	+		25	17
White hake	<i>Urophycis tenuis</i>	+	+			2
*Silver hake	<i>Merluccius bilinearis</i>		+			2
Atlantic silverside	<i>Menidia menidia</i>		+	+		12
Mummichug	<i>Fundulus heteroclitus</i>		+			
Northern pipefish	<i>Syngnathus fuscus</i>		+			6
Smooth flounder	<i>Liopsetta putnami</i>		+		3	7
Winter flounder	<i>Pseudopleuronectes americanus</i>	+	+		1	18
Windowpane	<i>Scophthalmus aquosus</i>		+			2
Striped bass	<i>Morone saxatilis</i>	+	+	+		
Butterfish	<i>Peprilis triacanthus</i>		+			
Sea raven	<i>Hemitripterus americanus</i>	+	+	+		10
Grubby	<i>Myoxocephalus aeneus</i>	+	+	+		5
# Shorthorn sculpin	<i>Myoxocephalus scorpius</i>					1
# Lumpfish	<i>Cyclopterus lumpus</i>					1
# Atlantic seasnail	<i>Liparis atlanticus</i>					6
Ocean pout	<i>Macrozoarces americanus</i>	+	+			4
Rock gunnell	<i>Pholis gunnellus</i>	+	+	+		7
Northern sand lance	<i>Ammodytes dubius</i>		+			
# Goosefish	<i>Lophius americanus</i> (Observed)					1
Total species	36					

†From a 1959 National Museum seine haul at Evangeline Beach except for Atlantic menhaden which is a Royal Ontario Museum specimen from Kingsport wharf.

New records.

*Picked up dead.

+Netted off Burntcoat Head, Cobequid Bay.

vulgaris (Verrill), a species not noted by Bousfield and Leim (1960) as occurring in the Minas Basin. The diameter of these tubes is only in the order of 2 mm but they have been built one upon the other to form an intertwining layer,

as thick as 5 inches, which is easily crushed underfoot. Rocks are sparse in this "Crunchy Zone," but such items as a wooden barrel, a wharf piling, a tree trunk, and a rectangular stone block have been observed and each



FIGURE 1. Kingsport shore, Minas Basin, from a position at the edge of the *Sabellaria vulgaris* tube-worm zone, approximately 48 feet below high-water level, which is evident at the undercut base of the sandstone cliffs. Note large boulder-like sandstone outcrops on upper beach, scattered rocks across lower beach, and foreground of sand grains cemented into a carpet of worm tubes. Footprints near basket demonstrate the "crunchy" aspect of this zone, which is exposed only briefly by low water spring tides. Photo was taken 23 June 1971, (2.1' tide), but trenches created by moving ice blocks in February and March 1971 are still evident.

possessed a rich epifauna of barnacles, porifera, hydrozoans, ectoprocts, and nudibranchs. The Atlantic sea snail, *Liparis atlanticus*, was usually found associated with such solid objects.

The Fishes

Table 1 lists the fish species collected and now deposited at the National Museum of Natural Sciences, Ottawa, as well as other museum and literature records reported from Minas Basin by Huntsman (1922), Bousfield and Leim (1960), Leim and Scott (1966), and Case (1968.) It includes those specimens collected or recorded on 14 of 24 field trips to Kingsport by the senior author, usually accompanied by students; and one collection made by the second author in August 1959. Smaller specimens were

invariably in the pools, but larger fish were more often conspicuously perched upon the exposed *Sabellaria* ridges. No attempt was made to collect the larger specimens of skates, flounders, sea ravens, lumpfish, and goosefish on each trip as the prime interest was invertebrates and the fish collections were deliberately limited to only a few specimens of each species. The composition of the ichthyological strandings of these E.L.W.S. was always a surprise, and no two trips ever produced quite the same faunal list. Often one species dominated in the immediate limited acreage of the search group. There were skate nights, sea-raven mornings, species-diversity evenings, and on 5 October 1971 the unique appearance of dozens of the northern pipefish *Sygnathus fuscus* in a Basin where *Zostera* is unknown.

