Subtidal Hydroids (Cnidaria) of Northumberland Strait, Atlantic Canada, with Observations on Their Life Cycles and Distributions

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Hydroids were examined in collections from a biological survey of Northumberland Strait undertaken by Fisheries and Oceans Canada from June to August 1975. No investigations have been undertaken previously on hydroids of the study area. Forty-eight species referable to 12 families were present in the samples, with Sertulariidae dominating in both numbers of species (12) and frequency. Gonophores were found in 30 of the species. As usual in hydroids of higher latitudes, a majority of those represented do not have a medusa stage in their life cycle. Gonophores in 42 of the 48 species are known to be fixed sporosacs while free medusae or medusoids occur in only six. Two major species groups were distinguished in a numerical analysis of hydroid species/station data. One of these groups included the three most ubiquitous species (*Calycella syringa, Hydrallmania falcata, Sertularia latiuscula*) together with 15 others most prevalent in samples from shallower (<20 m) and warmer stations. The second group included species occurring primarily in samples from stations in deeper (>20 m) and mostly colder waters. Two species (*Lafoeina tenuis, Halecium lankesteri*) are new to the Atlantic coast of North America. Eight others (*Bougainvillia* sp., *Eudendrium dispar, Eudendrium ramosum, Cuspidella humilis, Opercularella pumila, Halecium scutum, Halecium sessile, Diphasia fallax*) are reported in the southwestern Gulf of St. Lawrence for the first time. The subtidal hydroid fauna in open waters of Northumberland Strait is a cold-water assemblage typical of the boreal zone in the western North Atlantic, and no relict warm-temperate species were found.

Key Words: hydroids, Cnidaria, Hydrozoa, Northumberland Strait, Prince Edward Island, Nova Scotia, New Brunswick, Gulf of St. Lawrence, reproduction, zoogeography.

Research on hydroids in Atlantic Canada began with Stimpson's (1854) synopsis of marine invertebrates in waters around Grand Manan Island, at the mouth of the Bay of Fundy, New Brunswick. Since then, however, fewer than two-dozen systematic accounts have been published on hydroids of the region. Most available knowledge was summarized in a guidebook, now more than six decades old, on species of the Atlantic coast of North America (Fraser 1944). Original information on hydroids of the southwestern Gulf of St. Lawrence is limited to five reports (Whiteaves 1901; Stafford 1912; Fraser 1926, 1927, 1944). None of these dealt with the fauna of Northumberland Strait, a sea channel separating Prince Edward Island from New Brunswick and Nova Scotia.

The southwestern Gulf of St. Lawrence, including Northumberland Strait, is biologically productive and of longstanding biogeographic interest (Ganong 1890). Being relatively shallow, waters undergo a wide annual range of temperature. Ice forms in the area during winter, while surface temperatures may approach or exceed 20°C in summer. As a result, a number of eurytopic temperate to warm-temperate species (e.g., the molluscs *Crassostrea virginica*, *Mercenaria mercenaria*, *Mulinia lateralis*, and *Urosalpinx cinerea*, the barnacle *Balanus improvisus*, the decapods *Ovalipes ocellatus* and *Rithropanopeus harrisii*, and the estuarine hydroid *Garveia franciscana*) occur in some localities. These invertebrates, considered relicts of a warmer period, are generally thought to be isolated from principal populations of their species occurring further south along the east coast of the United States by perpetually cold waters along much of the outer coast of Nova Scotia, the lower Bay of Fundy, and the northeastern Gulf of Maine (Ganong 1890; Whiteaves 1901; Fraser 1926; Bousfield 1960; Bousfield and Thomas 1975).

Objectives of this study were to census the subtidal hydroids of Northumberland Strait in the southwestern Gulf of St. Lawrence, and to determine their reproductive states, predominant life cycle patterns, and geographic affinities.

Materials and Methods

Materials examined were collected as part of the 1975 Northumberland Strait Project undertaken by the St. Andrews Biological Station, Fisheries and Oceans Canada. Marine invertebrates from this biological survey, including the hydroids studied here, were subsequently deposited at the Royal Ontario Museum (Carson 1985). Ninety-six stations were occupied between June and August 1975, during R/V *Harengus* Cruise Number 120, along a series of 13 transects extending across the strait in sequence from its northwestern to northeastern entrances into the Gulf of St. Lawrence. Samples of epibenthos were collected by beam trawl

TABLE 1. Stations in Northumberland Strait, eastern Canada, at which hydroids were collected during R/V *Harengus* cruise 120, 1975. BT = beam trawl; SD = scallop drag; NR = not recorded.

