AN ARCTIC ALASKAN KELP BED*

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THE purpose of this paper is to report an unusual occurrence of a kelp bed in arctic Alaskan waters, to describe its composition and its associated fauna, including a fish new to the Arctic, and to point out the significance of the lack of extensive kelp beds in the Alaskan Arctic for the development of the fauna. The studies on which this paper is based were aided by a contract between the Office of Naval Research, Department of the Navy and the Arctic Institute of North America, Inc., and by a contract between the Office of Naval Research and Stanford University. The field work was conducted from the Arctic Research Laboratory of the Office of Naval Research, Point Barrow, Alaska.

We are indebted to Dr. Ira L. Wiggins and to Prof. and Mrs. G. E. MacGinitie for stimulating discussions of the problems raised and to all persons participating in the field work. The aid given by Mr. Oliver Newton of the University of Southern California herbarium is gratefully acknowledged.

Probably no other feature of the marine biota of the Point Barrow area of northern Alaska is more striking than the absence of a macroscopic benthic algal component. Although occasionally stranded pieces of laminarioids are found, careful search of the shores after storms has usually yielded no conspicuous algae, though sessile animals (sponges, bryozoans, hydrocorals, tunicates) have been present in abundance and even mats of dislodged tundra plants have occurred. Farlow's (1885) paper in the Report of the International Polar Expedition to Point Barrow lists only *Phyllophora interrupta* (Grev.) J. Agardh, *Odonthalia dentata* Lyngbye and an undeterminable rhodophycean (possibly *Rhodymenia pertusa* (Bail. and Harv.) J. Agardh) and fragments of an *Ulva*. Collins (1927) reports no laminarioids in the collections of the Canadian Arctic Expedition 1913-18 between a station (at 69°30'N 163°27'W) below Point Lay west of Point Barrow and Spy Island (70°33'N 149°40'W) to the east. His data permit the interpretation that no extensive stands of laminarioids were encountered between western Alaska and Dolphin and Union Strait, N.W.T. (116°30'W).

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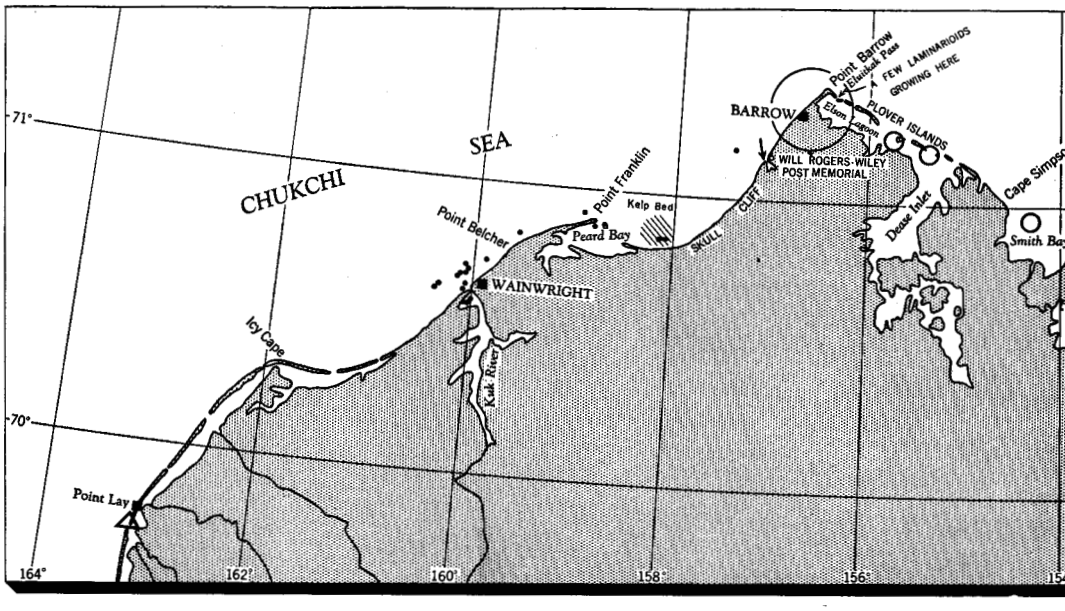
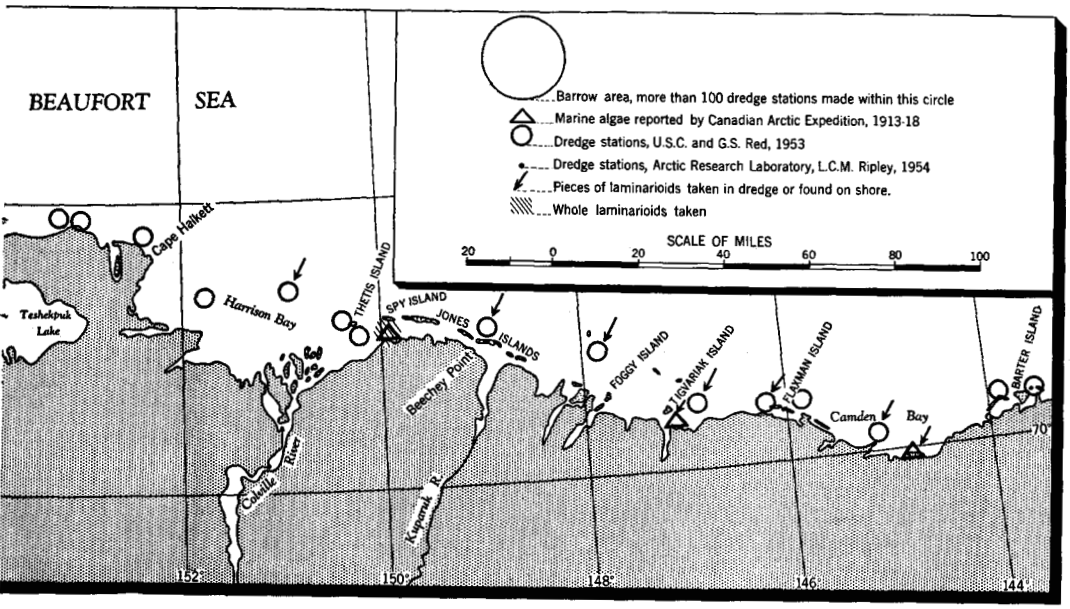


