Journal of Applied Phycology (2006) 18: 637–641
DOI: 10.1007/s10811-006-9076-0


# Biogeography of Alaskan seaweeds

Sandra C. Lindstrom
*Department of Botany, #3529-6270 University Blvd., University of British Columbia, Vancouver, BC, Canada V6T 1Z4*

e-mail: sandracl@interchange.ubc.ca

*Key words:* Alaska, biogeography, macroalgae, seaweeds

**Abstract**

A recent survey of seaweed specimens collected in Alaska over the past two centuries, together with the application of molecular techniques to recent collections, has revealed a surprisingly diverse flora given the history of glaciation, large areas of unsuitable habitat, and otherwise harsh environmental conditions. The number of recognized species has increased from 376 in 1977 to about 550 today. Species show a variety of biogeographic patterns: species that occur primarily to the south and have their northern limit in Alaska, species that occur primarily to the west and have their eastern limit in Alaska, species that are primarily Atlantic but extend through the Arctic to Alaska, and a number of endemics. Within these broad distribution patterns are more localized patterns often involving disjunctions. These disjunctions, the occurrence of endemic species, patterns of genotype distributions, and the overall richness of the seaweed flora support the idea that marine refugia must have existed in Alaska during Pleistocene glaciations.

## Introduction

Situated at the convergence of the Asian and North American continents and at the confluence of the Pacific and Arctic Oceans, Alaska has a coastline of 75,000 km, longer than all the rest of the United States. Its morphologically diverse coastal areas support a rich assortment of macroalgae and other marine life, despite having been largely glaciated during Pleistocene Ice Ages.

Collection of seaweeds in Alaska began with the Russian expeditions in the eighteenth century, and a number of well-known northeast Pacific Ocean species are from types collected during these early Russian explorations in Alaska: *Alaria fistulosa* Postels et Ruprecht, *Ahnfeltia fastigiata* (Postels et Ruprecht) Makienko, *Bossiella cretacea* (Postels et Ruprecht) H.W. Johansen, *Calliarthron tuberculosum* (Postels et Ruprecht) E.Y. Dawson, *Endocladia muricata* (Endlicher) J. Agardh, *Osmundea spectabilis* (Postels et Ruprecht) Nam and *Soranthera ulvoidea* Postels et Ruprecht (1840).

Late nineteenth century collections were made by the Vega Expedition (Kjellman, 1889), the Harriman Alaska Expedition (Saunders, 1901) and the University of California Botanical Expedition to Alaska (Setchell & Gardner, 1903). Two expeditions in 1913, the U.S. Bureau of Soils Kelp Expedition (Frye, 1915; Rigg, 1915) and the Canadian Arctic Expedition (Collins, 1927), added to knowledge of the seaweed flora. Interest revived in the 1960s, with a number of expeditions organized in relation to the underground nuclear tests carried out at Amchitka Island (Lebednik et al., 1971; Wynne, 1970a,b, 1971a,b, 1980a,b, 1981), the Great Alaska Earthquake (Johansen, 1971) and by the University of British Columbia (Druehl, 1968, 1970; Widdowson, 1971; Scagel et al., 1989). More recent ecological and environmental studies have added significantly to knowledge of the flora, although many collections remain unexamined and, in some instances, even unprocessed.

Lindstrom (1977) provided a summary of knowledge of the seaweeds of Alaska and included a brief history of collecting efforts up to that time. The

present effort, to inventory existing collections of seaweeds, was in response to a recognized need for an updated summary and as the first phase of a Seaweed Flora of Alaska. In this paper I summarize some of the conclusions that can be drawn from these collections.

## Materials and methods

Seaweed specimens collected in Alaska were examined, species identifications were updated or corrected, and collection data were entered into a Microsoft Access database. Specimens came from the following herbaria (abbreviations after Holmgren et al., 1990): ALA, ALAJ, CANA, DUKE, HSC, L, LD, LE, MASS, MIL, SAP, SAPA, TEX, TNS, UC, UPS, as well as a number of private herbaria. Previously entered specimen data for UBC collections were appended to the database, and only specimens that appeared anomalous or questionable were examined.

## Results and discussion

The Alaska Seaweed Database housed at the University of British Columbia currently consists of 22,413 records of seaweed specimens collected in Alaska (the database continues to be updated as more specimens are examined). Nearly 1000 names of specific and infraspecific taxa have been used for Alaskan seaweeds, of which approximately 550 are currently recognized as distinct species.

Among these 550 species, 321 that also occur in more southerly parts of North America (California, Oregon, Washington and/or British Columbia) reach their northwestern distribution limit in Alaska (Table 1). These data indicate that some areas of Alaska have a larger loss of species than others, and these trends are upheld even when the numbers are normalized to the total number of species occurring in the area or to the number of specimens examined from the area. The greatest proportion of southern species reach their northern limit in Southeast Alaska, followed by Prince William Sound, the Bering Sea, and the Western Aleutian Islands. Data for the latter two areas is somewhat artificial since some of the species indicated as dropping out in these areas actually extend further west to Siberia. The Kodiak Archipelago and the Eastern Aleutian Islands represent other significant distribution endpoints.

A smaller percentage of species (ca 200 of 550) occur primarily to the west and have their eastern distribution limit in Alaska. Among these are *Dumontia simplex* Cotton, *Neohypophyllum middendorfii* (Ruprecht) M.J. Wynne, *Pleonosporium kobayashii* Okamura, and *Porphyra pseudolinearis* Ueda, all of which show disjunctions within Alaska, between the northwestern Gulf of Alaska and the cold inside waters of northern Southeast Alaska. Table 2 lists species that fall into this category but represent new records for Alaska (i.e., not previously recorded in Lindstrom, 1977, or Scagel et al., 1989).

*Table 1.* Number of "southern" species that reach their northern distribution limit in each area

| From<br>To | California | Oregon | Washington | British Columbia | Total | As % of local species |
|---|---|---|---|---|---|---|
| Southeast | 60 | 2 | 9 | 2 | 73 | 73/368 = 19.8% |
| Yakutat | 9 | 0 | 0 | 1 | 10 | 10/182 = 5.6% |
| Prince William Sound | 34 | 3 | 3 | 1 | 41 | 41/273 = 15.0% |
| Kenai Fjords | 9 | 0 | 3 | 1 | 13 | 13/142 = 9.2% |
| Cook Inlet | 5 | 1 | 0 | 0 | 6 | 6/160 = 3.8% |
| Kodiak Archipelago | 19 | 1 | 7 | 2 | 29 | 29/210 = 13.8% |
| Alaska Peninsula | 8 | 2 | 1 | 0 | 11 | 11/166 = 6.6% |
| Eastern Aleutian Is. | 23 | 2 | 3 | 3 | 29 | 29/183 = 15.8% |
| Central Aleutian Is. | 6 | 1 | 0 | 0 | 7 | 7/117 = 6.0% |
| Western Aleutian Is. | 29 | 2 | 3 | 3 | 37 | 37/170 = 21.8% |
| Pribilof Islands | 20 | 0 | 2 | 0 | 12 | 12/97 = 12.4% |
| Bering Sea | 19 | 2 | 11 | 6 | 38 | 38/117 = 32.5% |
| Arctic Ocean | 13 | 1 | 1 | 0 | 15 | 15/70 = 21.4% |
| Total | 244 | 17 | 43 | 17 | 321 | |