SEASONAL OCCURRENCE AND ECOLOGY OF MARINE ALGAE IN A NEW HAMPSHIRE TIDAL RAPID[1]

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Water motion is a major factor determining the growth and abundance of benthic plants in the ocean since it enhances their metabolism (Conover, 1968) and assists in the propagation of plants and their dispersal to new areas. Several workers (see Lewis, 1964) have discussed the effects of wave action on the species composition and distribution of seaweeds. Exposed coastal sites typically have more productive and diverse algal populations than sheltered locations, presumably because of differential water motion. Sheltered embayments with strong tidal currents are also rich, productive habitats (Lewis, 1968; Schwenke, 1971). To date, few detailed studies have been conducted of tidal rapid communities except for the comprehensive biological-hydrographical studies at Lough Ine, Ireland (Kitching and Ebling, 1967). In the present paper we describe the seasonal occurrence and ecology of seaweeds at the Dover Point, New Hampshire tidal rapid.

The tidal rapid at Dover Point, New Hampshire, has several unique features which distinguish it from other tidal rapids. Foremost, it is located in the middle of the Great Bay Estuary System, rather than near the open coast (Fig. 1). Secondly, its substrate is stable even though it is partially composed of small pebbles and cobbles. Thirdly, it has one of the fastest currents on the east coast of North America (Anon., 1969).

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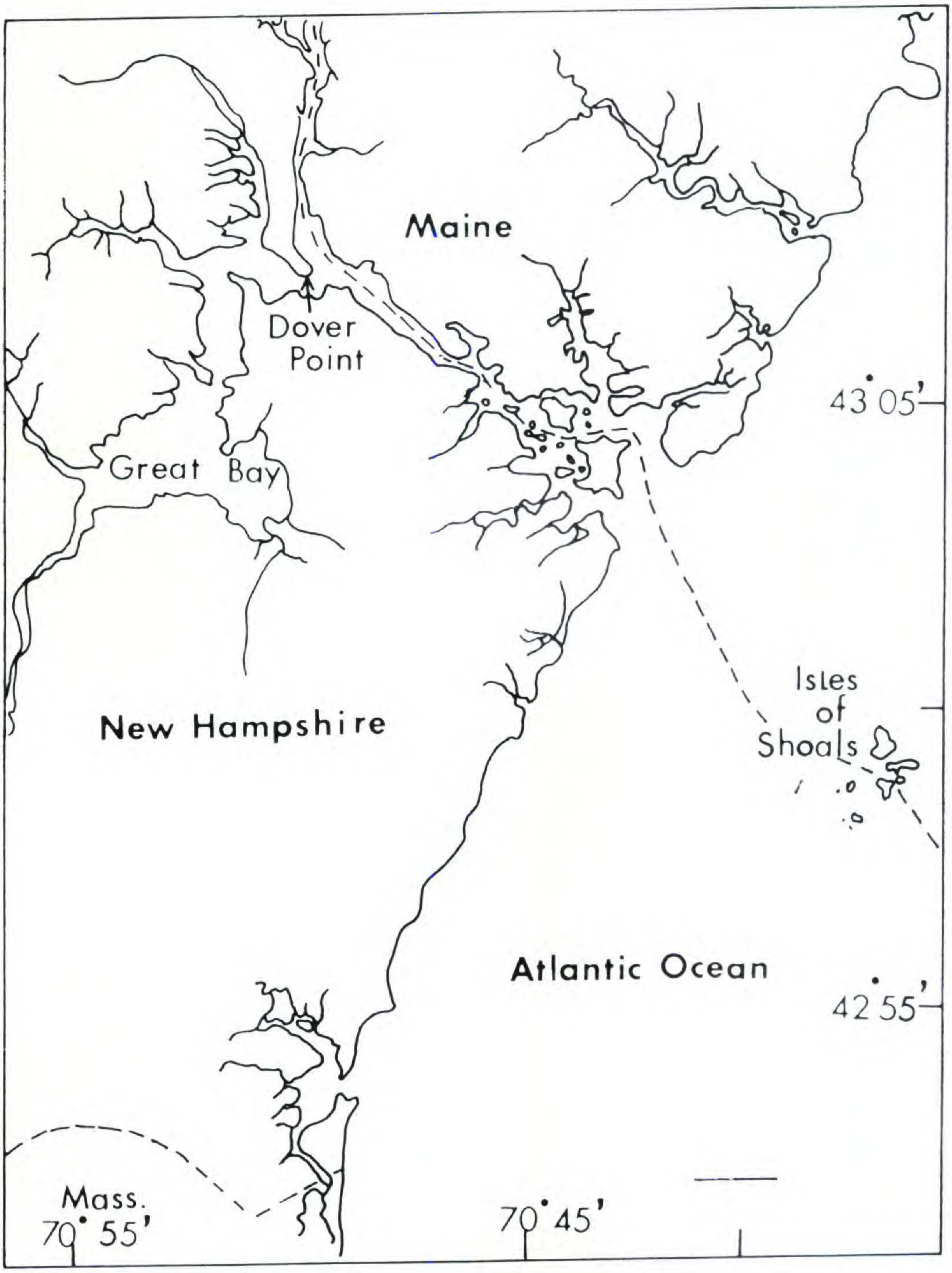

Fig. 1. The New Hampshire Coast and the Great Bay Estuary System.