Station	Date	North Latitude	West Longitude	Gear	Depth (m)	Temp. (°C)	Bottom Type	Number of Species
Northwestern Sector								
2	11-VI-75	46°57’45”	64°45’15”	BT	13	11.0	NR	6
3	11-VI-75	46°57’45”	64°39’10”	BT	22	13.0	sandy	11
4	11-VI-75	46°57’45”	64°33’40”	BT	23	6.7	sandy	6
5	12-VI-75	46°57’’45”	64°25’15”	BT	36	6.6	sandy/muddy	2
10	18-VI-75	46°52’40”	64°16’15”	BT	16	9.8	NR	4
11	18-VI-75	46°52’20”	64°22’15”	BT	29	2.5	NR	9
12	02-VII-75	46°52’15”	64°24’45”	BT	29	9.0	shell/gravel/boulders	13
13	02-VII-75	46°51’30”	64°39’50”	BT	25	10.5	NR	18
14	02-VII-75	46°51’20”	64°42’40”	BT	18	12.6	boulders	14
18	03-VII-75	46°43’40”	64°40’00”	SD	18	11.7	boulders	19
21	04-VII-75	46°44’00”	64°32’30”	SD	22	12.2	NR	8
22	04-VII-75	46°44’10”	64°30’10”	SD	25	12.0	mud/gravel/shell	14
24	04-VII-75	46°44’30”	64°23’30”	SD	11	15.5	boulders	12
West-central Sector								
25	04-VII-75	46°36’20”	64°23’25”	SD	07	17.0	shell/gravel/boulders	12
26	01-VII-75	46°35’35”	64°24’00”	BT	13	14.2	NR	4
30	26-VI-75	46°27’25”	64°30’05”	BT	09	14.1	sand	6
31	26-VI-75	46°26’30”	64°30’55”	BT	09	15.3	sand	12
32	26-VI-75	46°23’10”	64°33’20”	SD	05	16.2	sand	5
33	13-VI-75	46°17’15”	64°29’00”	BT	22	16.8	sand/mud	1
34	13-VI-75	46°18’35”	64°25’00”	BT	09	10.7	sand/mud	8
35	13-VI-75	46°19’20”	64°22’30”	BT	14	11.4	sand/mud	14
36	13-VI-75	46°20’15”	64°20’00”	BT	14	11.4	shell/gravel/sand	2
38	10-VI-75	46°22’05”	64°14’05”	BT	13	10.8	shell/gravel/sand	7
40	05-VI-75	46°24’00”	64°08’35”	BT	07	11.5	shell/gravel/sand	6
42	03-VI-75	46°18’00”	63°52’30”	BT	14	11.5	sand	11
43	03-VI-75	46°14’10”	63°54’15”	BT	22	11.4	mud	7
44	03-VI-75	46°11’45”	63°55’15”	BT	11	11.6	sand	8
45	24-VI-75	46°07’45”	63°45’10”	BT	09	15.1	sand/mud	6
46	24-VI-75	46°09’30”	63°45’30”	SD	29	13.5	shell/gravel/sand	11
48	24-VI-75	46°15’00”	63°43’00”	BT	09	14.6	shell/gravel/sand	14
East-central Sector								
49	10-VII-75	46°08’05”	63°19’15”	BT	09	14.8	sand/mud	4
52	09-VII-75	46°01’45”	63°27’50”	BT	22	11.0	mud	2
59	16-VII-75	45°54’10”	63°04’40”	BT	31	10.9	NR	1
60	18-VII-75	45°56’30”	63°05’15”	BT	27	10.8	mud	2
61	18-VII-75	45°58’30”	63°05’14”	BT	22	14.5	mud	12
62	18-VII-75	45°59’05”	63°05’50”	BT	22	13.5	mud	6
65	30-VII-75	45°56’50”	62°44’30”	BT	09	12.3	shell/gravel/sand	7
66	30-VII-75	45°55’45”	62°43’50”	BT	31	7.6	mud	14
67	30-VII-75	45°55’15”	62°40’40”	SD	29	10.9	mud	17
68	30-VII-75	45°49’30”	62°39’30”	SD	20	12.8	mud	8
71	24-VII-75	45°43’40”	62°35’40”	BT	09	16.2	sand	1
72	24-VII-75	45°43’00”	62°35’00”	SD	14	17.0	mud	2
73	10-VIII-75	45°46’15”	62°10’45”	BT	14	14.6	sand	11
74	10-VIII-75	45°47’00”	62°11’40”	BT	29	7.6	mud	3
75	10-VIII-75	45°48’10”	62°13’00”	BT	32	6.2	mud	2
76	31-VII-75	45°52’45”	62°18’40”	BT	31	5.3	mud	5
78	31-VII-75	45°56’15”	62°23’30”	BT	36	6.1	mud	17
79	31-VII-75	45°57’15”	62°24’00”	BT	36	3.4	mud	1
80	31-VII-75	45°59’40”	62°27’15”	BT	14	11.6	sand/mud	10
87	21-VII-75	45°51’15”	62°01’15”	BT	25	19.0	mud	1
Northeastern Sector								
84	24-VII-75	46°03’45”	62°16’45”	BT	34	13.5	mud	9
86	24-VII-75	46°01’00”	62°12’20”	BT	34	14.0	mud	10
90	22-VII-75	45°54’30”	61°53’10”	SD	32	15.0	mud	1
91	22-VII-75	46°00’10”	61°57’30”	BT	49	10.0	mud	1
92	22-VII-75	46°04’45”	62°00’00”	SD	32	12.0	boulders	10