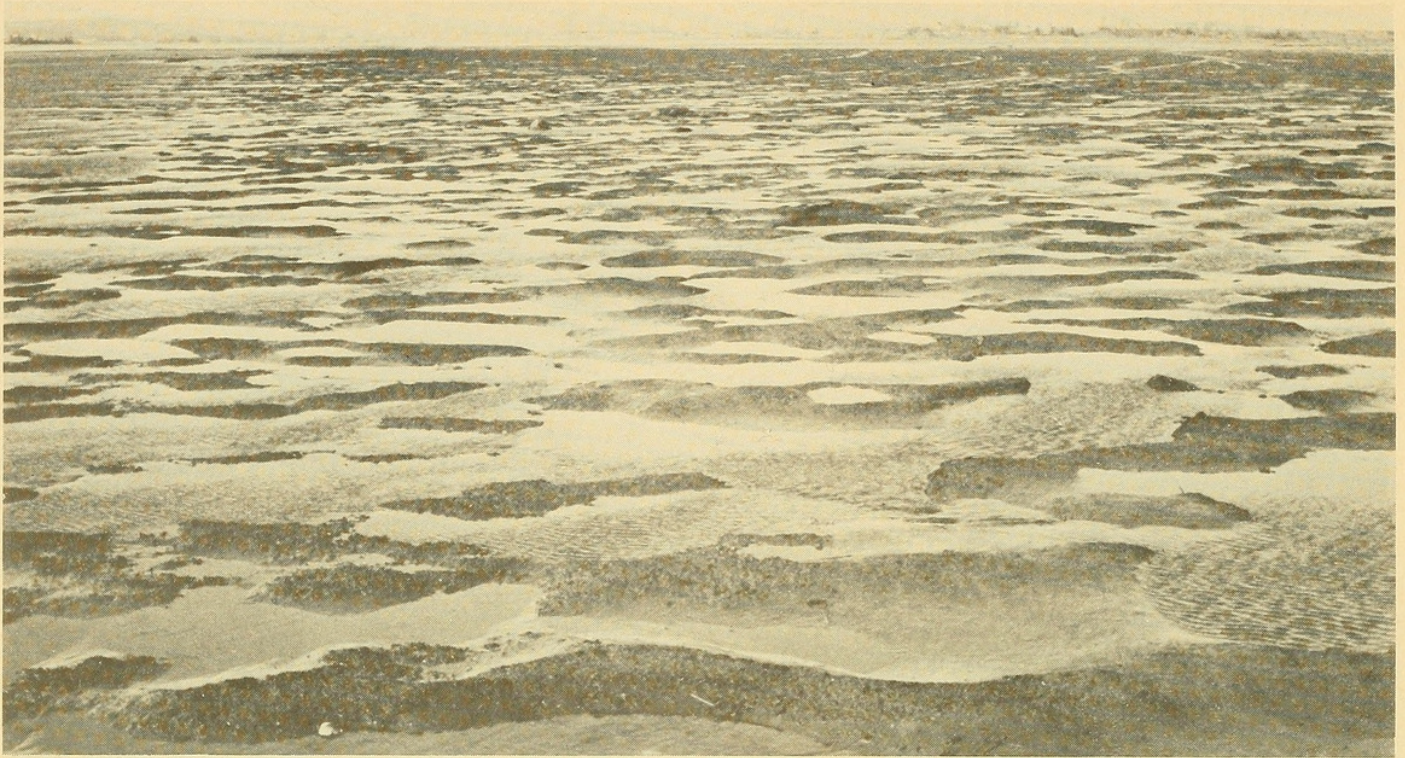


FIGURE 2. Sublittoral fringe at Kingsport showing acres of ridges of sand cemented together by the polychaeta *Sabella ia vulgaris* and shallow pools between. Twenty-one species of fishes have been found stranded in this habitat during maximal E.L.W.S. There is a characteristic paucity of rocks in this area. (26 April 1967; $-0.3'$ tide.)

