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# Fire in South African Mountain Fynbos

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Ecosystem, Community  
and Species Response at Swartboskloof

With 98 Figures and 72 Tables



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# Preface

Ecologists are increasingly being drawn into the task of addressing problems of environmental degradation. They are expected to find solutions that will lead to sustainable resource use throughout the world. In doing so, the robustness of the science becomes increasingly important, and the problem of extrapolating the results of research conducted within what is usually a relatively limited geographical scope is increasingly highlighted.

One approach to developing a globally robust ecology involves more or less formal intercontinental comparative studies, usually focused on the question of ecological convergence. These studies are directed at testing the prediction that similar physical and other environmental factors in different parts of the world, through their selective influences, will give rise to ecosystems which share common structural and functional features. Should this be true, the predictive power of ecology developed within such a framework should be sufficient to solve similar problems elsewhere in such biomes. There is a long history of such an approach in mediterranean-type ecosystems, documented in a series of volumes and their accompanying scientific papers beginning with that of Di Castri and Mooney (1973).

These studies have varied in their focus, ranging from global syntheses (Mooney 1977; Miller 1981a; Conrad and Oechel 1982; Kruger et al. 1983; Dell et al. 1986; Tenhunen et al. 1987; Specht 1988; Kruger et al. 1989; Orshan 1989; Groves and Di Castri in press) to detailed site studies (Specht and Rayson 1957 and subsequent papers; Mooney and Parsons 1973; Thrower and Bradbury 1977). Both approaches are necessary to build the body of knowledge required for the progressive development of a predictive ecology. The power of this approach lies in the fact that the mediterranean-climate regions of the world are geographically separated and clearly similar in many of their physical environmental features. They offer a ready-made global experiment for testing the predictions of ecology. Theory developed within such a framework

should contribute not only to the solution of problems of resource use in mediterranean-climate regions but also to a broader understanding of ecology, and indeed of the robustness of ecology as a whole.

One factor that pervades mediterranean ecosystems is the frequent occurrence of intense fires in the vegetation. This phenomenon and its consequences has been well documented in many studies and syntheses (e.g. Mooney and Conrad 1977; Gill et al. 1981; Booysen and Tainton 1984). Our understanding of the role of fire in these ecosystems, as well as its use for management for the conservation of ecosystems (and to the benefit of the populations within the regions concerned) has grown rapidly over the past several decades. Even so, there are many substantial gaps in our understanding of the nature of the ecological effects of fire. The policies for fire management have continued to evolve in the search for more effective approaches appropriate to each circumstance. Questions surrounding the issue of fire include that of the optimum fire regime for maintaining biotic diversity, the fire regime which will allow for conservation while at the same time ensuring that protection needs are met, and the sustainable utilization of ecosystems subject to recurrent fire.

In South Africa these issues are of special importance. The funds available for intensive management of fynbos ecosystems, though limited, were relatively freely available until recently. Changing national priorities will dictate a diversion of funds in other directions in the future. The continued conservation of the unique fynbos ecosystems and their contribution to the regional economy through utilization, recreation, education and tourist opportunities, will in future depend on our contributions to a proper understanding and perception of these values, on the one hand, and to cost-effective systems for the management of these ecosystems, on the other hand. Innovative ways of treating the problems of fire management and all the issues surrounding it will be needed if supportable management policies and assistance are to be found.

This book incorporates some of the results of research conducted in the Swartboskloof catchment of the Jonkershoek Valley near Stellenbosch, South Africa. The research was conducted under the auspices of the Fynbos Biome Project, an enterprise within the National Programme for Environmental Sciences (Jarman 1982; Huntley 1987). The work was initiated to provide a detailed understanding of certain aspects of the functioning of a mountain fynbos ecosystem, through comparison with the results obtained from a lowland fynbos ecosystem at Pella (Jarman 1988; see also Brown et al. 1984; Mitchell et al. 1984) as well as with results obtained from detailed studies on other continents. The focus of the

research in Swartboskloof was on the ecological effects of a single fire with three clear objectives in view. These were: (1) to document fully the regeneration and recolonization strategies of the biota of the ecosystems concerned, with a view to developing our capability to predict the processes that follow fire in this respect; (2) to study the stability or otherwise of the boundaries between vegetation communities, and to examine the effects of a fire and other factors which determine those boundaries; and (3) to examine the effects of a fire on resource availability, particularly with respect to mineral nutrient cycling and water yield at a catchment level.

The objectives of this volume are to consolidate and document the information on the effects of the fire in Swartboskloof, to place these findings in context with analogous findings from similar site studies elsewhere in the world, and then to draw conclusions from the research regarding future research needs, policies and practices for the management of fire-prone ecosystems. The book addresses the interaction between climate and structural features of the vegetation as it determines the incidence and behaviour of fire. It examines the fire in Swartboskloof, and places this into perspective through comparison to fire in fynbos in general. It examines the composition and structure of vegetation, the effects of fire on this, the responses of the individual species (both indigenous and introduced), and synthesizes this information in such a way as to draw general conclusions about the effects of a fire regime on fynbos communities. The interactions between fire and faunal groups are also examined, with emphasis on the consequences for the regenerating vegetation. Finally, it examines the effects of fire on the water and mineral nutrient balances of the system, and in so doing it addresses questions on the sustainability of fire management in fynbos ecosystems.

In compiling this volume, we recognized the limitations and constraints which operate in these kind of studies. First, any biome (and especially the fynbos biome) is complex in its spatial and temporal variation (Cowling 1991). Clearly, no single site can accommodate this complexity. Studies of this kind can merely provide benchmark information, but as such this information is valuable in that the depth of understanding provided allows more critical comparative analysis than would be available from more superficial replicated or regional studies. The second major constraint arises from the fact that the resources of expertise and finance limit severely the scope of any study of this kind. This, together with the practical problems arising from the heterogeneity of the system addressed at the scale of this study, mean necessarily that the picture which emerges can be no more than the first approximation of the structure and functioning of the ecosystem

examined. Nevertheless, this approximation is an important one on the path towards an adequate understanding that is needed to support the formulation of objectives with regard to both fynbos ecosystems and ecology for southern Africa and elsewhere.

Except where authors names are given, taxonomic nomenclature in this volume follows Bond and Goldblatt (1984) for plants, Maclean (1985) for birds, Smithers (1983) for mammals and the South African Museum, Cape Town, for ants.

Pretoria and Stellenbosch, April 1992

F.J. Kruger  
B.W. van Wilgen



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