MATERIALS AND METHODS

Monthly collections of seaweeds were made during low tides from September, 1967, to September, 1969. Seasonal collections of sublittoral plants were made (by SCUBA) during 1968. Diving was only possible for about 20 minutes at dead low tide; it was further restricted by the severe winter weather. No drift specimens are reported. All specimens were processed immediately after collection. Herbarium voucher specimens (a total of 1,264) were deposited in the Algal Herbarium of the University of New Hampshire (NHA). The specimens were identified according to Taylor (1957), with the exception of *Fucus* (Powell, 1957a, 1957b, 1963), *Porphyra* (Conway, 1964a, 1964b), and *Laminaria* (Wilce, 1965). The revised nomenclature of Parke and Dixon (1968) was applied whenever possible. The longevity of the plants was designated according to Feldman's (1951) terminology.

General weather conditions (rainfall, air temperatures and occurrence of ice) were recorded during field observa-

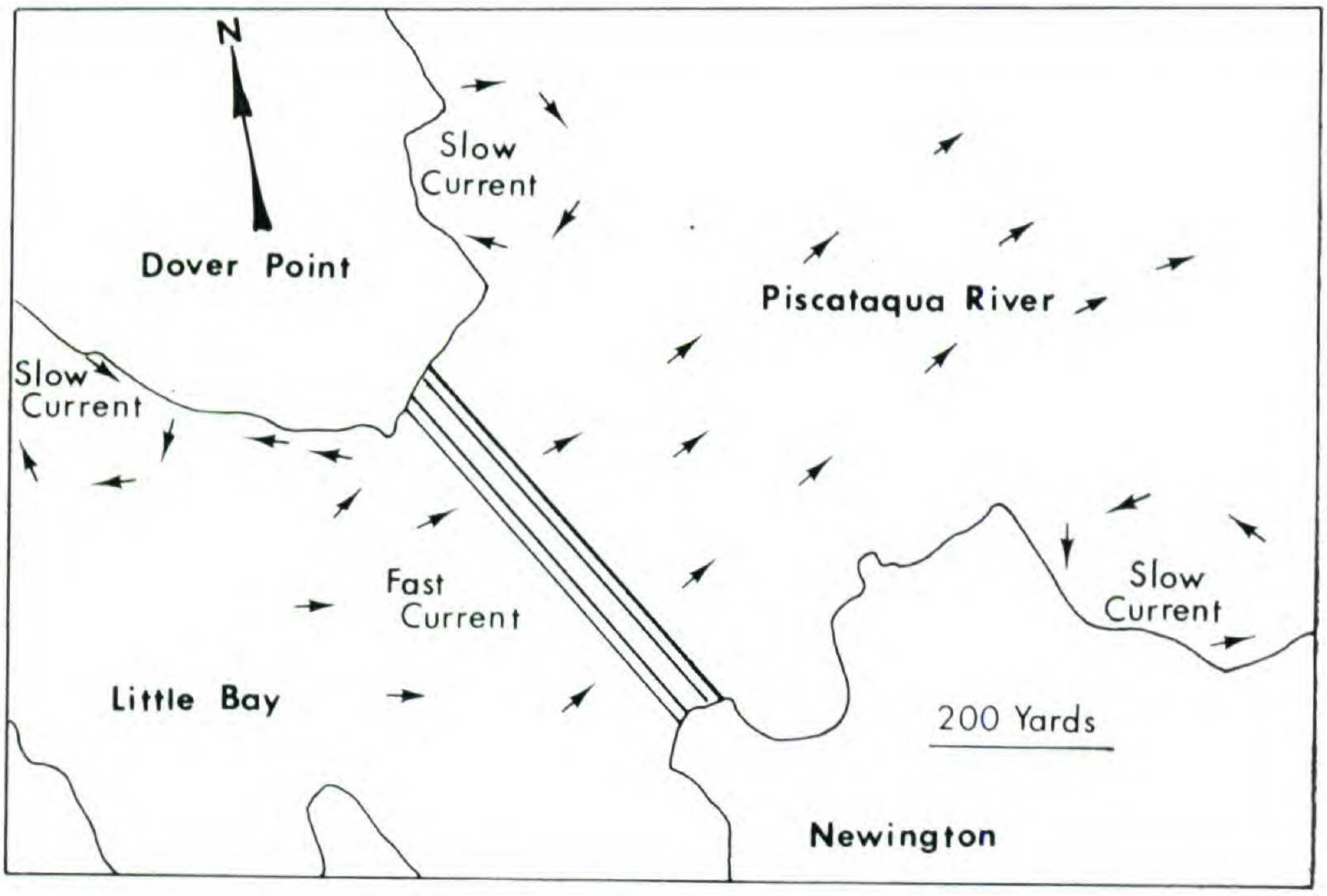

Fig. 2. Dover Point and surrounding areas.

tions. Biweekly records of surface water temperatures, salinities and dissolved oxygen concentrations were monitored at dead low tide in the high and low current areas at Dover Point (Fig. 2). Salinities were recorded in the field with a set of hydrometers (G. M. Mfg. Co., New York); all of the values were corrected to 15°C. Temperatures were recorded with a common immersible thermometer. Oxygen concentrations were determined by use of a modified Winkler method (Hach Chem. Co., Ames, Iowa). Diurnal variations of temperature, salinity, oxygen concentration and current speed were recorded on five separate occasions. Salinities and temperatures were recorded at multiple depths with an Electrodeless Induction Salinometer (G. M. Mfg. Co., New York). The current speed was recorded with a Little Captain boat speedometer (Swift Instrument Company of Boston, Massachusetts), which was modified with a six-foot well tube. The accuracy of the instruments is ± 1/4 knots.