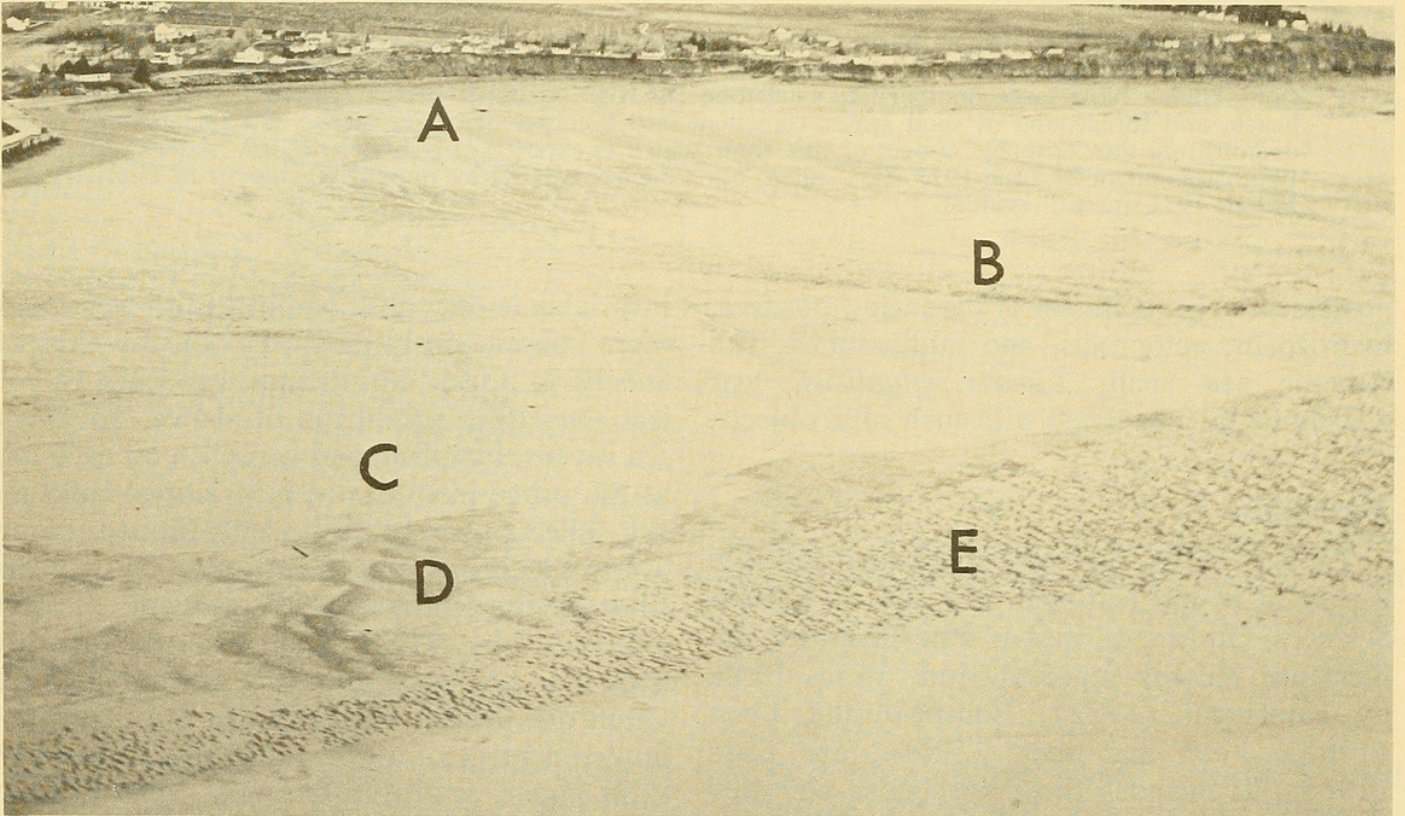


FIGURE 3. Air photo of beach area immediately east of Kingsport wharf, which is in upper left corner. Black objects on upper beach A, are sandstone outcroppings. The dark diagonal area B is strewn with rocks. Area C is muddy, D is sandy, and E consists of sand cemented together by the polychaeta *Sabellaria vulgaris*. (27 April 1971; $0.7'$ tide.)



FIGURE 4. Upper *Sabellaria* tube-worm zone showing ice-scoured trenches running diagonally from incoming tide. Stones in foreground and in centerground beside the basket (shown again in Figure 2) were transported by blocks of ice. (23 June 1971; 2.1' tide.)

Discussion

Twenty-one species were collected or observed on the Minas Basin tide flats. Benthic or benthopelagic species predominated and *Enchelyopus cimbrius*, *Myoxocephalus scorpius*, *Cyclopterus lumpus*, *Liparis atlanticus*, and *Lophius americanus* had not previously been reported from Minas Basin.

The reduced salinity of the basin, 29.0 to 30.5 reported by Bousfield and Leim (1960) and the discharge of the Avon and Schubencadie watersheds is reflected in euryhalinity of one third of the species. These are either anadromous, catadromous, or brackish-water tolerants.

Species stranded are deprived of the liquid medium upon which their vertical equilibrium depends and thus the presence of benthic fishes with flattened bodies, such as skates and floun-

ders, and those with large broad-base heads like the sculpins, liparids, and goosefishes is to be expected.

The turbidity fostered by extreme tides also presents potential difficulties, for Robins (1957) reported that much of the mortality in shore fishes during storms can be attributed to wave-disturbed sediments which clog the gills. Whether there has been selection for improved filtering mechanisms in Minas Basin populations has yet to be determined. Tomcod, the commonest Basin species, hake, and rockling are provided on the chin and filaments on the pelvic fin with barbels which bear taste buds (Herrick 1903), enabling these species to find food even though turbidity prevents visual prey location. Most of these species thus have one or more adaptations fitting them to live in this extensive Minas Basin intertidal zone with its dynamic semi-diurnal tides of nearly 50-foot amplitude.

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