

# Functional Ecosystems and Communities

**Abbreviation:** Func. Ecosyst. Commun.

**Print:** ISSN 1749-0502

**Scope and target readership:** *Functional Ecosystems and Communities* explores the dynamic nature of populations, communities and ecosystems in all organisms. Particular emphasis will be placed on the ecology of vascular plants and bryophytes in terrestrial, aquatic, wetland, marine, brackish, estuarine or freshwater ecosystems. Papers reporting on experimental, descriptive, and historical studies of any aspect of plant population, physiological, community, ecosystem and landscape ecology as well as on theoretical ecology are within the scope of the journal. Studies on molecular plant systematics and taxonomy, encompassing evolutionary, phylogenetic and biogeographical studies at the populational, specific, higher taxonomic levels in all kingdoms (but focusing primarily on higher plants) are also welcome. We encourage manuscripts on physiological ecology, evolutionary ecology, mechanistic community ecology, ecological functional genomics, and ecosystem function.

One of the main focuses of *Functional Ecosystems and Communities* will be on molecular genetic techniques to address ecology, evolution, behaviour and conservation. Studies may employ neutral markers for inference about ecological and evolutionary processes or examine ecologically important genes and their products directly. Research areas of interest to the journal include: analytical methods, conservation genetics, ecological interactions, evolutionary dynamics of QTLs, genetic marker development, impact of GMOs and GMPs, individual and species identification, microbial biodiversity, molecular adaptation and environmental genomics, population genetic theory, relatedness and kin selection, reproductive strategies, sex allocation, speciation genetics.

We also encourage studies on:

- 1) Aquatic Ecology (limnology and oceanology), the structure and organization of lower levels into higher levels (intraspecific and interspecific interactions). Food web studies including ecophysiological investigations on kairomones and infochemicals, and their influence on matter and energy transfer are acceptable.
- 2) Biological Invasions: analytical syntheses and overviews of invasive biotas; ecological consequences of invasions relative to alterations in community-ecosystem structure (including energy flow, biodiversity, and invasion-mediated extinction); evolutionary consequences of invasions in both historical and geological time are especially encouraged; factors that influence inoculation, establishment, and persistence of invasions; mechanisms that control the abundance and distribution of invasive species, biogeography, genetics, dispersal vectors; patterns and processes of biological invasions (human-mediated introductions and natural range expansions) in terrestrial, freshwater, and marine (including brackish) ecosystems.
- 3) Biology, Fertility and Productivity of Soils: the link between, and impact of agriculture, deforestation and industrialization on ecological systems.
- 4) Management and policy issues related to conservation programs and global amelioration or control of invasions.
- 5) Population structure and phylogeography.
- 6) Weeds: biology and control, herbicides, invasive plant species in all environments, population and spatial biology, modelling, genetics, biodiversity and parasitic plants.

## Editor-in-Chief

Jaime A. Teixeira da Silva, Japan

## Technical Editor

Kasumi Shima, Japan

## Editorial Board and Advisory Panels

### Bioremediation and Bioavailability (D3)

Abdolkarim Chehregani, Iran  
Jude C. Igwe, Nigeria  
Anushree Malik, India  
Benkeblia Nouredine, Japan  
Geert Potters, Belgium  
S. Sudhakaran, India

### Ecosystems and Communities (D6)

Xinhua He, Japan  
Mercedes G. Lopez, Mexico  
Anushree Malik, India  
Aluri Jacob Solomon Raju, India  
Harminder Pal Singh, India

### Soil Systems (D16)

Hany A. El-Shemy, Egypt  
Xinhua He, Japan  
Harminder Pal Singh, India  
P. Ponmurugan, India  
Gamal Hassan Rabie, Egypt  
S. Sudhakaran, India  
James T. Tambong, Canada

### Water Science and Technology, and Management (D19)

Zeng-Yei Hseu, Taiwan  
Jude C. Igwe, Nigeria  
Sean Liu, USA  
Anushree Malik, India  
Harminder Pal Singh, India

Global Science Books, Ltd.  
46 Syon Lane, Isleworth, Middlesex  
TW7 5NQ, United Kingdom

Editorial Office: Takamatsu, Japan  
Accounting: Lagos, Portugal



GSB homepage: [www.globalsciencebooks.com](http://www.globalsciencebooks.com)  
GSB Japan: <http://www17.plala.or.jp/gsbjapan>  
GSB™ is a trademark of Global Science Books, Ltd.