DESCRIPTION OF AREA AND ENVIRONMENTAL FACTORS

Dover Point is located at latitude 47°07′05″ N. and longitude 70°49′50″ W. in Dover, New Hampshire (Fig. 1). It is 5 miles northwest of Portsmouth, New Hampshire, and 5 miles east southeast of Durham, New Hampshire, at the junction of the Piscataqua River and Little Bay. All of the waters entering and leaving Little Bay, Great Bay and their five tributaries pass through the constricted channel at Dover Point, which is 470 yards wide and has a maximum depth of 34 feet.

The rock outcroppings at Dover Point are of the Eliot formation (Novotny, 1968). A variety of substrate types are present; they grade from boulders to cobbles, pebbles, sand and mud. The rocks are composed of mica schist with garnet crystals, phyllite, pegmatite-quarts, feldspar and metasiltstone. Smaller rocks and pebbles are stabilized by extensive mussel populations, which allow them to support relatively large plants. Most of the collections were ob-

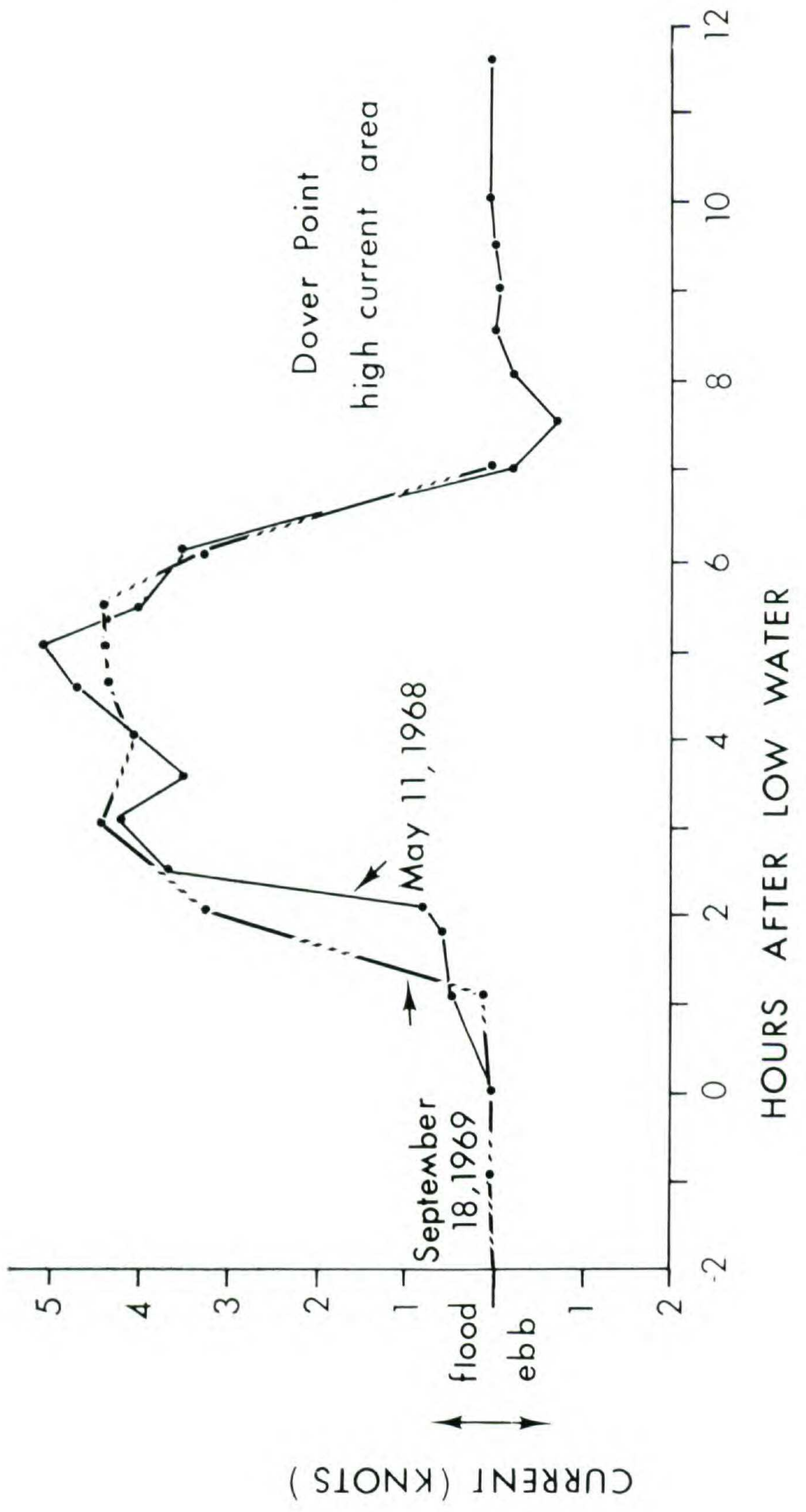

Fig. 3. Variations in current velocity during tidal cycles.

tained in the areas of high currents under the bridge (Fig. 2). The locations to the northeast and southwest of the bridge are mud flats which have reduced currents. The substrate in the high current area grades from rock near shore into mud at approximately 20 feet below mean low water.