at 68 of the stations, and by scallop drag at the remaining 28. Hydroids were identified in samples from 55 of the stations (Table 1), and presence or absence of gonophores was determined.

Species associations in the collection were determined by numerical analysis (Rohlf 1990) of a data matrix recording presence or absence of each of 48 species encountered overall at each of 55 stations. Qualitative similarity coefficients were computed using the SIMQUAL program, employing the PHI coefficient. Inverse (species-group) cluster analysis was then undertaken by the SAHN program employing the UPGMA clustering method and using a beta value of –0.25.

Study Area

Northumberland Strait separates Prince Edward Island from New Brunswick and Nova Scotia in Atlantic Canada. Some 330 km in length, it comprises a moderately sheltered central region with funnel-shaped openings to the Gulf of St. Lawrence at its northwestern and northeastern ends. Minimum width across the strait is 12 km, maximum depth is approximately 50 m, tidal range averages about 3 m, salinities are typically euhaline (>30%), and the shoreline is predominantly sandy. Surface waters of the strait freeze over in winter but approach or exceed 20°C in summer.

At 96 stations occupied in late spring and summer during the 1975 Northumberland Strait Project, water temperatures varied from 2.5°C (Station 11) to 19.5°C (Stations 81, 89). Station depths ranged from 5 m (Stations 32, 57) to 49 m (Station 91). Bottoms consisted primarily of boulders or sand in the Northwestern Sector of the strait (Stations 1-24, north of 46°40'N), shell/gravel/sand or sand in the West-central Sector (Stations 25-48, eastward to 63°40'W), mud in the East-central Sector (Stations 49-80, 87, and 88, eastward to a line from Cape Bear [46°00'N, 62°28'W] to Cape George [61°56'N, 45°53'W]), and mud or boulders in the Northeastern Sector (Stations 81-86 and 89-96, northeast of the East-central Sector).

Results

Hydroid diversity in Northumberland Strait was moderately low, with 48 species identified in the samples (Table 2). Leptothecates accounted for 40 of these and anthoathecates eight. Five of the species (*Calycella syringa*, *Hydrallmania falcata*, *Sertularia latiuscula, Sertularella polyzonias*, *Obelia longissima*), all leptothecates, were found at 24 or more of the 96 stations. These and six other ubiquitous species (*Symplectoscyphus tricuspidatus, Abietinaria abietina, Hydractinia polyclina*, *Rhizocaulus verticillatus, Gonothyraea loveni*, *Lafoea dumosa*) occurred in samples from all four sectors of the strait (Northwestern, West-central, East-central, and Northeastern). Two species (*Lafoeina tenuis*, *Halecium lankesteri*) are new to the Atlantic coast of North America. Eight others (*Bougainvillia* sp., *Eudendrium dispar*, *Eudendrium ramosum*, *Cuspidella humilis*, *Opercularella pumila*, *Halecium scutum*, *Halecium sessile*, *Diphasia fallax*) are reported in waters of the southwestern Gulf of St. Lawrence for the first time. Of the 12 families of hydroids represented in the collection, Sertulariidae dominated both in numbers of species (12) and frequency in the samples (Table 2).

Colonies with gonophores were observed in 30 of the 48 species from the collections (Table 2), although most specimens were infertile. Of 427 records of hydroid species, gonophores were present in 108 (25%) but absent or undetected in the remaining 319 (75%). Fertile colonies were noted in 26 of 50 specimen records of anthoathecate species but in only 82 of 377 records of leptothecate species.

