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FRESHWATER AND INTERTIDAL FISHES OF SCATARIE ISLAND, NOVA SCOTIA

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Intertidal and shallow subtidal marine fish communities are largely undocumented in Atlantic Canada, as is the freshwater fish distribution on islands in this area. Accordingly Scatarie Island, off of the northeast coast of Cape Breton, was subjected to an intensive, short-term biological survey in the summer of 2005, in which freshwater and shallow water marine fish were sampled. The most commonly captured species were Atlantic herring (*Clupea harengus*), grubby (*Myoxocephalus aenaeus*), white hake (*Urophycis tenuis*) and cunner (*Tautogolabrus adspersus*). The catch per unit effort (CPUE) was low (<0.11 fish/hr) throughout all trapping sessions.

Les populations de poissons des zones intertidales et des zones infralittorales peu profondes sont peu documentées au Canada atlantique. Il en est de même de la répartition des poissons d'eau douce dans les îles de la région. C'est pourquoi l'île Scatarie, située au large de la côte nord-est du Cap-Breton, a fait l'objet d'une étude biologique intensive sur une courte période au cours de l'été 2005, dans laquelle des échantillons de poissons d'eau douce et de poissons d'eau de mer peu profonde ont été recueillis. Les espèces les plus capturées étaient le hareng de l'Atlantique (*Clupea harengus*), le chaboisseau bronzé (*Myoxocephalus aenaeus*), la merluche blanche (*Urophycis tenuis*) et la tanche-tautogue (*Tautogolabrus adspersus*). Les prises par unité d'effort (PUE) ont été faibles (< 0,11 poisson par heure) durant toutes les opérations de capture.

INTRODUCTION

Insular freshwater fish faunas are depauperate relative to neighboring mainland areas, requiring those species which do colonize and utilize freshwaters of islands to be tolerant of sea-water to effect a crossing. Basic island biogeography theory (MacArthur & Wilson 1967) predicts small islands with relatively little freshwater will be expected to have very few freshwater fish species, not only because of difficulties in colonization, but also because the risk of extinction occurring in small isolated populations is high. The freshwater fish fauna of Nova Scotia, the source population for nearby islands, is relatively low in terms of species richness compared with the adjacent provinces of New Brunswick and Québec, being approximately 35, 46 and 96, respectively (compiled from Scott and Crossman (1973)

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and includes diadromous as well as wholly freshwater species). This low richness is a result of the river systems of Nova Scotia generally being short and isolated from each other, requiring colonization from river-to-river by sea-water tolerant species, or historic (post-glacial) colonization while the drainages were connected prior to isostatic rebound which separated catchments. The result is that the pool of available freshwater fish species to colonize offshore islands from the Nova Scotia mainland or Cape Breton is small to begin with. For these reasons offshore islands of Nova Scotia are expected to have low freshwater fish species richness, and those species present will be sea-water tolerant.

The intertidal and shallow subtidal fish fauna of rocky shores in Atlantic Canada is largely undocumented. Tyler (1971) reported use of intertidal areas by fish in Passamoquoddy Bay, New Brunswick. Black and Miller (1991) looked at use of intertidal areas by fish at six adjacent sites in Yarmouth County, Nova Scotia, and Stokesbury and Stokesbury (1999) examined shallow subtidal fishes in the Baie des Chaleurs. There is an absence of other published literature on the fish communities of these habitats in this area of the northwest Atlantic. The fish communities that do exist in the Maritimes may be expected to be of relatively low richness because of the annual disturbances (ice scour) of these environments; these frequent disturbances prevent establishment of high species richness over long time periods.

To date very little information has been collected on the freshwater or marine fish fauna associated with Scatarie Island. This knowledge is important for planning conservation or protection strategies and therefore, the fish fauna of the island's intertidal and freshwaters were sampled in August, 2005 as one component of a biological survey intended to provide the Protected Areas Branch with information for successfully managing this Wilderness Area.