Fig. 1. Biological collecting stations along arctic coas
made in the waters off Barrow, Alaska

Consequently it is noteworthy that a kelp bed was encountered on a cruise made by the LCM *William E. Ripley*, research vessel of the Arctic Research Laboratory, Point Barrow. On August 10, 1954 a four-foot biological dredge was towed for about twenty minutes (from 2035 to 2055) in water about 39 feet deep approximately 50 miles southwest of Point Barrow at 70°51′30″N 158°08′30″W (Cruise II, Station 20; Wilimovsky, 1954). When raised to the deck, the dredge was overflowing with seaweeds. Dr. G. Dallas Hanna, geologist of the cruise, characterized the bottom as "rocky with a minor amount of sand" (Fig. 2).

The laminarioid *Phyllaria dermatodea* (De La Pylaie) Le Jolis was the dominant alga. Two other phaeophyceans, *Laminaria saccharina* (L.) Lamouroux and *Desmarestia viridis* (O. F. Müller) Lamouroux, were abundant and seven rhodophyceans were represented, namely *Turnerella pennyi* (Harvey) Schmitz, *Phyllophora interrupta* (Grev.) J. Agardh, *Antithamnion americanum* (Harvey) Farlow, *Phycodrys sinuosa* (Good & Wood) Kütz, *Polysiphonia arctica* J. Agardh, *Odonthalia dentata* (L.) Lyngbye, and (probably) *Rhodomela lycopodioides* f. *flagellaris* Kjellman. Materials of these species have been deposited in several herbaria: U.S. National Herbarium, Washington, D.C.; Allan Hancock Foundation, University of Southern California, Los Angeles; Dudley Herbarium, Stanford University; University of California, Berkeley; University of Michigan, Ann Arbor; University of



of Alaska. More than 125 additional stations have been by Prof. E. G. MacGinitie or the writers.

British Columbia, Vancouver; University of Illinois, Urbana; University of Minnesota, Minneapolis; Arctic Research Laboratory; British Museum (Natural History).

Taken among the algae were relatively few invertebrates (all polychaetous annelids and arthropods) and six species of fishes. The polychaetes were represented by numerous serpulids (*Spirorbis* sp.) attached to brown algae and by a scaleworm (Polynoidae). The arthropods, all crustaceans, included numerous *Caprella* sp., six hermit crabs (Paguridae), a true crab (*Hyas coarctatus aleuticus*) and four genera of shrimps: many *Sclerocrangon*, one individual with a parasitic isopod, *Argis*, *Eualus*, and a few *Spirontocharis*.