The fauna was divisible ecologically into two major species groups (Table 2) based on results of an inverse cluster analysis. Group I included the three most ubiquitous species (*Calycella syringa*, *Hydrallmania falcata*, *Sertularia latiuscula*) as well as 15 others associated for the most part with stations in shallower and somewhat warmer waters (mean depth 15.4 m; mean water temperature 12.5°C). Group II species, 30 in number, were generally associated with deeper and colder sites (mean depth 23.1 m; mean water temperature 11.3°C). Eight of these 30 (*Keratosum maximum*, *Lafoeina tenuis*, *Halecium muricatum*, *Halecium scutum*, *Campanularia groenlandica*, *Orthopyxis integra*, *Grammaria gracilis*, *Lafoea gracillima*) were found only at stations in the more exposed northwestern and northeastern entrances of the strait.

Discussion

Of the 48 species identified here from Northumberland Strait, 10 have not been reported before from the southwestern Gulf of St. Lawrence region (*Bougainvillia* sp., *Eudendrium dispar*, *Eudendrium ramosum*, *Cuspidella humilis*, *Lafoeina tenuis*, *Opercularella pumila*, *Halecium lankesteri*, *Halecium scutum*, *Halecium sessile*, *Diphasia fallax*). All of them, however, are regarded as typical of boreal Atlantic waters (Table 2) and they are unlikely to have been recently introduced. Hydroid species reported from other localities in the southwestern gulf, but not found here, are listed in Table 3.

Gonophores were observed in 30 of the species. It is not known whether colonies of the remaining 18 are fertile during summer in the area. Numerous factors, including water temperature, nutrition, environmental stresses, and in some species even lunar and diurnal cycles (e.g., Elmhirst 1925; Ballard 1942; Stebbing 1980; Arai 1987; Calder 1990, 1991; Cornelius 1990; Piraino 1991; Gili and Hughes 1995), are likely to influence physiological functions such as the periodicity and frequency of gonophore production and gamete or medusa release. Gonophore formation in hydroids appears to be decidedly seasonal in spe-

TABLE 2. Hydroid species in samples from Northumberland Strait, with station records and gonophore types. Numbers in bold indicate stations with samples having hydroids with gonophores. Gonophore types: Fx=fixed; Me=medusa; Md=medusoid. Species Group I=shallow-water assemblage; Species Group II= deeper-water assemblage.

Species	Stations	Type of Gonophore			Species Group	Known Range, Western North Atlantic Neritic Zone
		Fx	Me	Md		
ORDER ANTHOATHECATA						
Family Bougainvilliidae						
Bougainvillia sp.	**46**, 80		+		I	
Dicoryne conferta (Alder, 1856)	5, **13**, **14**, **35**, **84**	+			II	Gulf of St. Lawrence—Massachusetts Bay
Family Hydractiniidae						
Hydractinia polyclina (L. Agassiz, 1860)	4, 5, **11**, **12**, **13**, **14**, **31**, **32**, **33**, 35, **36**, **38**, **71**, 80, 87, **90**, 91	+			II	Gulf of St. Lawrence—New England
Family Eudendriidae						
Eudendrium album Nutting, 1896	61, 68, **73**, 84	+			I	Gulf of St. Lawrence—Florida
Eudendrium dispar L. Agassiz, 1862	**18**, 38	+			II	Gulf of St. Lawrence—Block Island Sound
Eudendrium ramosum (Linnaeus, 1758)	**3**, 12, 13, 24, 25, 26, 30, **31**, 34, 35, **42**, 43, **45**, **46**, 48, **67**, 78	+			I	Gulf of St. Lawrence—Chesapeake Bay
Family Corymorphidae						
Corymorpha pendula L. Agassiz, 1862	**78**	+			II	Gulf of St. Lawrence—Block Island Sound
Family Tubulariidae						
Ectopleura larynx (Ellis & Solander, 1786)	18, **73**	+			II	Gulf of St. Lawrence—Long Island Sound
ORDER LEPTOTHECATA						
Family Calycellidae						
Calycella syringa (Linnaeus, 1767)	2, 3, 10, 11, 12, 13, **14**, **18**, 22, 24, 25, 26, 30, 31, 32, 34, **35**, 36, 38, 40, **42**, **43**, 44, 45, **46**, **48**, 49, 61, 62, 66, 67, 68, 73, 76, 80, 84, 86, **92**	+			I	Arctic Ocean—Long Island Sound
Family Incertae Sedis						
Cuspidella humilis Hincks, 1866	44		+		I	Arctic Ocean—George's Bank
Keratosum maximum (Levinsen, 1893)	12	+			II	Arctic Ocean—Cape Cod
Lafoeina tenuis G. O. Sars, 1874	11	+			II	Northumberland Strait (this study)
Family Phialellidae						
Opercularella lacerata (Johnston, 1847)	31, 32, 42, 48	+			I	Arctic Ocean—Long Island Sound
Opercularella pumila Clark, 1875	**26**, 31, **35**, 40, **44**	+			I	Northumberland Strait—Chesapeake Bay
Family Haleciidae						
Halecium beanii (Johnston, 1838)	35	+			II	Gulf of St. Lawrence—Long Island Sound
Halecium halecinum (Linnaeus, 1758)	38, 44, **46**, **61**, **68**	+			I	Strait of Belle Isle—Chesapeake Bay
Halecium labrosum Alder, 1859	42, 48, 78	+			I	Frobisher Bay—George's Bank
Halecium lankesteri (Bourne, 1890)	42	+			I	Northumberland Strait (this study)