STUDY AREA

Scatarie Island is washed by the Nova Scotia Current flowing out of Cabot Strait and traveling at an estimated 0.05-0.10 m/s (Davis & Browne, 1996). The coastal morphology of the shoreline is one of broad coves and indentations containing sand and cobble beaches interspersed with rocky headlands. SCUBA diving transects by Moore et al. (1986) at two locations (northern Scatarie and Tin Cove; see Figure 1) indicated a gentle sloping substrate of about 6% out for 120 to 160 m from shore (7 and 10 m depth by these points, respectively). These transects showed the substrate to be largely bedrock and boulders, with sand and scattered gravel. Algal

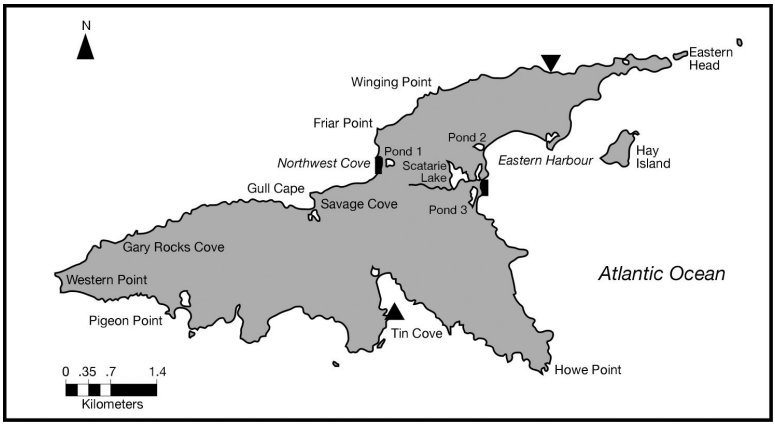

Fig 1 Study area of Scatarie Island illustrating Scatarie Lake and the three sampled ponds, two intertidal sampling locations (black rectangles) and two areas of transects of Moore et al. (1986) (black triangles).

communities were primarily *Fucus* sp.*, Laminaria longicruris*, and *Saccorhiza dermatodea*, with lesser amounts of *Chondrus crispus, L. digitata*, and *Agarum cribrosum*.

Two coastal locations were sampled during the work described here: Northwest Cove and Eastern Harbour. Northwest Cove is a broad west-facing cove composed primarily of sand beach, grading to a small area of cobble beach at the north end. The beach drops off relatively rapidly creating conditions of moderate water depth near the shore. In contrast, Eastern Harbour is an east-facing sand beach interspersed with rocky headlands. Water depth is shallow as the beach gradient is low. Unlike Northwest Cove, Eastern Harbour appears to be a higher energy site based on the presence of gravel and cobble in the high intertidal zone.

There is limited freshwater on the island, and that which is present occurs primarily in isolated water bodies. The largest pond on the island (unnamed, but herein called Scatarie Lake) is approximately 10.5 ha. (Fig 1). There are also seven ponds between 2 and 6 ha, and approximately 22 small bodies of water **<**1.0 ha. Combined, these ponds form about 3.5% of the island area. These bodies of standing water are distributed primarily within two general land-forms: (1) bogs and barrens, and (2) in the low-lying areas behind the berms of coastal beaches. The ponds are largely isolated from each other with only Scatarie Lake having an appreciable inflow and outflow stream. The area drained by the Scatarie Lake catchment is approximately 81 ha (~5.5% of island). The water within the ponds is dark (colored), creating “brown-water” systems.

This feature is consistent with draining a bog and barren landscape. At the time of sampling, visibility in the water column was estimated as less than 15 cm.