The fishes comprise the polar cod, *Boreogadus saida* (9 individuals), a single juvenile of *Gymnelis viridis*, and four species of cottids. Of these the cod may have been feeding on the benthos, while the remaining species are characteristic bottom inhabitants. The cottids include 16 examples of *Gymnocanthus tricuspis*, a like number of *Myoxocephalus scorpius*, and 13 *Artediellus scaber beringianus*. The fourth species of cottid, *Enophrys diceraus*, represented by two small examples, deserves some remarks as it is heretofore unrecorded from arctic waters. *Enophrys diceraus* (Pallas), which is known from the Okhotsk and Bering Seas to Southeast Alaska, has been recorded only once north of Cape Olyutorsky, Kamchatka. Andriyashev (1952) records this species from Providence Bay on the southern Chukchi Peninsula, Bering Sea,

where, he intimates, it is a straggler. Our find is some 600 miles northeast of this point. Meristic and other morphological features of these specimens will be reported upon elsewhere (N. J. W.). Popov's (1933) observation that *Enophrys diceraus* in Avatcha Bay, Kamchatka, "was always taken from the rocks covered by Serpulidae" is interesting in view of the numerous *Spirorbis* (Serpulidae) found attached to the *Phyllaria* dominant in the kelp bed.

Several fishes were examined for stomach contents. The food was predominantly crustacean. The polar cod contained small to tiny benthic gammaridean amphipods and numerous copepods. As the cottids occupy essentially one habitat, for our purposes the stomach contents may be considered as a whole. They contained mainly gammaridean and caprellidean amphipods, an unidentified juvenile crab, a small shrimp (*Sclerocrangon*), and polychaete and molluscan (probably pteropod, *Limacina*), remains. A small amount of plant material could be recognized. It is interesting that the general proportions of the crustaceans, particularly of amphipods, to other forms in the stomachs of these fishes are consistent with the findings of Pirozhnikov (1955) for fishes of the estuarine areas of the Laptev Sea.

Of the animals taken with the algae in this dredge-haul, only the caprellids and *Spirorbis* appear to be closely tied to the algal association although the taking of four species of cottids suggests the importance of the bed as a feeding

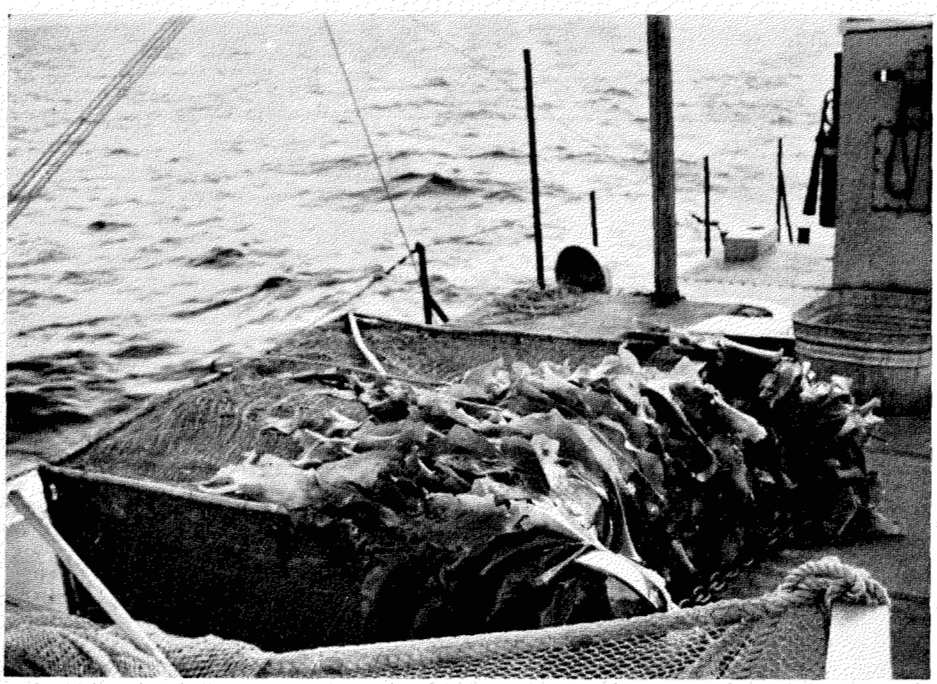


Fig. 2. Four-foot dredge with algae on deck of LMC *William E. Ripley*, August 10, 1954. The principal species about the mouth of the dredge is *Phyllaria dermatodea*.

area. Caprellids elsewhere in this region occur on sponges, bryozoans, tunicates, or other organisms which provide elevated positions in the habitat. Wesenberg-Lund (1951) has remarked that *Spirorbis spirillum* (which may be conspecific with our examples) is confined to brown algal substrates. Pettibone (1954) claims to have found this species in a variety of situations, none algal, about Point Barrow. The faunal components suggest that the kelp bed supplies a combination of habitats for forms ordinarily found on a number of different substrates of the North Alaskan shelf, but they do not in themselves constitute a characteristic kelp bed facies.