The tides at Dover Point are semi-diurnal, and they occur 87 minutes later than those of the adjacent open coast (Anon., 1965). The tidal amplitude is 6.8 feet. A maximum tidal current of 5.5 knots occurs 2.5 to 5 hours after low tide (Fig. 3). During ebb tide the current is concentrated on the Newington side of the channel; it is accompanied by a slight back eddy on the Dover Point side. Organisms in the lower intertidal and subtidal zones are exposed to strong currents at least 50% of the time (flood tide), while organisms in the upper intertidal zone are rarely exposed to strong currents. Subtidal organisms beyond the second piling (Fig. 2) are exposed to a nearly continuous current of high intensity.

The annual range of water temperatures was −2.0° to 19.0°C (Fig. 4). Diurnal temperature fluctuations at Dover Point depend on the two water masses involved — i.e., Great Bay and the Atlantic Ocean. Little or no diurnal variation (0-0.5°C) occurred during the winter. The largest diurnal variation (5°C) occurred during the late spring and summer. The annual range of salinity at Dover Point was 7.5 o/oo at spring runoff to 31.0 o/oo in the late summer (Fig. 4). It usually varied from 23-29 o/oo. The greatest diurnal fluctuation of salinity was recorded during March, 1969 (i.e., 10 o/oo). In general there was a decrease in salinity from low tide until one hour after the predicted low. Thereafter it rose until high tide at which time it decreased for two to three hours. The dissolved oxygen concentration varied seasonally, with peak values occurring in the spring (12-14 ppm) and minimal values in the late summer (6-8 ppm). No obvious differences in temperature, salinity and oxygen values were found between the high and low current areas.

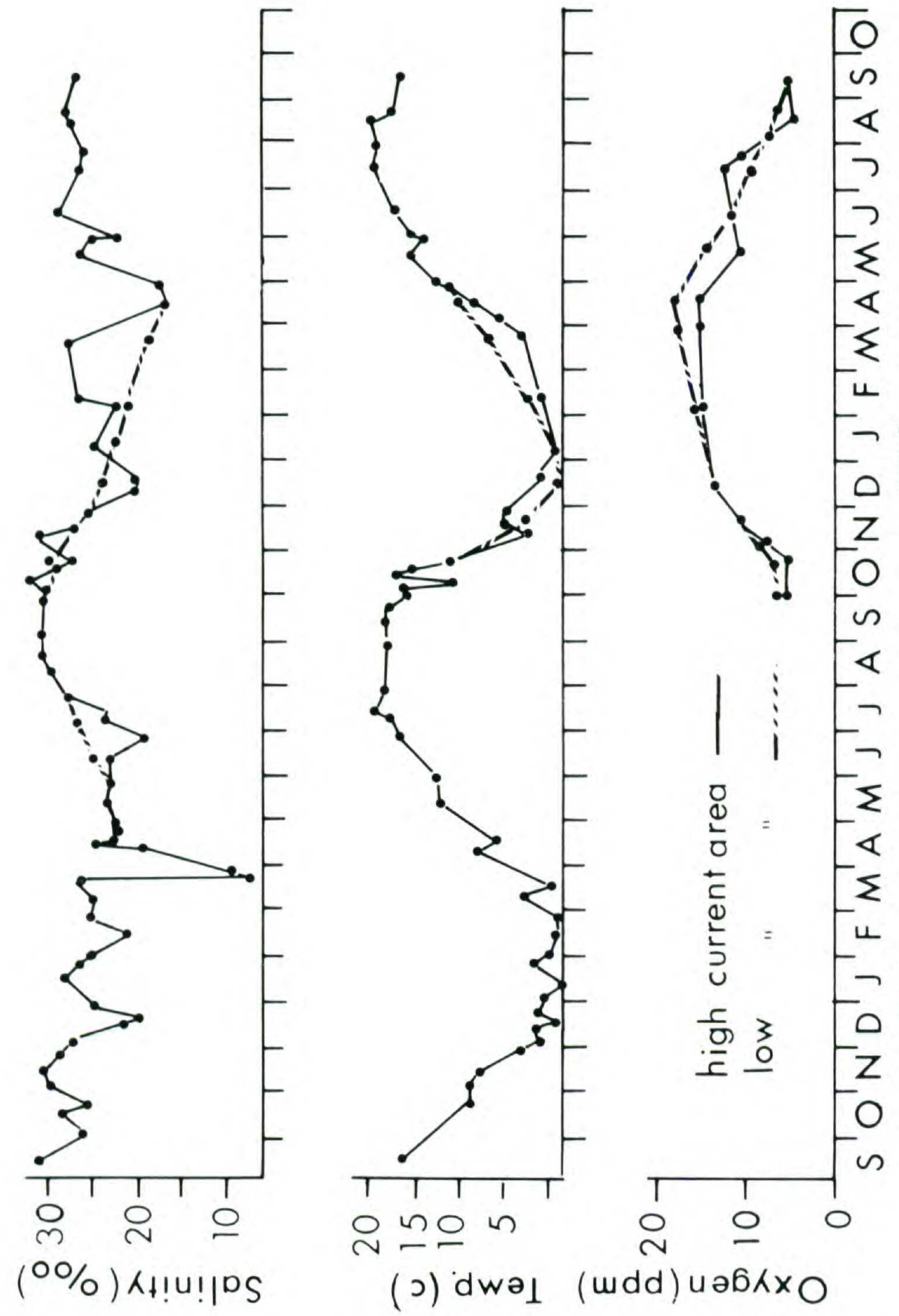

Fig. 4. Seasonal temperature, salinity and oxygen variations.