Functional Ecosystems and Communities ©2007 Global Science Books, Ltd.

All rights reserved. No parts of this journal may be reproduced, stored in a retrieval system or transmitted in any form or by any means, electronic, mechanical, photocopying, microfilming, recording, or otherwise without written permission from Global Science Books, Ltd.

For additional copies, photocopies, bulk orders, or copyright permissions, please refer requests in writing to the above address, or apply online.

**Cover photo:** Top left: Inflorescences of *Habenaria pleiophylla* being visited and pollinated by moths of *Plusia admonens* (Noctuidae). Notice that in both cases moths are laden with pollinaria. Top right: *Plusia admo-nens* (Noctuidae) up close. Bottom center: Details of the column in *H. pleiophylla* in frontal view. More details in Singer *et al.*, pp 10-14.

**Disclaimers:** All comments, conclusions, opinions, and recommendations are those of the author(s), and do not necessarily reflect the views of the publisher, or the Editor(s). GSB does not specifically endorse any product mentioned in any manuscript, and accepts product descriptions and details to be an integral part of the scientific content.

Printed in Japan on acid-free paper.

## CONTENTS

<b>Jana C. Vamosi, Simon J. Goring, Brad F. Kennedy, Rachel J. Mayberry, Clea M. Moray, Lisa A. Neame, Nicole D. Tunbridge, Elizabeth Elle (Canada)</b> Pollination, Floral Display, and the Ecological Correlates of Polyploidy	1
<b>Rodrigo B. Singer, Tiago Böer Breier, Adriana Flach, Rosana Farias-Singer (Brazil)</b> The Pollination Mechanism of <i>Habenaria pleiophylla</i> Hoehne & Schlechter (Orchidaceae: Orchidinae)	10
<b>Elcida de Lima Araújo, Cibele Cardoso de Castro, Ulysses Paulino de Albuquerque (Brazil)</b> Dynamics of Brazilian Caatinga – a Review Concerning the Plants, Environment and People	15
<b>Reinaldo I. Barbosa, Ciro Campos, Flavia Pinto, Philip M. Fearnside (Brazil)</b> The “ <i>Lavrados</i> ” of Roraima: Biodiversity and Conservation of Brazil's Amazonian Savannas	29
<b>Rita de Cássia L. Figueiredo-Ribeiro, Maria Angela M. Carvalho, Rosemeire A.B. Pessoni, Márcia R. Braga, Sonia M.C. Dietrich (Brazil)</b> Inulin and Microbial Inulinases from the Brazilian Cerrado: Occurrence, Characterization and Potential Uses	42
<b>Xiongwen Chen (USA)</b> Energetics of Forest Biomes	49
<b>Mirosław Nakonieczny, Andrzej Kędziorski, Katarzyna Michalczyk (Poland)</b> Apollo Butterfly <i>Parnassius apollo</i> L. in Europe – Its History, Decline and Perspectives of Conservation	56

**Jana C. Vamosi, Simon J. Goring, Brad F. Kennedy, Rachel J. Mayberry, Clea M. Moray, Lisa A. Neame, Nicole D. Tunbridge, Elizabeth Elle (Canada)** Pollination, Floral Display, and the Ecological Correlates of Polyploidy (pp 1-9)

#### ABSTRACT

**Invited Mini-Review:** Polyploidy is recognized as having a significant impact on plant evolution, with estimates of half of all vascular plants being of polyploid origin. It was first suggested in the 1940's that polyploid species are concentrated in perennial herbs and in northern, temperate climates. Since then, there has been further attention concentrated on the ecological correlates of polyploidy, with an emerging interest in how polyploidization influences the pollination of a species. Here, we highlight recent work in pollination dynamics subsequent to polyploidization and gather information on differences in flower display characters between polyploids versus diploids. We posit that more thorough study of the effects of polyploidization on floral display is required, as this sub-field potentially provides keen insights into when and where polyploidy may be favoured via its effects on pollen delivery. Furthermore, our review of the evidence reveals that correlations between polyploidy and floral display in terms of flower size and flower number may influence perceived correlations between polyploidy and self-compatibility.