Although the natural sequence of occurrence of the plants may have been somewhat disturbed in the course of dredging, the coarser brown algae were observed at the top of the dredge (that is, they were presumably taken during the last portion of the haul) and the smaller red algae were in the deeper part of the dredge (thus taken in the early part of the haul). Because the dredge-haul was run from deeper water farther offshore in a shoreward direction, it is inferred that the algae were vertically stratified in their natural habitat. This stratification, involving some of the same species, has been noted for North East Greenland by Rosenvinge (1910) and Thorson (1933). That these algae probably occur in separate beds, at least in some nearby stands, is evidenced by the finding of large quantities of one species, *Phycodrys sinuosa*, strewn on the beach (71°18'N 157°12'W) in the same general area after more than a week of heavy seas. Because this stranding was observed August 27, 1954, less than three weeks after the collection reported was made, the absence of laminarioids from the windrows cannot be accounted for by seasonal variation. The fishes taken also suggest that two types of bottom areas were sampled in the dredging. Collection records of fish (N. J. W.) indicate that whereas *Gymnocanthus* and *Myoxocephalus* are frequently taken together, *Artediellus* does not ordinarily occur with *Gymnocanthus*.

The validity of our conclusions as to the floral poverty of much of northern Alaska may be open to question. The accuracy of our observations is limited by the small number of samples and by the fact that no phycologist took part in our field work, with the further consequence that no special gear for taking algae was employed. Some beds were almost certainly missed in the sampling patterns. Particularly, inconspicuous forms were probably taken, but overlooked by collectors specializing in other groups. Recognizing these limitations, we still believe that the generalization is justified that there occur only few and small algal beds, limited in species and in numbers of individuals. These conclusions are based on the following data: The occurrence of laminarioids in only three of the more than 20 stations between Point Lay, Alaska, and Dolphin and Union Strait, N.W.T., occupied by the Canadian Arctic Expedition 1913-18 (Collins, 1927). The representation of laminarioids at only six (and these by fragments only) of 18 stations occupied by the U.S. Coast & Geodetic Survey LCM *Red* in 1953 (N. J. Wilimovsky participating) between Barter Island and Point Barrow, Alaska (Wilimovsky, 1953), and

the lack of any laminarioids at 17 of 18 stations occupied by the Arctic Research Laboratory LCM *William E. Ripley* in 1954 between Point Barrow and Wainwright, Alaska (J. L. M., N. J. W. participating [Wilimovsky, 1954]). A further lack of any examples of brown algae from many stations in the vicinity of Point Barrow during the summers of 1951 to 1954 and from the strand-lines after storms appear to us to substantiate MacGinitie's (1955) observation of "the total absence of macroscopic algae (except for about two species in Elson Lagoon)" from the Barrow area. In their general reviews, neither Shchapova (1948) nor Taylor (1954) mentions the existence of kelp beds along the arctic coast.

Equally important in considering the accuracy of the opinion that northern Alaska is poor in marine algae, both in comparison with lower latitudes on the Pacific Coast and with corresponding latitudes of Greenland, are available data on the character of the bottom sampled (Buffington *et al.*, 1950; Carsola, 1952). These indicate that the general substrate from western arctic Alaska to beyond the Mackenzie Delta in the east is composed of sediments without large regions of rocks or boulders. Dall (1875) points out for the Bering Sea that "the distribution of the algae seems to be largely dependent on the character of the rocks" and that the absence of algal stands from large portions of the borders of that sea is directly connected with the presence of sediments. Although virtually ripe fruiting areas were observed on fronds of the dominant *Phyllaria dermatodea,* both in the field and during laboratory examination (E. Y. D.), we have no data on reproduction and continuity of any of the algal beds. It seems likely that at least some of the kelp beds have more than a single season's duration. Examination of known inshore current patterns (U.S.C. & G.S., 1947) does not suggest that annual "seeding" alone would account for such a well established kelp bed as that reported here. The establishment and development of sporophytes is limited by the fact that their probable major period of production (late summer and fall) occurs at the time of greatest turbulence and sedimentation in the inshore waters, with the probability of their effective burial or the prevention of their attachment to suitable rocky substrates in the few areas in which these are present. MacGinitie's (1955) observations on the churning of bottom sediments and attendant silting effects by sea ice in winter give an especially clear picture of a force precluding the general establishment of kelp beds.

The data are too few to warrant more than provisional generalizations about the effects on the biota resulting from the lack of extensive beds of macroscopic algae along the Alaskan arctic coast. Certainly the presence of such plants in other northern areas provides there a broader energy base (photosynthetic) and appears to result in a much richer fauna. This may be manifested in the benthic biomass, in the presence of abundant reproductive stages (cf. Thorson, 1935, on the egg cases of gastropods in West Greenland), or even the existence of a *Fucus* epifauna in the intertidal between boulders at Thule (Vibe, 1950).

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