DESERT PLANTS

IOPB symposium: origin and biology of desert floras

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Deserts are one of the major terrestrial ecosystems on earth, amounting to about one-fifth of the total surface area of the planet. The distinctive and defining characteristic of all deserts is aridity. Deserts encompass landscapes that are also subjected to extremes of temperature, high evapo-transpiration, unpredictable precipitation, and complex soil types. They comprise a wide variety of environments ranging from extreme arid regions to semi-desert shrublands and grasslands. Although often sparsely vegetated as a result of the harsh conditions, these regions are the domains of surprisingly diverse floristic elements. Relatively few botanical studies have considered the evolutionary biology and systematics of desert plant taxa, particularly non-vascular plants. This paucity of information led to the organization of this symposium to highlight recent research on desert plants that explores the biology, evolution, and origin of plants in arid environments. At a time when human activities are increasingly impacting desert regions, knowledge of systematics and biology of desert floras is critical for the conservation and management of plant biodiversity.

In August 2001 at the Botany 2001 Meetings in Albuquerque, New Mexico, USA, I convened a symposium entitled the "Origin and Biology of Desert Floras", which was sponsored by the International Organization of Plant Biosystematists (IOPB). Originally there were five presentations in the symposium but only three are featured here. This symposium brought together researchers with a diversity of botanical expertise and interests. Research on vascular and non-vascular plants is featured in the symposium papers, which address interesting questions in desert plant biology from a variety of fields of botany including molecular phylogenetics, plant anatomy, and floristic ecology. The research is largely focused on the North American deserts with one contribution examining taxa occurring in deserts on three continents: North America, Africa, and South America. The diversity of the research highlights how much there is to learn about the systematics and biology of desert floras.

THE PAPERS

Microbiotic soil crusts are widespread in deserts of the world and play important roles in soil stabilization and nutrient cycling in arid environments. The crusts are composed of diverse groups of organisms. In the first paper, Lewis focuses on the systematics and adaptations of soil-based green algae in western North American deserts, which are one of the major groups of crust organisms. The green algae that occur in crusts represent a diverse assemblage of taxa spanning three classes of algae, the Chlorophyceae, Trebouxiophyceae, and Charophyceae. Her research has led to the discovery of many new taxa in the soil crusts. Molecular phylogenetic analyses indicate that microbiotic crust green algae have evolved from aquatic green algae at least five independent times. In addition, desert green algae have so far been shown to be derived only from freshwater green algae rather than marine green algae. Ongoing studies are addressing the ways in which desert green algae are adapted to living in the stressful desert conditions.

In the second paper, Muldavin explores floristic characteristics of the Chihuahuan Desert. He presents a simple floristic affinity index that can be used to characterize selected plant communities in terms of their Chihuahuan Desert affinity. In particular he attempts to define the northern boundary of the Chihuahuan Desert in the North American Southwest. Furthermore, he examines the question of how floristic assemblages segregate themselves in the Chihuahuan Desert environment. This is a timely contribution because the plant communities included in the study are currently the focus of intensive research on desertification processes, ecological interactions from the plant to the biome level, and biodiversity conservation in the Chihuahuan Desert.

In the final paper, Landrum focuses on an evolutionary examination of stem and leaf anatomical adaptations and attempts to link paleoclimatology to the evolution of these traits in Aizoaceae sensu lato, Cactaceae, Didiereaceae, and Portulacaceae of succulent angiosperms in Caryophyllales that have radiated into North and South American and/or southern African deserts over the past few million years. The families have been able

to diversify their anatomical, physiological, and morphological systems in ways found in few other dicotyledonous families. Landrum uses characters from the three systems to perform a phylogenetic analysis of the relationships of the four families. His results accord well with recent molecular studies. Furthermore, the research indicates that there has been recent and rapid evolution of succulent genera in these families in response to the stabilization of desert landscapes over the past five million years.

CONCLUSION

The diversity of the research presented in these symposium contributions provides fascinating insights into the floristic affinities, evolution, and biology of desert floras. The harsh weather and climatic conditions of deserts have been powerful selective forces on the constituent plants. It is clear that there is an enormous amount yet to be learned about the systematics and biology of desert floras especially on the cryptogamic components of the floras.