**Rodrigo B. Singer, Tiago Böer Breier, Adriana Flach, Rosana Farias-Singer (Brazil)** The Pollination Mechanism of *Habenaria pleiophylla* Hoehne & Schlechter (Orchidaceae: Orchidinae) (pp 10-14)

#### ABSTRACT

**Original Research Paper:** Pre-existing literature reports that plants of *Habenaria pleiophylla* Hoehne & Schlechter (Orchidaceae: Orchidinae) occurring in *Eucalyptus* plantations in Rio Grande do Sul (Southern Brazil) are pollinated by diurnal Nymphalid butterflies. This is surprising, since several flower features of this orchid suggest nocturnal pollination. Field evidence obtained by the authors in a natural population occurring in Ilha Do Cardoso State Park (São Paulo State, Southeastern Brazil) clearly demonstrated pollination by crepuscular/nocturnal Lepidoptera. Thus, the aim of this contribution is to present the first detailed description of this orchid's pollination biology under natural conditions. *H. pleiophylla* flowers secrete nectar and are fragrant at dusk and during the night. Pollinators are moths of *Cosmosoma auge* (L. 1767) (Arctiidae) and *Plusia admonens* Walker, [1858] (Noctuidae, Plusiinae). Moths bore 2-9 pollinaria which adhered to the surface of their eyes. During our observations, the male efficiency factor was 1.8 (meaning that 1.8 flowers were pollinated per pollinarium removed). Individual fruiting success ranged from 61 to 100%. Possible consequences for plant reproductive success of both, flower intrinsic morphological features and pollinator behaviour are discussed. Self-pollinated flowers under epifluorescence microscopy showed normal and abundant pollen tubes, thus suggesting that flowers of *H. pleiophylla* may be self-compatible. To our knowledge, this is the first formal citation of *H. pleiophylla* for the orchid flora of Ilha do Cardoso. Unpublished, preliminary field observations made in May 1996, at Ilha do Cardoso (Paraná State) suggest that short-tongued sphingid moths (*Aellopos* sp.) may also act as pollinators.

**Elcida de Lima Araújo, Cibele Cardoso de Castro, Ulysses Paulino de Albuquerque (Brazil)** Dynamics of Brazilian Caatinga – a Review Concerning the Plants, Environment and People (pp 15-28)

#### ABSTRACT

**Invited Review:** The Caatinga is a xerophyte, deciduous plant formation that occupies more than 50% of the northeastern region of Brazil (approximately 800.000km<sup>2</sup>). This formation presents a high biological and cultural diversity, including several endemic species of plants and animals, as well as many ethnic groups such as indigenous and rural communities. Distinct scenario types found within the Caatinga domain can be interpreted as a result of the interaction of many factors, such as the soil and the climate, which greatly influence the vegetation type, as well as the historical processes of occupation by man, and the socio-cultural features of local populations. The interaction of all these factors induces dynamic processes in Caatinga that influence local diversity, affecting the structure and dynamics of plant populations and communities, as well as social processes. The objective of this study is to present an overview of the diversity of plants (Angiosperms) and of ecological processes in Caatinga, discussing the manners in which people use this diversity. We also suggest some studies that may contribute to the conservation and management of Caatinga resources, considering the structure and the functioning of this ecosystem.

**Reinaldo I. Barbosa, Ciro Campos, Flavia Pinto, Philip M. Fearnside (Brazil)** The “*Lavrados*” of Roraima: Biodiversity and Conservation of Brazil's Amazonian Savannas (pp 29-41)

