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Range and Pasture Management

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organisms—the general adaptations of defense and offense, parasitism, reproduction, etc. To be sure, most of the animals cited as examples inhabit the intertidal area, but most of them are not confined to that habitat, and many characterize infratidal, or even fresh-water or terrestrial situations. Only one chapter (about one thirteenth of the whole book) is specifically devoted to the “special problems of shore life.” Being so curtailed, the treatment of these problems—which might have been made the central theme of the work—is necessarily incomplete. Little effort is made to trace the origin of either the organisms of the intertidal waters or of their adaptations to the severe conditions of existence which prevail in this narrow belt between land and sea. No stress is laid on the increased resistance to desiccation, to reduced salinity and to high temperature, which is exhibited by such plants and animals of the higher tidal levels as are especially subjected to such conditions. In the account of “methods of resisting dessication,” the rôle of the secretion of gelatinous or mucous material by the plants and fishes of the reefs is not mentioned. In general, little discussion is offered of the biology of the fishes of the intertidal zone; this fact, however, probably only reflects the relatively poor development of reef fishes in the North Atlantic.

As a whole, however, the vast field of knowledge of the biology of the sea-shore is well abstracted, and original observations not infrequently added. The treatment of the British forms is most complete (probably intentionally so), but many exotic species are discussed. For instance, a page is devoted to the remarkable tide-controlled breeding habits of the “grunion,” *Leuresthes tenuis*, an atherinid fish of the Californian coast.

As an introduction to the general “natural history” of sea-shore animals, the work under review is the most satisfactory of any with which the writer is familiar. The book moreover is crowded with interesting suggestions and valuable references, and for these reasons should prove a source of stimulation and of help to students of marine ecology.

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RANGE AND PASTURE MANAGEMENT¹

Sampson's range and pasture management is an excellent example of the application of the principles of ecology to the solution of economic problems. In grazing experiments it is of equal importance to know what is happening to the stock and to the vegetation. This emphasizes the fact, which ecologists are coming more and more to recognize, that animals, both wild and domesticated, have a proper place in the environment and that they play an important rôle in modifying the vegetational development. This volume con-

¹ “Range and Pasture Management,” Arthur W. Sampson, associate professor of range management and forest ecology, University of California. Pp. xix + 421, with 1 colored plate and 130 figures in the text. John Wiley and Sons, Inc., New York. 1923.

sists largely of first-hand information obtained by the author during fifteen years of intensive pasture investigations for the United States Forest Service, much of which has heretofore been published and is more or less familiar to most ecologists. In addition, all information dealing with the range and pasture problem, particularly the excellent work done in the arid southwest, has been brought together and the whole arranged and coordinated in a most pleasing manner.

The purpose of the book is threefold: (1) to encourage agricultural colleges to include courses in pasture and range management, (2) to assist the land owners in the solution of local pasture problems, and (3) especially to provide systematic instruction for those who desire a practical working knowledge of the subject, as well as for those who wish to follow technical grazing as a profession. The need of such a treatise may be clearly seen when we learn that "nearly everywhere in this country today the solution of the pasture problem is urgently pressing," while the importance of the field it covers is emphasized by the fact that "approximately one third of the cost of eating and a considerable part of the cost of living are expended upon meats and the by-products of the livestock industry."

The four major theses are: (1) the grazing industry and range control, (2) pasture vegetation and forage maintenance, (3) range and pasture protection, and (4) pasture improvement and research methods. The extent of grazing lands in the United States is conservatively estimated at 350,000,000 acres. Forage crop areas and native range lands are delimited, the history of range control is given, and National Forest, state and private grazing lands, and the National Forest regulated grazing policy and its beneficial results considered. It is estimated that the carrying capacity of the National Forest ranges has been increased about 20 per cent from 1905 to 1920. Since the demands for grazing permits is sure to increase, the closest possible use of the forage may be expected. Without the most intensive, judicious utilization of the forage on the National Forest ranges each year, it would be impossible either to make adequate use of the feeds grown on the adjacent farms or to maintain sufficient grazing animals to utilize the desert range during the winter months.

Tests of reseeding grazing lands to forage crops are exceedingly interesting ecological experiments and were conducted in a thoroughly scientific manner, while in natural reseeding and maintenance of western pasture lands, requirements of plant growth are considered in detail, largely a study in autecology. Effects of year-long grazing and year-long protection are considered and the benefits of the deferred grazing system discussed. The decline in the grazing capacity of range and pasture lands, practically everywhere, may be traced almost wholly to a failure to recognize the requirements of plant growth. That native western pasture lands may be fully revegetated without the loss of a single season's forage crop was determined after years

of intensive, experimental, ecological study. On many western ranges an increase of from 50 to more than 200 per cent in carrying capacity has been obtained within three seasons by the method of deferred grazing thus worked out. The application of deferred grazing on range of "winter annuals" in California is of much interest.