SPECIES COMPOSITION

The algal flora at Dover Point shows a high diversity of species for an estuarine habitat. Eighty-three taxa of seaweeds were recorded from the tidal rapid site at Dover Point, including 39 Rhodophyceae, 24 Chlorophyceae and 20 Phaeophyceae. Table I summarizes the number and kind of seaweeds encountered at Dover Point as well as at adjacent coastal and estuarine locations. Seventy-one of the taxa found at Dover Point were also found on the adjacent open coast (Mathieson & Fralick, 1972; Maithieson, Hehre & Reynolds, in press). In contrast, only 59 taxa from Dover Point were found in adjacent estuarine sites with calm waters (Mathieson, Reynolds & Hehre, in press). The red and brown algae at Dover Point showed more affinities to the open coast than the green algae (Table I).

SEASONAL OCCURRENCE

Tables II-IV summarize the monthly occurrence and longevity of each species based on three years of monthly collections at Dover Point. The maximum number of species of Rhydophyceae were found in July (Table V). Peak numbers of Chlorophyceae were evident in May, while the Phaeophyceae showed peaks in April and May (Table V). Table V also records the total number of seaweeds collected per month; the largest number of species occurred during May to July. The low numbers recorded in January and September resulted from a lack of subtidal collections.

Several taxa were rare at Dover Point. *Bryopsis plumosa, Enteromorpha compressa, Monostroma leptodermum, Ascophyllum nodosum* forma *scorpioides, Fucus distichus* spp. *evanenscens, Myrionema strangulans, Sphacelaria cirrosa, Ceramium strictum, Dermatolithon pustulatum, Gloiosiphonia capillaris, Melobesia lejolisii* and *Rhodochorton purpureum* were only found once during the entire three year period. Of particular interest was the sporadic occurrence of *Gloiosiphonia capillaris*, for it was only seen during a two week period and it was represented by 10 plants within a 10 ft^2 area. A comparison of Tables II-IV shows that six of the above species are annuals, which might be expected to have a sporadic distribution. Other seaweeds such as *Callithamnion baileyi, Dasya pedicellata, Lomentaria orcadensis, Polysiphonia harveyi, P. lanosa* and *Laminaria longicruris* were collected twice during the 36 month study. *Monostroma pulchrum, Gracilaria foliifera, Porphyra miniata* and *Chordaria flagelliformis* were collected three times. *Laminaria longicruris, Gracilaria foliifera* and *Polysiphonia lanosa* are perennials, while all the others are annuals (Tables III and IV).

Forty-two of the 83 taxa collected at Dover Point were considered to be perennials (Table VI). Most of the green algae were annuals (79%). A larger portion of the brown (65%) and red algae (62%) were perennials. Two distinct types of annuals are present at Dover Point: seasonal and aseasonal. Seasonal annuals occur during a certain season and subsequently disappear. *Monostroma grevillei, Spongomorpha arcta, Bangia fuscopurpurea,* and *Urospora penicilliformis* are examples of late winter and/or spring annuals. *Chorda tomentosa, Bryopsis plumosa, Antithamnion cruciatum, Callithamnion baileyi, Ceramium strictum* and *Dasya pedicellata* are summer annuals. Aseasonal annuals, such as *Ectocarpus confervoides, Petalonia fascia, Scytospihon lomentaria, Enteromorpha intestinalis* and *Ulothrix flacca* occur all year long, although they may have peaks in the spring and summer. Aseasonal annuals are represented by several generations of plants.

Two major types of perennial algae are also evident at Dover Point. *Ascophyllum nodosum, Fucus vesiculosus, Laminaria* spp., *Pseudendoclonium marinum, Ahnfeltia plicata, Chondrus crispus, Gigartina stellata, Phyllophora membranifolia* and *Rhodymenia palmata* are typical of the most common type where the whole plant is perennial. Other species such as *Elachista fucicola, Pilaiella littoralis, Cladophora sericeae* and *Phycodrys rubens* perenniate by a portion of the thallus. Transitional forms are also evident between the two types. Knight and Parke (1931) designate plants as pseudperennials if a small persistent portion of the thallus can regenerate the intact plant.

DISCUSSION

The algal flora at Dover Point is "open coastal" in character for it has a very productive and diverse flora, as well as a large number of species in common with the open coast. It should be emphasized that adjacent, estuarine areas, that lack currents but have similar substrate and hydrographic conditions support a less diverse and reduced vegetation. Lewis (1964) reports a similar biological characterization of tidal rapids in Scotland and Ireland. In addition he records the "dying out" of more delicate algae in favor of more robust forms with increased water flow.

Kitching and Ebling (1967) state that the major influence of tidal currents is exerted on the sublittoral zone. They also suggest that tidal currents are analogous to wave action, for they prevent the deposition of sediment, reduce local extremes of temperature and oxygen, and exert strong mechanical pull. Moore (1966) states that tidal rapids support open coastal invertebrates, even though the locations are essentially sheltered. The sublittoral zone at Dover Point has more "open coastal" species than the littoral zone.