METHODS

Two intertidal locations and four freshwater ponds were sampled for fish presence on Scatarie Island from 8-11 August 2005. Access and logistical constraints (few roads, no vehicle transportation and fish sampling being relatively equipment intensive) limited the sampling to the northern portion of the island, with intertidal sampling conducted at Northwest Cove and Eastern Harbour and freshwater sampling at Scatarie Lake and three unnamed ponds (herein called Ponds 1, 2, 3; see Fig 1 and Table 1). Sampling of the intertidal area was carried out by beach seine, Fyke net and minnow traps, while the freshwater sampling utilized only minnow traps. The beach seine (18 m long, mesh size 7 mm) was deployed only in Northwest Cove. No attempt was made to standardize the area swept by the net among sweeps, and the area enclosed was not estimated. A single Fyke net (3 m long, mouth of 0.40 m^2, mesh size 1.5 cm) was set either overnight (8-9 August) or for six hours (10 August) as convenient; no effort was made to set on a particular tide. Standard minnow traps were set in pairs at a given site and baited with beef liver. Those traps set within Scatarie Lake contained chemical light sticks ("glow sticks") the night of 8-9 August to aid in attracting fish; the following night attractants were not used. Generally, minnow traps were set overnight, though on occasion were lifted or retrieved before nightfall and moved to a new location. The sampling regime is summarized in Table 1.

Captured fish were identified to the level of species using Leim and Scott (1966), measured for length and returned to the water. Incidental mortalities and voucher specimens were retained as appropriate.

RESULTS

A total effort of 300 minnow trap-hours (127 hours in marine water, 173 in freshwater), 21 Fyke net-hours and four beach seine sets yielded nine species of intertidal or freshwater fish (Table 2). The most commonly captured fish were Atlantic herring (*Clupea harengus*), grubby (*Myoxocephalus aenaeus*), white hake (*Urophycis tenuis*), and cunner (*Tautogolabrus adspersus*). Other species encountered were a few nine-spine stickleback (*Pungitius pungitius*) and one each of winter flounder (*Pseudopleuronectes americanus*),

Table 1 Summary of fish sampling regime on Scatarie Island, 8-11 August 2005.

Date	Location	Coordinates (Lat/Long)	Capture method	Number set	Hours set	Effort (trap-hours)
8-9 August	Eastern Harbour	46°01.33' / 59°42.7'	Fyke net	1	15	15
8-9 August	Eastern Harbour	46°01.33' / 59°42.7'	Minnow trap	2	22	44
8-9 August	Scatarie Lake	46°01.32' / 59°43.23'	Minnow trap	2	15	30
8-9 August	Pond 1	46°01.48' / 59°44.24'	Minnow trap	2	11	22
8-9 August	Pond 2	not recorded	Minnow trap	2	15	30
9 August	Northwest Cove	46°01.31' / 59°43.92'	Beach seine	3	N/A	N/A
9-10 August	Eastern Harbour	46°01.17' / 59°42.71'	Minnow trap	2	16.5	33
9-10 August	Northwest Cove	46°01.31' / 59°43.92'	Minnow trap	2	14	28
9-10 August	Scatarie Lake	46°01.32' / 59°43.23'	Minnow trap	2	17	34
9-10 August	Pond 3	46°01.27' / 59°42.76'	Minnow trap	2	23	46
10 August	Northwest Cove	46°01.31' / 59°43.92'	Minnow trap	2	5.5	11
10 August	Northwest Cove	46°01.18' / 59°43.99'	Minnow trap	2	5.5	11
10 August	Northwest Cove	46°01.31' / 59°43.92'	Fyke net	1	6	6
10 August	Northwest Cove	46°01.31' / 59°43.92'	Beach seine	1	N/A	N/A
10 August	Pond 1	46°01.48' / 59°44.24'	Minnow trap	2	5.5	11
					Total = 321	

Table 2 Summary of results of intertidal and freshwater fish sampling on Scatarie Island, 8-11 August 2005.

Family	Species	Location	Method	Number captured	CPUE *
Intertidal					
Pleuronectidae	Winter flounder	Eastern Harbour	Fyke net	1	0.067
Gadidae	White hake	Eastern Harbour	Fyke net	1	0.067
		Eastern Harbour	Minnow trap	3	0.039
	Unidentified Hake	Northwest Cove	Beach seine	1	N/A
Cottidae	Grubby	Eastern Harbour	Minnow trap	8	0.104
Clupeidae	Atlantic herring	Northwest Cove	Beach seine	~650	N/A
	Blueback herring/Gaspereau	Northwest Cove	Beach seine	1	N/A
Labridae	Cunner	Northwest Cove	Minnow trap	2	0.040
		Northwest Cove	Beach seine	1	N/A
Scombridae	Atlantic mackerel	Northwest Cove	Beach seine	1	N/A
Freshwater					
Gasterostidae	9-spine stickleback	Pond 1	Minnow trap	1	0.030
		Pond 3	Minnow trap	3	0.065

