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Seagrass Ecosystems

A SCIENTIFIC PERSPECTIVE

about the book . . .

Seagrass Ecosystems: A Scientific Perspective consists of a review and summation of research to date in the field, as initially presented at the International Seagrass Workshop held in Leiden, the Netherlands, and revised and expanded in accord with criticism and information provided by workshop participants. Five general research aspects of seagrass ecosystems are covered: productivity/physiology, systematics, decomposition, consumers, and system oceanography. Additional papers, covering such topics as the wasting disease and geographic reviews of areas whose seagrass ecosystems have been little reported until now, including Mexico, Israel, and Australia, have also been incorporated into the book at the suggestion of those involved.

The only book available that addresses the ecosystems of seagrasses rather than their biology alone, *Seagrass Ecosystems: A Scientific Perspective* is a valuable source of information on the nearshore sea for students, scientists, and coastal managers.

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PRODUCTION ECOLOGY AND PHYSIOLOGY OF SEAGRASSES

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I. INTRODUCTION

A seagrass meadow is a highly productive and dynamic ecosystem; it ranks among the most productive in the ocean. Today we are faced with numerous studies of the productivity of seagrasses, dating back

to the pioneering work of Petersen (1913), that give widely varying rates and little understanding of the driving mechanisms. In addition, productivity research has been largely confined to two species, *Zostera marina*, the temperate eelgrass, and *Thalassia testudinum*, the turtle grass of the tropics. In this chapter we have attempted to summarize existing data on the productivity and standing stock of seagrasses with some view toward a global comparison of our understanding of the contribution of this system to the productivity of the sea.

The productivity of the sea, as the many expeditions since the *Galathea* have shown, consists basically of a pattern of a vast expanse of open ocean that has a low, relatively uniform primary production plus a few hot spots of extremely high production (Gessner, 1959; Ryther, 1969). These high production areas serve as the primary sites for the biological fixation of carbon that through advective processes and food webs is distributed to a much larger ocean area. Examples of the productive areas are the upwelling regions on the continental shelf, the shallow protected bays of any coast, salt marshes, sea-tree forests (mangroves), and seagrass meadows. These meadows, although more inconspicuous than many other coastal ecosystems, are extremely widespread throughout the world ocean and make a more measurable contribution to coastal productivity than might otherwise be imagined.

Primary production in a seagrass meadow is extremely complex and contributes some unique problems to the measurement of marine productivity. All components of the total productivity must be measured fully to estimate the magnitude of the productivity of the system. These components include benthic algae, epiphytic algae, and phytoplankton, as well as the seagrasses. Each requires special techniques that vary considerably in complexity from the now routine measurement of phytoplankton productivity to the still experimental and extremely difficult measurements of seagrass plants and their associated epiphytic flora. In spite of considerable sophistication in chemical methods, our knowledge of seagrass productivity has not advanced much beyond what Petersen learned more than 60 years ago.

If little has been learned about the productivity of seagrass ecosystems in nature, even less is known about the dynamics of

productivity, the driving forces and mechanisms. Obviously light and temperature are major factors in controlling photosynthesis, but the relationships are poorly defined, and we would have little success today in predicting growth rates of a seagrass meadow from such essentially hydrographic data. Physiological studies that give ecological insight are indeed few. Scientific knowledge today is not much better equipped to explain a "wasting disease"--that widespread disappearance of *Zostera marina* that occurred in the early 1930s--than it was then.

A high productivity implies a high nutrient demand and dynamic cycling of trace metals and other compounds involved in plant growth. The physiological processes involved in the supply and cycling of elements by these plants remain to be defined, although part of the answer must lie in the capability of seagrasses, since they are rooted, to absorb compounds from the sediments. In this respect seagrasses present a system for returning nutrients and other compounds to the water column that are lost to the sediments in other marine areas. It is also probable that a seagrass meadow can function as a filter and effectively trap materials from the water column.

In this review we have tried to examine the literature on all of these problems and give the reader our version of a critique of existing data; however, we can tell you now that the conclusion for most of these problems is that our knowledge is in fact minimal.

II. STANDING STOCK AND PRODUCTIVITY

A. Comparative Criteria and Units

Westlake (1963) set standards for comparisons of plant productivity, and we have, in general, followed his procedures. In this chapter all standing stock data are presented in terms of grams dry weight per square meter (g dry/m^2). Biomass data originally presented in terms of wet weight were converted by a ratio of 10:1, which is based on experience with eelgrass (McRoy, 1970b) as well as convenience. Productivity data are generally the average rates of net production or net photosynthesis in terms of carbon fixed per unit area (g C/m^2 -day) or per unit weight (mg C/g dry-h) presented in the