The chapter on improvement of farm pastures impresses the reader with the small amount of work that has been done on this problem and the splendid opportunity, especially throughout the eastern half of our country, for ecological studies along this line. Weeds constitute a problem of pasture management needing very serious study. Recognizing and correcting a declining forage yield necessitates a thorough understanding of the principles of plant succession and the use of indicator vegetation. Sampson uses his "Plant succession in relation to range management"² data very effectively in illustrating the method. The autecology and grazing values of eleven of the most important forage grasses are given as well as that of many introduced legumes of high forage value.

Under range and pasture protection the chief emphasis is laid upon control of erosion, grazing of woodlands, and its relation to future timber supply, burning and its effect upon forage production, plants poisonous and mechanically injurious to stock and their control. Erosion is described as the most serious disturbing, single factor in the development of the national reserves, and nearly one half of the United States—the hilly half—is being seriously impaired by runaway waters. Here, as elsewhere, the author is writing from his own store of first-hand investigation.³ The damaging effects of erosion, largely a result of forest cutting and over grazing, the falling off in forage yield (where both nutrients and the water retaining power of the soil are decreased), the silting up of adjoining agricultural lands, and (if the efficiency of the water shed is removed) the loss of water for irrigation are repeatedly emphasized. The solution is pointed out in the maintenance of a good cover of vegetation. The effects of burning grasslands, brushlands, wooded pastures, and forest ranges are thoroughly considered in relation to humus formation and its attendant benefits, to harmful effects upon the plants and the throwing back of the successional development, etc.

Among the most valuable features of the book are its numerous illustrations, nearly all of which are original. A colored plate shows the main stock-poisoning plants in their natural colors. Distribution and habits of the principal poisonous plants are given and illustrated. Under range improvement the development of watering places both in relation to effect on stock and on the vegetation is discussed, the object, method and results of grazing reconnaissance outlined as well as grazing capacity and pasture inspection. The

² Plant Succession in Relation to Range Management," U. S. Dept. of Agr. Bull. 791, 1919.

³ "Range Preservation and its Relation to Erosion Control on Western Grazing Lands," U. S. Dept. of Agr. Bull. 675, 1918.

research methods in range and pasture revegetation are largely those of the quadrat and its various modifications. Since "any plan of range management which aims to improve the carrying capacity of pastures must be based on the fundamentals of botanical science" and on a thorough training in auxiliary subjects as well as in range management, the author has been led to restate his syllabus for grazing courses.⁴

The book is well written and is exceptionally free from typographical errors. A bibliography accompanies each chapter as well as a list of questions bringing out the most important findings in the text. The 130 illustrations, mostly halftones, are very clear and, best of all, so much of the subject matter has been obtained first-hand by the author that a fine spirit of enthusiasm pervades, and the modest yet firm "it is" replaces the too often met "it is reported to be thus and so."

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SOCIAL LIFE AMONG THE INSECTS¹

Wheeler's book "Social Life among the Insects" emphasizes the importance of food relations and nutrition in explaining the aggregation of insects into organized societies.

Social habits have arisen in at least 24 groups of solitary insects, and we find evidence of well developed social life among the ants as early as the Lower Oligocene, perhaps 65 millions of years ago. Possibly the starting point in the development of such a habit is to be found in the propensity of the female insect to lay her eggs on food suitable for the hatching larvae. Then if the parent survives till after the hatching of the offspring a continuation of such behavior might readily induce the parent to remain with the young, perhaps even to feed and protect them. Thus the lengthening of the adult life makes possible the simple family group or primitive society. "As the societies grow in size and complexity they naturally change from associations in which the progeny depend on their parents to associations in which the parents come to depend on their progeny." Specialization of activities and a physiological division of labor among the members of the colony follows, leading to the formation of castes.

The author considers the activities of insects as an expression of three fundamental appetites—hunger, sex and fear—and of these he has chosen to emphasize that of hunger more particularly in the present book. The important part which food plays in keeping insects together in more or less complex societies is well illustrated in the chapter on social beetles.

⁴ "Suggestions for Instruction in Range Management," *Jour. of Forestry*, Vol. 17, No. 5, pp. 523-545, 1919.

¹ Wheeler, William Morton, "Social Life Among the Insects, Harcourt Brace and Company, New York, 1923.