Pronounced seasonal fluctuations of algal species were recorded at Dover Point, with the largest number of species occurring in July and the lowest in the winter. The wide range of hydrographic conditions, particularly temperature, probably causes the seasonal differences in its flora. Williams (1948, 1949) and Coleman and Mathieson (1975) have also recorded a wide range of annuals in areas with pronounced temperature fluctuations. A combination of boreal (e.g., *Dumontia incrassata, Porphyra umbilicalis*) and warm temperate annuals (e.g., *Callithamnion baileyi, Dasya pedicellata*) are present in the Great Bay Estuary System, because of the wide range of temperatures (Mathieson, Reynolds and Hehre, in press). The seasonal occurrence of organisms at Dover Point is very similar to that at the adjacent open coast near Portsmouth, New Hampshire (Mathieson, Hehre & Reynolds, in press), except that a larger number of spring annuals is evident during April on the open coast.

TABLE I. SPECIES COMPOSITION AT DOVER POINT AND ADJACENT LOCATIONS

Rhodophyceae

TAXON	Dover Point Tidal Rapid	Open Coast	Estuarine nontidal rapid
Ahnfeltia plicata (Huds.) Fries	X	X	X
Antithamnion cruciatum (C. Ag.) Nageli	X	X	
Audouinella membranacea (Magn.) Papenfuss	X	X	X
Bangia fuscopurpurea (Dillw.) Lyngb.	X	X	X
Callithamnion baileyi Harvey	X	X	X
Callithamnion corymbosum (Smith) Lyngb.	X		
Ceramium rubrum (Huds.) J. Ag.	X	X	X
Ceramium strictum Harvey	X		X
Chrondrus crispus Stackhouse	X	X	X
Clathromorphum circumscriptum (Stromf.) Foslie	X	X	
Cystoclonium purpureum (Huds.) Batters var. *cirrhosum* Harvey	X	X	X
Dasya pedicellata (C. Ag.) C. Ag.	X		X
Dermatholithon pustulatum (Lamouroux) Foslie	X	X	
Dumontia incrassata (Mull.) Lamouroux	X	X	X
Gigartina stellata (Stackhouse) Batt.	X	X	X
Gloiosiphonia capillaris (Huds.) Carm. *ex* Berkley	X	X	
Gracilaria foliifera (Forsskal) Borgesen	X		X
Hildenbrandia prototypus Nardo	X	X	X
Kylinia secundata (Lyngb.) Papenfuss	X	X	X
Lomentaria orcadensis (Harvey) Collins	X	X	

TABLE I. — Rhodophyceae (continued)

TAXON	Dover Point Tidal Rapid	Open Coast	Estuarine non tidal rapid
Melobesia lejolisii Rosan.	X	X	X
Petrocelis middendorfii (Ruprecht) Kjell.	X	X	
Phycodrys rubens (L.) Batt.	X	X	
Phyllophora membranifolia (Good. *et* Woodw.) J. Ag.	X	X	
Phymatolithon lennormandi (Aresch.) Adey	X	X	
Polyides rotundus (Huds.) Grev.	X	X	
Polysiphonia dendata (Dillw.) Grev. *ex* Harv. in Hook.	X		X
Polysiphonia elontata (Huds.) Grev. *ex* Harv. in Hook.	X		X
Polysiphonia harveyi Bailey	X		X
Polysiphonia lanosa (L.) Tandy	X	X	
Polysiphonia nigra (Huds.) Batt.	X	X	X
Polysiphonia nigrescens (Huds.) Grev.	X	X	X
Polysiphonia novae-angliae Taylor	X	X	X
Polysiphonia urceolata (Lightfoot *ex* Dillw.) Grev.	X	X	
Porphyra leucosticta Thur. in Le Jol. sensu Conway	X	X	
Porphyra miniata (C. Ag.) C. Ag. sensu Conway	X	X	X
Porphyra umbilicalis (L.) J. Ag. sensu Conway	X	X	X
Rhodochorton purpureum (Lightfoot) Rosenvinge	X	X	
Rhodymenia palmata (L.) Grev.	X	X	
Subtotal	39	32	23
% of subtotal	100%	82%	58%

TABLE I. — (continued)

Phaeophyceae

TAXON	Dover Point Tidal Rapid	Open Coast	Estuarine non tidal rapid
Ascophyllum nodosum (L.) Le Jolis	X	X	X
Ascophyllum nodosum (L.) Le Jolis f. *scorpioides* (Hornemann) Reinke	X		X
Chorda tomentosa Lyngb.	X	X	
Chordaria flagelliformis (Müll.) C. Ag.	X	X	
Ectocarpus confervoides (Roth) Le Jolis	X	X	X
Elachista fuciocola (Velley) Areschoug	X	X	
Fucus distichus (L.) emend. Powell spp. *edentatus* (De la Pylaie) Powell	X	X	X
Fucus distichus (L.) emend. Powell spp. *evanescens* (C. Ag.) Powell	X	X	X
Fucus vesiculosus L.	X	X	X
Fucus vesiculosus L. var. *spiralis* Farlow	X		X
Griffordia granulosa (J. E. Smith) Hamel	X		X
Laminaria digitata (Huds.) Lamouroux	X	X	
Laminaria longicruris de la Pylaie	X	X	
Laminaria saccharina (L.) Lamour. sensu Wilce	X	X	X
Myrionema strangulans Grev.	X	X	
Petalonia fascia (O. F. Müll.) Kuntze	X	X	X
Pilayella littoralis (L.) Kjell.	X	X	X
Ralfsia verrucosa (Aresch.) J. Ag.	X	X	X

