Book Reviews

Harper, J.L.: Population Biology of Plants. London: Academic Press 1981. 892 pp. Soft bound £ 12.20.

Population biology has developed as a largely zoological discipline – dealing with birth and death rates, immigration and emigration, exponential growth rates, processes of colonization, consequences from overcrowding etc. Population biology of plants had been only studied in a very brief period in the history of plant ecology (Sukatschew, Clements, Tansley) and all subsequent investigations of plant ecologists concentrated on the description of vegetation, the evolution of ecotypes, the physiology of adaptation and more recently on productivity. But now population biology with plants had been revived by research in agriculture and forestry, because these applied plant sciences need a population-biology – knowledge for managing commercial populations of crops and trees. The purpose of this book is to give a summarized review of the main results which might be relevant to understanding the population biology of plants.

First, we will give some references to the classification and content of the book, which has been divided into 24 chapters (organized in 5 larger sections), a gigantic list of references (more than thousand titles!) and some useful indices (author index, species index, subject index).

Section 1 "Dispersal, Dormancy and Recruitment" presents basic concepts of dispersal patterns, dormant phases, dynamics of the "seed bank" in the soil environment under plant communities and the relations and dependencies between this seed bank and the population of growing seedlings.

Section 2 "The Effects of Neighbours" deals with the influence of density on yield, mortality, form and reproduction. Furthermore, mixtures of species are described referring to problems of space and proportions as well as changes with time – including the mechanisms of interaction between species. The limiting resources of the environment are discussed with special regard to light, water and nitrates.

Section 3 "The Effects of Predators" covers defoliation-effects, facts connected with seasonality and life cycles, the role of grazing animals in grassland communities, predation of seeds and fruits, problems of plant pathogens and, finally, regulatory processes in plant populations caused by predation had been analysed,

Section 4 "The Natural Dynamics of Plant Populations" treats the population dynamic aspects for annuals and biennials, herbaceous perennials and woody plants separately.

Section 5 "Plants, Vegetation and Evolution" contains the well-known material on the following topics: reproduction and growth; reproduction – life cycles and fertility schedules; community structure and diversity; natural selection and the population biology of plants.

Many examples with experimental data and results from the literature are included in the comprehensive text – most in the form of illustrative figures, the remaining in clear tables. Both, figures and tables, are provided with informative headings. These numerous examples have been taken from forestry and agriculture, because these are the sources of most of the known facts.

The book is preceded by 24 useful chapter summaries which – together with the different indices at the end of the book – facilitate the use of this voluminous volume as a valuable reference book for both students and research workers.

In the final chapters the author gives some general conclusions and statements such as: a) Strategies of growth and reproduction must be interpreted as compromises between conflicting specific adaptabilities towards maximizing fitness. b) There exists a physiological and genetic potential for profound changes in life-cycle strategy within plant populations. c) The biological diversity of plant communities is required to give the branches in food chains a sufficient stability. d) Because the evolutionary process is driven by effects on individual fitness one cannot expect a maximized performance in groups, which, however, is required in agriculture and forestry. Therefore, selection acting on groups may be the most proper type of selection for improving the productivity of crop and forest plants and plant breeding must be concerned with group selection.

All these statements represent well-known results in the fields of population genetics and population ecology – for example topic d): The relevance of group selection – especially in connection with breeding-purposes – has been widely acknowledged and intensively studied in different ways: Griffing's concept of group-selection, Hamilton's kin-selection, Wright's adaptive field model, Levins' extinction-paper. Even all investigations including frequency-dependent selection-models are efforts along these lines.

This approach to a study of plant communities will be greatly welcome but the presentation, nevertheless, involves some disadvantages:

1) In our opinion aspects of population genetics must be a major part of each population biology – irrespective of the special object (animals or plants) and irrespective of the special approach. The present book, however, mentions population genetic models and results only marginally – if at all.

2) Furthermore, we think that the development, analysis and testing of quantitative relations between the parameters and the construction of mathematical models are of an essential importance for an understanding of population-biology-phenomena. Yield-density-relation, logistic equation and Lotka-Volterra-model here are the only facts formulated mathematically. Almost all other fundamental quantitative aspects and results have been omitted. With regard to this criticism we refer to the well-known textbooks by Wilson/Bossert (A primer of population biology), Stern/Tigerstedt (Ecological genetics) and Elseth/Baumgardner (Population biology) where these mathematical and quantitative aspects of a population-biology-approach have been introduced and treated excellently.

3) It seems to me, that the author's inductive approach of collecting and summarizing this gigantic experimental material with the intention of integrating these specific results towards an uniform theory of population biology must be problematical methodologically: a major part of the experimental results comes from investigations with forest trees. Therefore many conclusions towards a general theory are based upon these empirical facts. Populations of forest trees, however, are communities showing specific structures and properties, which cannot be generalized towards a general population biology without introducing restrictions. Therefore many of the author's facts and conclusions may be combined and regarded as parts of a mosaic in the direction towards a general theory of population biology. Such a mosaic may become a uniform theory only by including some deductive elements, meaning: formulation and analysis of mathematical models – initiated originally by the numerous empirical facts – and using and testing these theoretical equations for prediction purposes.

These critical comments, however, should in no way narrow the value of this recommendable compilation of a major part of our present knowledge of plants that might be relevant to come to an understanding of their population biology. It is greatly welcome as a reference book for both students and research workers, since it gathers together the relevant publications in this field, scattered over diverse scientific periodicals, and presents them orderly and comprehensively arranged.

M. Hühn, Kiel