TABLE 2. *(continued)* Hydroid species in samples from Northumberland Strait, with station records and gonophore types. Numbers in bold indicate stations with samples having hydroids with gonophores. Gonophore types: Fx=fixed; Me=medusa; Md=medusoid. Species Group I=shallow-water assemblage; Species Group II= deeper-water assemblage.

Species	Stations	Type of Gonophore			Species	Known Range,
		Fx	Me	Md	Group	Western North Atlantic Neritic Zone
Halecium muricatum (Ellis & Solander, 1786)	**2**, **3**, **13**, 14, 18, 92	+			II	Arctic Ocean—Cape Cod
Halecium scutum Clark, 1877	**3**	+			II	Frobisher Bay—Northumberland Strait
Halecium sessile Norman, 1867	65, 66, 67	+			II	Gulf of St. Lawrence—Gulf of Maine
Halecium undulatum Billard, 1922	46, 66, 80	+			I	Frobisher Bay—Northumberland Strait
Family Campanulariidae						
Campanularia groenlandica Levinsen, 1893	22, 92	+			II	Arctic Ocean—Cape Cod
Campanularia volubilis (Linnaeus, 1758)	13, 18, 21, 22, 48, 66, 67	+			II	Arctic Ocean—Block Island Sound
Orthopyxis integra (Macgillivray, 1842)	92			+	II	Arctic Ocean—Vineyard Sound
Clytia hemisphaerica (Linnaeus, 1767)	24, 25, 30, 31, 34, 35, 38, 42, 46, 48, 49, **61**, **73**		+		I	Labrador—Florida
Gonothyraea loveni (Allman, 1859)	14, 22, 35, 40, 42, 43, 46, 48, 49, 61, 66, 86	+			I	Foxe Basin—South Carolina
Laomedea neglecta Alder, 1856	**48**, 73	+			I	Gulf of St. Lawrence—Woods Hole
Obelia geniculata (Linnaeus, 1758)	**31**, 32, 34, 35, 40, 44, 45, **48**, 52,75		+		I	northern Hudson Bay—Caribbean Sea
Obelia longissima auct.	12, 13, 18, 24, 25, 31, 34, 35, 40, 42, 46, 48, **61**, 62, 66, 67, 68, 72, 73, 74, 78, 80, 84, 86		+		II	Ungava Bay—South Carolina
Rhizocaulus verticillatus (Linnaeus, 1758)	4, **12**, 14, **18**, 22, 46, 60, **61**, 62, **67**, 76, 78, 84, **86**	+			II	Frobisher Bay—Long Island Sound
Family Lafoeidae						
Filellum serpens (Hassall, 1848)	2, 11, 13, 14, 18, 22, 24, 61, 62, 65, 66, **67**, 78, **92**	+			II	northern Foxe Basin—Buzzard's Bay
Grammaria gracilis Stimpson, 1854	3, 4, 13, 86	+			II	Foxe Basin—Bay of Fundy
Lafoea dumosa (Fleming, 1828)	11, 12, 13, 18, 22, 25, 67, 78, 86	+			II	Ungava Bay—Mid-Atlantic Bight
Lafoea gracillima (Alder, 1856)	**18**, 84	+			II	Arctic Ocean—Nantucket Sound
Family Sertulariidae						
Abietinaria abietina (Linnaeus, 1758)	**2**, 3, **12**, 13, 14, **18**, 21, 22, 24, 25, 65, 66, 67, 68, 76, 78, 80, **92**	+			II	northern Hudson Bay—Nantucket Sound
Abietinaria pulchra (Nutting, 1904)	**18**, **25**, **35**, 43, **73**, 78	+			II	Hudson Bay—Gulf of St. Lawrence
Diphasia fallax (Johnston, 1847)	12, 13, 14, 18, 21, 22, 24, **25,** **65**, 66, 80	+			II	Northumberland Strait—Block Island Sound
Hydrallmania falcata (Linnaeus, 1758)	**2**, 3, **4**, 10, **11**, **12**, 13, 14, 18, **21**, 22, **24**, 25, **30**, **31**, **34**, **35**,	+			I	Strait of Belle Isle—Long Island Sound