TABLE I. — PHAEOPHYCEAE (continued)

TAXON	Dover Point Tidal Rapid	Open Coast	Estuarine non tidal rapid
Scytosiphon lomentaria (Lyngb.) Link	X	X	X
Sphacelaria cirrosa (Roth) C. Ag.	X	X	X
Subtotal	20	17	14
% of subtotal	100%	85%	70%

Chlorophyceae

TAXON	Dover Point Tidal Rapid	Open Coast	Estuarine non tidal rapid
Blidingia minima (Nag. *ex* Kutz.) Kylin	X	X	X
Bryopsis plumosa (Huds.) C. Ag.	X		X
Chaetomorpha linum (Mull.) Kütz.	X	X	X
Chaetomorpha melagonium (Web. *et* Mohr) Kutz.	X	X	
Cladophora sericeae (Huds.) Kutz. sensu van den Hoek	X	X	X
Enteromorpha compressa (L.) Grev.	X	X	X
Enteromorpha erecta (Lyngb.) J. Ag.	X	X	X
Enteromorpha intestinalis (L.) Link	X	X	X
Enteromorpha linza (L.) J. Ag.	X	X	X
Enteromorpha prolifera (Müll.) J. Ag.	X	X	X
Monostroma fuscum (Post. *et* Rupr.) Wittr.	X	X	X
Monostroma grevillei (Thuret) Wittr.	X	X	X
Monostroma leptodermum Kjell.	X	X	X

TABLE I. — CHLOROPHYCEAE (continued)

TAXON	Dover Point Tidal Rapid	Open Coast	Estuarine non tidal rapid
Monostroma oxyspermum (Kütz.) Doty	X		X
Monostroma pulchrum Farlow	X	X	X
Percursaria percursa (C. Ag.) Rosenvinge	X	X	X
Pseudendoclonium marinum (Rein.) Aleem *et* Schulz	X	X	X
Rhizoclonium riparium (Roth) Harvey var. *implexum* (Dillw.) Rosenvinge	X	X	X
Rhizoclonium tortuosum Kütz.	X	X	X
Spongomorpha arcta (Dillw.) Kütz.	X	X	
Ulothrix flacca (Dillw.) Thur. in Le Jol.	X	X	X
Ulva lactuca L.	X	X	X
Urospora collabens (C. Ag.) Holmes *et* Batt.	X	X	X
Urospora penicilliformis (Roth) Aresch.	X	X	X
Subtotal	24	22	22
% of subtotal	100%	91%	91%

TABLE II. SEASONAL OCCURRENCE AND LONGEVITY OF CHLOROPHYCEAE

TAXON	Months: J	F	M	A	M	J	J	A	S	O	N	D	Longevity*
Blidingia minima	X								X	X	X	X	A
Bryopsis plumosa							X						A
Chaetomorpha linum	X	X	X	X	X	X	X	X	X	X	X	X	P
Chaetomorpha melagonium						X	X	X	X	X			P
Cladophora sericeae	X	X	X		X	X	X	X	X	X	X	X	PP
Enteromorpha compressa										X			A
Enteromorpha erecta				X		X	X	X	X			X	A
Enteromorpha intestinalis	X	X	X	X	X	X	X	X	X	X	X	X	A
Enteromorpha linza					X	X	X	X	X	X			A
Enteromorpha prolifera							X		X	X			A
Monstroma fuscum	X		X	X	X	X	X	X				X	A
Monostroma grevillei	X	X	X	X	X						X	X	A
Monostroma leptodermum											X		A
Monostroma oxyspermum		X			X							X	A
Monostroma pulchrum					X						X		A
Percursaria percursa		X		X	X	X				X		X	A or PP
Pseudendoclonium marinum	X	X	X	X	X	X	X	X	X	X	X	X	P
Rhizoclonium riparium var. *implexum*								X		X	X		A
Rhizoclonium tortuosum			X	X	X	X							A
Spongomorpha arcta	X	X	X	X	X				X				A or PP
Ulothrix flacca	X	X	X	X	X	X	X	X	X	X	X	X	A
Ulva lactuca		X	X	X	X		X	X	X	X	X	X	A or PP
Urospora collabens		X	X	X	X	X	X						A
Urospora penicilliformis			X	X						X			A