* CPUE = catch per unit effort

blueback herring or gaspereaux (*Alosa* sp.), Atlantic mackerel (*Scomber scombrus*), and an unidentified hake (*Urophycis* sp.). This hake was retained and submitted to L. Van Guelpen (Curator of Fishes and Collections Manager, Atlantic Reference Centre, Huntsman Marine Science Centre, St Andrews, New Brunswick) for positive identification. This fish could not be positively identified as a spotted hake (*U. regia*) or white hake and its identity remains uncertain. (It is archived at the Atlantic Reference Centre). Catch per unit effort (CPUE) for the minnow traps was low, ranging between 0.03 and 0.10 fish/trap-hour. Lengths of captured fish by species are presented in Figure 2.

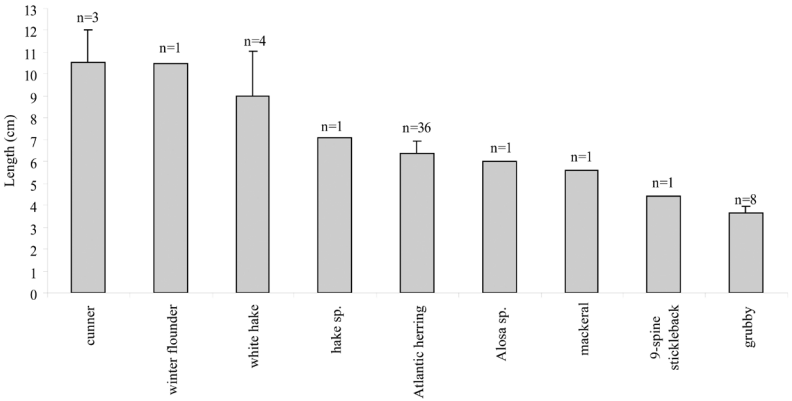

Fig 2 Mean length of captured fish species from Scatarie Island. Measure is total length except herring, Alosa sp, and mackerel which are fork length. Error bars are SD, where appropriate. Values indicate number of fish in sample.

In addition to the fish species described above, three observations are relevant in interpreting fish distributions on Scatarie Island. Tadpoles of a frog species, tentatively identified as green frog (*Rana clamitans*), were captured in minnow traps in Pond 2. This indicates that this pond is freshwater and not significantly influenced by salinity; therefore, wholly freshwater or euryhaline species such as sticklebacks would be expected here. Second and surprisingly no fish were captured in Scatarie Lake, the largest body of freshwater on the island. This despite 64 trap-hours (37% of total freshwater sampling) expended here. It is premature to state that it is fishless, but the capture methodology used did not show any fish presence. Finally, a limitation of the minnow trap as a sampling tool was demonstrated at Pond 3 where, after eight

hours the traps were lifted and two sticklebacks were present in one trap. The traps were replaced with the fish in them and the following morning checked again (total set time 23 hours). The trap which had contained the two fish now had none, and the trap originally with zero fish had one stickleback. Clearly, these small fish in the freshwater environment were easily getting in and out of the trap.

DISCUSSION

The freshwaters of Scatarie Island contained only a single known fish species, the nine-spine stickleback. This low species richness is explained by the isolated nature of islands, requiring a fish to tolerate seawater in order to colonize [the nine-spine stickleback is found in both freshwater and marine environments (Scott & Scott 1988)]. In the case of Scatarie Island, colonization difficulty is exacerbated by the low relief, bog nature of the landscape creating slow-moving, dark water streams unsuitable for many diadromous species. Island biogeography theory maintains that both island size and distance from mainland have profound effects on colonization rate. Scatarie Island is a small island close to a larger island (Cape Breton) which itself has reduced diversity. Therefore, the low richness is not surprising.