TABLE 2. *(continued)* Hydroid species in samples from Northumberland Strait, with station records and gonophore types. Numbers in bold indicate stations with samples having hydroids with gonophores. Gonophore types: Fx=fixed; Me=medusa; Md=medusoid. Species Group I=shallow-water assemblage; Species Group II= deeper-water assemblage.

Species	Stations	Type of Gonophore Fx	Me	Md	Species Group	Known Range, Western North Atlantic Neritic Zone
	38, **42**, **43**, **44**, 45, 46, 48, 52, **61**, 62, 65, 66, 67, 68, 72, 73, **78**, **80**, 86					
Pericladium mirabile (Verrill, 1873)	4, **11**, 13, 18, 22, 67	+			II	Hudson Strait—George's Bank
Sertularella polyzonias (Linnaeus, 1758)	3, 10, 11, 13, 14, 18, 21, 22, **24**, **25**, 59, 60, 61, **65**, **66**, **67**, 68, 76, 78, 79, 80, 84, 86, 92	+			II	Foxe Basin—Long Island Sound
Sertularella rugosa (Linnaeus, 1758)	**2**, 24, 30, 31, 32, **34**, 35, 38, 42, 43, **44**, 45, **48**, 49, 73	+			I	Labrador—Long Island Sound
Sertularia cupressina Linnaeus,1758	12, 18, 24, 25, **43**, 66, 67, 68, 74, **78**	+			II	Labrador—Mid-Atlantic Bight
Sertularia fabricii Levinsen, 1893	48, **67**, **73**, **78**, **84**	+			II	Strait of Belle Isle—Block Island Sound
Sertularia latiuscula Stimpson, 1854	**3**, 4, 13, 14, **21**, 22, **24**, 26, 30, **31**, 34, **35**, 40, **42**, 44, 45, 46, 48, 61, 66, 67, 73, 75, 76, 78, 80, **84**, **86**, 92	+			I	Gulf of St. Lawrence—Mid-Atlantic Bight
Sertularia similis Clark, 1877	3, 12, 13, 14, 21, 67, 74, 78, 92	+			II	Foxe Basin—Mid-Atlantic Bight
Symplectoscyphus tricuspidatus (Alder, 1856)	3, 10, 11, 12, 13, 14, 18, 21, 22, 25, 31, 61, 62, 65, 66, 67, 78, 86, 92	+			II	Arctic Ocean—Long Island Sound
Thuiaria laxa Allman, 1874	18, 78	+			II	Strait of Belle Isle—Cape Cod
Gonophore Type, Totals		42	5	1		

TABLE 3. Additional species of hydroids reported from the southwestern Gulf of St. Lawrence region, eastern Canada, but not found in samples from R/V *Harengus* Cruise No. 120 to Northumberland Strait.