*A = Annual P = Perennial PP = Pseudoperennial

TABLE III. SEASONAL OCCURRENCE AND LONGEVITY OF PHAEOPHYCEAE

TAXON	Months												Lon-gevity*
	J	F	M	A	M	J	J	A	S	O	N	D	
Ascophyllum nodosum	X	X	X	X	X	X	X	X	X	X	X	X	P
Ascophyllum nodosum f. *scorpioides*				X									P
Chorda tomentosa				X	X	X							A
Chordaria flagelliformis					X		X						A
Ectocarpus confervoides	X	X	X	X	X	X	X	X	X	X		X	A
Elachista fuciocola					X	X		X	X	X		X	P
Fucus distichus spp. *edentatus*	X	X	X	X		X	X	X	X	X	X	X	P
Fucus distichus spp. *evanescens*	X	X	X	X	X	X	X	X	X	X	X	X	P
Fucus vesiculosus	X	X	X	X	X	X	X	X	X	X	X	X	P
Fucus vesiculosus var. *spiralis*			X	X	X	X	X		X		X		P
Giffordia granulosa		X	X	X						X	X	X	A
Laminaria digitata	X	X	X	X	X	X	X	X	X	X	X	X	P
Laminaria longicruris		X			X								P
Laminaria saccharina	X	X	X	X	X	X	X	X	X	X	X	X	P
Myrionema strangulans		X											A
Petalonia fascia	X	X	X	X	X	X	X	X	X	X		X	A
Pilayella littoralis			X	X	X	X	X	X		X	X	X	P
Ralfsia verrucosa	X	X	X	X	X	X	X	X	X	X	X	X	P
Scytosiphon lomentaria	X	X	X	X	X	X	X		X	X	X	X	A
Sphacelaria cirrosa				X									P

*A = Annual P = Perennial

TABLE IV. SEASONAL OCCURRENCE AND LONGEVITY OF RHODOPHYCEAE

Taxon	J	F	M	A	M	J	J	A	S	O	N	D	Longevity*
	Months												
Ahnfeltia plicata	X	X	X	X	X	X	X	X	X	X	X	X	P
Antithamnion cruciatum						X	X	X		X			A
Audouinella membranacea						X	X		X			X	P
Bangia fuscopurpurea	X	X	X	X	X	X					X	X	A
Callithamnion baileyi							X						A
Callithamnion corymbosum	X	X	X	X	X	X	X	X			X	X	A
Ceramium rubrum	X		X	X	X	X	X	X	X	X	X	X	P
Ceramium strictum							X						A
Chondrus crispus	X	X	X	X	X	X	X	X	X	X	X	X	P
Clathromorphum circumscriptum	X	X	X	X	X	X	X	X	X	X	X	X	P
Cystoclonium purpureum var. *cirrhosum*	X	X	X	X	X	X	X	X	X	X	X	X	P
Dasya pedicellata							X						A
Dermatolithon pustulatum		X											P
Dumontia incrassata	X	X	X	X	X	X	X		X	X	X	X	A
Gigartina stellata	X	X	X	X	X	X	X	X	X	X	X	X	P
Gloiosiphonia capillaris							X						A
Gracilaria foliifera					X	X		X					P
Hildenbrandia prototypus	X	X	X	X	X	X	X	X	X	X	X	X	P
Kylinia secundata	X		X		X	X			X	X	X	X	P
Lomentaria orcadensis								X		X			A

*A = Annual P = Perennial

TABLE IV. — (continued)

Taxon	J	F	M	A	M	J	J	A	S	O	N	D	Longevity*
	Months												
Melobesia lejolisii					X								P
Petrocelis middendorfii					X		X						P
Phycodrys rubens	X		X	X	X	X	X						P
Phyllophora membranifolia		X	X		X	X		X		X			P
Phymatolithon lennormandi										X			P
Polyides rotundus	X	X	X	X	X	X				X			P
Polysiphonia denuda							X	X			X		A
Polysiphonia elongata	X	X	X	X	X	X	X	X	X	X	X	X	P
Polysiphonia harveyi											X	X	A
Polysiphonia lanosa								X		X			P
Polysiphonia nigra	X	X				X	X	X			X	X	A
Polysiphonia nigrescens	X	X	X	X	X	X	X	X	X	X	X	X	P
Polysiphonia novae-angliae	X	X	X	X	X		X	X	X	X	X	X	P
Polysiphonia urceolata													
Porphyra leucosticta	X	X	X	X	X	X					X	X	A
Porphyra miniata			X		X			X					A
Porphyra umbilicalis	X	X	X	X	X	X	X	X	X	X	X	X	A
Rhodochorton purpureum							X						P
Rhodymenia palmata	X	X	X	X	X	X	X	X	X	X	X	X	P

*A = Annual P = Perennial

TABLE V.

NUMBERS OF TAXA OF RHODOPHYCEAE, PHAEOPHYCEAE, AND CHLOROPHYCEAE COLLECTED AT DOVER POINT DURING VARIOUS MONTHS, 1967-1969

	J	F	M	A	M	J	J	A	S	O	N	D
Rhodophyceae	19	19	21	19	25	24	27	22	15	21	20	21
Phaeophyceae	10	13	13	16	15	14	13	11	11	13	11	12
Chlorophyceae	9	11	12	13	15	12	13	11	12	14	11	12
Total	38*	43	46	48	55	50	53	44	38*	48	42	45

*No subtidal collections were made

TABLE VI.

NUMBERS OF PERENNIAL RHODOPHYCEAE, PHAEOPHYCEAE AND CHLOROPHYCEAE AT DOVER POINT, 1967-1969

	Number of taxa potentially perennial	Total Number of taxa	% of total taxa which were perennial	% of perennial taxa/class
Rhodophyceae	24	39	29	62
Phaeophyceae	13	20	16	65
Chlorophyceae	5(7)	24	6(8)	21(29)
Grand Total	42(44)	83	61(64)	49(52)

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