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Life-forms of Algae and their Distribution

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By using the principles and methods of Raunkiaer (1934) and ecological data from the literature, life-form spectra were established for five seaweed floras representing arctic, temperate, warm temperate or Mediterranean and subtropical climates. Trends are apparent along the north-south climatic gradient and each region is characterized on the basis of life-forms. Major trends included 1) the absence of Ephemerophyceae in east Greenland and their increase along the gradient, 2) a decrease in Hypnophyceae from East Greenland to the French Mediterranean, 3) a higher percentage of Phanerophyceae and Chamaephyceae in arctic and temperate regions and their decrease toward the subtropics, 4) an increase in the percentage of Hemiphanoerophyceae from Greenland to the Gulf of Mexico, and 5) an overall increase in the percentage of annuals from the arctic to the subtropics. Changes in life-form spectra are related to variation in temperature, salinity and photoperiod. A spectrum high in Ephemerophyceae is predicted for a tropical flora. Speculation concerning the relationship between evolution of life-forms and their distribution is presented and compared with those of flowering plants.

Introduction

Since the turn of the century, numerous schemes have been proposed to describe biological types or life-forms of marine algae. Early schemes (Oltmanns 1905, Funk 1927, Gislén 1930) were based largely on morphological characters, although Funk (1927) differentiated between algae that went through several generations in a year and true perennial species. Setchell (1926) proposed the first ecological scheme for life-forms and distinguished between heliophobes and heliophiles, subdividing each of these on the basis of microhabitat. This scheme was criticized by Chapman (1962) for its limited applicability to tropical waters, particularly coral reefs.

The principles embodied in the life-form scheme of Raunkiaer (1934) for higher plants have been used as a basis of the life-form systems proposed for seaweeds by Knight and Parke (1931), Feldmann (1938), and Sears (1971). In these systems the life-forms are characterized by the mode of perennation and the life-span of the thallus.

The study of life-forms as applied to seaweeds has progressed little since Knight and Parke (1931) and Feldmann (1938) first proposed their systems of classification, even though the importance of life-forms has been stressed numerous times (Feldmann 1951, 1966; Chapman 1962). Ernst (1968) showed a change in life-

forms vertically from the sublittoral zone to the intertidal zone using only the dominants in each belt. Huvé (1969) discussed the theoretical relationship between life-forms and the colonization of bare surfaces. The work of Sears (1971) produced a life-form spectrum for the sublittoral zone in southern Cape Cod. Yet, despite this previous work, there has been no attempt to produce life-form spectra for complete floras in different regions of the world and to compare the distributions of the various life-forms.

The purpose of the present report is to present life-form spectra for five regions of the world and to point out the differences that occur from one region to another by using, as closely as possible, the principles and methods of Raunkiaer (1934).

The life-form schemes of Feldmann (1938) and Sears (1971) are basically similar. In this report I follow Feldmann's system because it is well established in the literature and contains a category for perennial, crustose forms (Chamaephyceae). Because of difficulty in distinguishing certain life-forms, this system was modified (see Tab. 1) so that the categories Eclipsiophyceae and Hemicryptophyceae are included under the Hypnophyceae and Hemiphanoerophyceae respectively.

Since the concept of life-form was first developed for seaweeds, this term has come to refer to many aspects of morphology and ecology. It is suggested that the term 'growth form' be used with reference to the morphological types described in the classification scheme of Olt-

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