Species	Reported as:	Location	References
ORDER ANTHOATHECATA			
Family Cordylophoridae			
Cordylophora caspia (Pallas, 1771)	*Cordylophora lacustris*	Miramichi estuary, low salinity	Fraser 1926
Family Hydractiniidae			
Clava multicornis (Forsskål, 1775)	*Clava leptostyla*	Miramichi estuary	Fraser 1926
Hydractinia carica Bergh, 1887	*Hydractinia minuta*	Magdalen Islands	Fraser 1927
Family Bougainvilliidae			
Garveia brevis (Fraser, 1918)[1]	*Bimeria brevis*	Cape Breton: Pleasant Bay	Fraser 1927
Garveia franciscana (Torrey, 1902)	*Calyptospadix cerulea*	Miramichi estuary, low salinity	Fraser 1926
Family Pandeidae			
Leuckartiara octona (Fleming, 1823)	*Perigonimus sessilis*	Miramichi Bay area	Fraser 1926
Family Tubulariidae			
Ectopleura crocea (L. Agassiz, 1862)	*Tubularia crocea*	Miramichi Bay	Fraser 1926
Tubularia indivisa Linnaeus, 1758	*Tubularia indivisa*	Miramichi Bay	Fraser 1926
		Between Cape Breton and Magdalen Islands	Fraser 1927
Family Corynidae			
Sarsia tubulosa (M. Sars, 1835)	*Syncoryne mirabilis*	Miramichi estuary, shallow water	Fraser 1926
		Cape Breton: Pleasant Bay	Fraser 1927
ORDER LEPTOTHECATA			
Family Haleciidae			
Halecium curvicaule Lorenz, 1886	*Halecium curvicaule*	Cape Breton: N of Cheticamp Island	Fraser 1927
Family Campanulariidae			
Campanularia hincksii Alder, 1856	*Campanularia hincksi*	Miramichi estuary	Fraser 1926
Hartlaubella gelatinosa (Pallas, 1766)	*Campanularia gelatinosa*	Miramichi estuary	Fraser 1926
		Magdalen Islands	Fraser 1927
Family Lafoeidae			
Grammaria abietina (M. Sars, 1850)	*Grammaria abietina*	Miramichi estuary	Fraser 1926
		Cape Breton: N of Cheticamp Island	Fraser 1927
Lafoea fruticosa (M. Sars, 1850)	*Lafoea fruticosa*	Miramichi estuary	Fraser 1926
		Cape Breton: off Cheticamp Island	Fraser 1927
Family Sertulariidae			
Abietinaria kincaidi (Nutting, 1901)	*Diphasia kincaidi*	Miramichi estuary	Fraser 1926
Abietinaria thuiarioides (Clark, 1877)	*Thuiaria thuiarioides*	Miramichi estuary	Fraser 1926
		Magdalen Islands	Fraser 1927
Dynamena pumila (Linnaeus, 1758)	*Sertularia pumila*	Cape Breton: Eastern Harbour; Cheticamp Island	Fraser 1927
		Souris, Prince Edward Island	Fraser 1944
Sertularella tenella (Alder, 1857)	*Sertularella tenella*	Cape Breton: N of Cheticamp Island	Fraser 1927
Sertularia argentea Linnaeus, 1758	*Thuiaria argentea*	Northumberland Strait	Whiteaves 1901
	Thuiaria argentea	Miramichi estuary	Fraser 1926

TABLE 3. *(concluded)* Additional species of hydroids reported from the southwestern Gulf of St. Lawrence region, eastern Canada, but not found in samples from R/V *Harengus* Cruise No. 120 to Northumberland Strait.

Species	Reported as:	Location	References
Sertularia argentea Linnaeus, 1758	*Thuiaria argentea*	Northumberland Strait	Whiteaves 1901
	Thuiaria argentea	Miramichi estuary	Fraser 1926
	Thuiaria argentea	Cape Breton: off Cheticamp Island between Cape Breton and Magdalen Island; Magdalen Island	Fraser 1927
Thuiaria alternitheca (Levinsen, 1893)	*Selaginopsis alternitheca*	Cape Breton: N of Cheticamp Island	Fraser 1927
Thuiaria articulata (Pallas, 1766)	*Thuiaria kolaensis*	Miramichi estuary	Fraser 1926
		Cape Breton: N of Cheticamp Island	Fraser 1927
Thuiaria carica Levinsen, 1893	*Thuiaria carica*	Miramichi estuary	Fraser 1926
ORDER LIMNOMEDUSAE			
Family Olindiidae			
Monobrachium parasitum Mereschkowsky 1877	*Monobrachium parasiticum*	Cape Breton: off Cheticamp Island	Fraser 1927

[1] Doubtful species

cies from areas subjected to significant annual water temperature ranges. Moreover, the duration of gonophore production in such areas is often considerably shorter than the period of trophosome activity for a given species, indicating that the range of factors conducive to production of gonophores is narrower than for vegetative activity and asexual colony growth. For example, gonophores were observed an average of 16 weeks a year in warm-water hydroid species vegetatively active for an average of 30 weeks, and 23 weeks a year in cold-water species active over an average of 32 weeks in southern Chesapeake Bay, Virginia (Calder 1990). None of these species produced gonophores or were vegetatively active throughout the year. In some of the rarer species from Northumberland Strait, specimens with gonophores may have simply been missed. However, the restricted sampling period (June through early August) in an area where temperatures vary widely from one season to another may also have been a factor. Stenothermal cold-water hydroids, especially those ranging into much higher latitudes, may not produce gonophores in Northumberland Strait during the warmest time of year when sampling was undertaken.