The capture of sticklebacks in Ponds 1 and 3, but not in Scatarie Lake is difficult to reconcile. The freshwater ponds appear isolated, with no apparent connection to other freshwater bodies and yet these contain fish.

The intertidal fish species richness in the waters of the island, based on the limited sampling conducted during the short window of opportunity, is relatively high for the northwest Atlantic. With any survey sampling, the number of species captured/observed is expected to rise with effort to an asymptote beyond which further effort yields very few additional species. Although that asymptote probably was not reached in the current study, the eight intertidal species are likely to have included the majority of the species present. Table 3 shows other studies evaluating intertidal and shallow sub-tidal fish communities in the northwest Atlantic from which it may be seen that even with great effort (i.e., multiple years) the fish species encountered remains below 30.

All marine species were captured at low abundance (low CPUE) with the exception of Atlantic herring. The much greater abundance of herring versus the other species results from their traveling in large schools (Scott & Scott 1988); when these are intercepted the yield is large.

Table 3 Summary of previous relevant studies on shallow inshore fish community composition.

Study	Location	Effort/methods	Number of species encountered	Species in common with Scatarie Island
Tyler (1971)	Passamaquoddy Bay, New Brunswick	204 hours television observation of intertidal	9	Atlantic herring Winter flounder
Black and Miller (1991)	Yarmouth County, Nova Scotia	6 sampling periods (early June-October) using trammel nets (135 sets) and beach seines (52 sets)	18	White hake Gaspereau Atlantic mackerel Cunner Grubby
Lazzari et al. (1999)	Kennebeck Point, Maine	Bi-weekly Fyke net and beach seine samples, April-Dec., 1990-1994 (320 samples)	27	Atlantic herring White hake *Alosa* sp. Nine-spine stickleback
Stokesbury and Stokesbury (1999)	Baie des Chaleurs, Quebec	Trammel nets and gill nets (sub-tidal) 679 sampling hours over two years	22 22	Atlantic herring White hake Winter flounder Cunner

This fish sampling provided a reconnaissance level survey of a few isolated locations on the island. Future survey trips should use a boat to access other coves and rocky headlands to sample with beach seine and minnow traps. In addition, snorkeling gear would add visual assessment for other species possibly missed by this sampling. Scatarie Lake should be sampled using fine mesh hand nets along the shoreline and minnow traps modified to a much finer mesh to contain very small fish. The use of a Fyke net and set lines in Scatarie Lake to provide further information on whether, in fact, it is truly fishless is also recommended.

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REFERENCES

Black R, Miller RJ (1991) Use of the intertidal zone by fish in Nova Scotia. *Environmental Biology of Fishes* 31(2):109-121.

Davis DS, Browne S (1996) The natural history of Nova Scotia, 2 vols, rev ed. Nova Scotia Museum and Nimbus Publishing, Halifax, Nova Scotia.

Leim AH, Scott WB (1966) Fishes of the Atlantic coast of Canada. Bulletin. Fisheries Research Board Canada. No.155.

MacArthur RH, Wilson EO (1967) The theory of island biogeography. Princeton University Press, Princeton, NJ.

Moore DS, Miller RJ, Meade LD (1986) Survey of shallow benthic habitat: Eastern Shore and Cape Breton, Nova Scotia. Canadian Technical Report of Fisheries and Aquatic Sciences 1546.

Scott WB, Crossman EJ (1973) Freshwater fishes of Canada. Bulletin. Fisheries Research Board Canada No. 184.

Scott WB, Scott MG (1988). Atlantic fishes of Canada. Bulletin. Fisheries Research Board Canada No. 219.

Stokesbury KDE, Stokesbury MJW (1999) Subtidal fishes associated with gravel and bedrock in the Baie des Chaleurs, Québec. *Canadian Field Naturalist* 113(3):466-471.

Tyler AV (1971) Surges of winter flounder, *Pseudopleuronectes americanus*, into the intertidal zone. *Journal of the Fisheries Research Board of Canada* 28(11):1727-1732.