Life cycles in only six of the species are known to include a free medusa (*Bougainvillia* sp., *Cuspidella humilis*, *Clytia hemisphaerica*, *Obelia geniculata*, *O. longissima*) or a medusoid (*Orthopyxis integra*). In the remaining 42, gonophores are fixed sporosacs (Table 2). Life cycles are abbreviated and gonophores fixed in seven of eight anthoathecate species and 35 of 40 leptothecates.

Correlations have long been noted between life cycle patterns of hydroids and their biotope. For example, fixed gonophores predominate among species living as obligate associates of the seagrass *Posidonia oceanica* in the Mediterranean (Philbert 1935; Picard 1952; Boero 1987) and asexual reproduction by stolonization is prevalent. Reduced dispersal in seagrass-inhabiting hydroids seems biologically advantageous because propagules tend to stay in the specialized habitat occupied by parent populations. Cornelius (1992a, b) and Calder (2000) noted that hydrozoans of oceanic islands and seamounts tended to be comprised largely of species with fixed gonophores instead of free medusae, thereby increasing the probability of larval retention within insular environments (see Johannesson 1988). Fixed gonophores were observed to be prevalent among hydroids living in cold waters along the western North Atlantic coast (Calder 1992), including the Gulf of St. Lawrence. By comparison, the proportion of species with a medusa stage in their life cycles was found to be greater at locations in lower latitudes, although hydroid species having free medusae outnumbered those having fixed gonophores only in temperate estuaries among localities studied. As with hydroids in high latitudes, including those of Northumberland Strait studied here, most species known from the deep-sea possess fixed gonophores (Vervoort 1966; Calder 1997; Calder and Vervoort 1998). Indeed, non-pelagic larval development generally predominates among benthic invertebrate species of both high latitudes and the abyss (e.g., see Thorson 1950; Gage and Tyler 1991). The suppression of pelagic larval development typical in the benthic fauna of these environments appears correlated at least in part with limited food availability for meroplanktonic stages, given the short growing season for phytoplankton in polar waters and the oligotrophic conditions prevailing in much of the deep sea. Such "attribute syndromes" were also noted and discussed in relation to epilithic and epizoic hydroid assemblages from heavily dredged scallop grounds in the Bay of Fundy (Henry and Kenchington 2004). Each kind of hydroid life cycle, whether fixed gonophores, reduced and ephemeral medusoids, or free medusae, seems to offer advantages and disadvantages depending upon the biological circumstances of individual species. It is thus apparent why reproduction by both fixed gonophores and free medusae has been retained in Hydrozoa, and why medusa suppression has evidently occurred independently a number of times in both anthoathecates and leptothecates.

Although waters of Northumberland Strait are relatively shallow, two species groups correlated at least in part with depth and water temperature were distinguished in a numerical analysis. Group I comprised an assemblage of 18 species, including a suite of 15 that were most prevalent in samples from shallower (<20 m) and somewhat warmer stations. The remaining three species of the group (*Calycella syringa, Hydrallmania falcata, Sertularia latiuscula*), all quite eurythermal, were the most ubiquitous hydroids in the collection. Group II species predominated at stations in deeper (>20 m) and typically colder waters, and several of them were either limited to or most frequent in samples from exposed stations in the two entrances of the strait. Earlier, two depth-related assemblages of hydroids had been recognized by Fraser (1926) in nearby waters of the Miramichi estuary, Miramichi Bay, and the adjacent Gulf of St. Lawrence. Fraser reported that the fauna from depths of less than 15 m in the Miramichi area included a number of species commonly ranging farther south, while more northern or arctic species were represented at depths of 15 m or greater.

Water temperatures in shallow areas of Northumberland Strait were mostly moderate during the study. Nevertheless, none of the hydroids examined here is considered a warm-water species with a disjunct distribution along this coast. The reported ranges of two hydroids (*Opercularella pumila*, *Diphasia fallax*) were extended northward on this coast to Northumberland Strait, but both are cold-temperate species whose distributions are unlikely to be discontinuous. With no fewer than 30 of the 48 species from this study extending into subarctic or even Arctic waters (Table 2), the subtidal hydroid fauna of the open strait is regarded here as an essentially cold-water (boreal) one. A marked zoogeographic affinity between hydroid assemblages of the southwestern Gulf of St. Lawrence (Miramichi and Cheticamp areas) with those of two continually cold-water areas elsewhere in Atlantic Canada (Canso, Nova Scotia; Passamaquoddy Bay, New Brunswick) was noted earlier (Calder 1992). A typically boreal fauna was also reported in a study of Bryozoa from the 1975 Northumberland Strait Project (Carson 1985).

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