#### ABSTRACT

**Invited Review:** The savannas (*lavrados*) of Roraima are located in the far northern portion of the Brazilian Amazon and are part of the “Savannas of Guyana” ecoregion of the Amazonian Biome. They cover an area of approximately 43,358 km<sup>2</sup>, or 70% of the total area of savannas that straddle the borders of Brazil, Guyana and Venezuela. This ecoregion contains diverse types of phytophysionomies forming a mosaic of non-forest (open areas) and forest ecosystems associated with different soil types, altitudinal gradients and climates. This diversification of ecosystems generates a great heterogeneity of habitats and is reflected in the diversity of plants and animals. The few existing studies of biological diversity are almost all concentrated along the main highways and therefore fail to indicate the true magnitude of the biodiversity of Roraima's savannas. In spite of Brazilian authorities having classified these ecosystems as having extremely high priority for conservation, no protected areas exist in the savannas of Roraima. However, 57.3% are protected in the form of Indigenous Lands. Large rural properties and settlements occupy 19.4% of the total area. The number of settlements in these savannas can be expected to increase significantly in the coming years due to legal impediments to creation of settlements in forest areas in Amazonia and due to the expansion of soy production, irrigated rice and commercial tree plantations in the state. It is estimated that 23.3% of the savanna area in Roraima is still available for creation of conservation areas.

**Rita de Cássia L. Figueiredo-Ribeiro, Maria Angela M. Carvalho, Rosemeire A.B. Pessoni, Márcia R. Braga, Sonia M.C. Dietrich (Brazil)** Inulin and Microbial Inulinases from the Brazilian Cerrado: Occurrence, Characterization and Potential Uses (pp 42-48)

#### ABSTRACT

**Invited Mini-Review:** During early embryonic development, a common body plan is established in all vertebrates. Subsequently, complex morphogenetic programmes together with tissue growth dominate further foetal development, and differences in these morphogenetic processes result in anatomical variations between species. Our current view is dominated by the discovery that many morphogenetic processes are based on conserved molecular mechanisms. However, plasticity of such conserved molecular mechanisms has the potential to create morphological diversity between different species. Morphogenesis of the vertebrate thyroid gland is unique in that the primordium relocates from its site of origin, the epithelium of the primitive pharynx, to a final position in the anterior neck region in amniotes or to a similar area ventral to the pharynx in fishes, respectively. Comparison between species reveals naturally occurring variation of primordial relocation, and in position and shape of the mature gland. This review gives an overview about functional studies in different model species that provide insight into the molecular mechanisms required for thyroid relocation. Based on these data and comparative studies, I present a model that could explain species-specific variation of thyroid position and shape. Furthermore, I refer to congenital defects in humans that can be related to abnormalities in thyroid relocation.

**Xiongwen Chen (USA)** Energetics of Forest Biomes (pp 49-55)

#### ABSTRACT

**Invited Mini-Review:** Forest energetics is the study of the mechanisms and general rules in forming and transferring energy or energy-containing materials within and between forest ecosystems. Understanding the spatial and temporal pattern of ecological energetics of forest biomes is important for the study of forest ecosystems, forestry planning and forest management at large scales. Currently this research area is receiving great attention because of the interest for strategic transition to biofuel or bioenergy. More and more field observations about forest biomass and productivity from different forest biomes all over the world have been conducted during the last decades, and it is time to generate some principles about the energetics of forest biomes. Based on the recent literature, the main indices to characterize forest energetics are summarized. The concepts in forest energetics could be used to analyze some system properties. The general emergent properties of forest energetics across biomes, such as the complexity and simplicity, are revealed. The possible underlying mechanisms are evaluated, some implications of forest energetics are also reviewed and the possible directions for future research are suggested. The study of energetics of forest biomes will shed new light on (forest) ecology.

#### **ABSTRACT**

**Invited Review:** *Parnassius apollo* colonized Europe in Neogen. Migrations during interglacial episodes probably resulted in its diversification into more than 200 identified subspecies inhabiting mainly grasslands both in lowland and mountainous areas throughout Europe. According to trophic preferences two main groups can be distinguished: ‘telephiophagous’ that prefer *Sedum telephium*, and ‘albophagous’ that feed predominantly on *Sedum album*. This division reflects a vertical distribution of occupied habitats and migration history. Subspecies inhabiting mountain ranges in western and southern Europe fall into the ‘albophagous’ group, while the forms from lowland habitats across Europe and from the Eastern Carpathians are ‘telephiophagous’. Since the 19<sup>th</sup> century Apollo has been in decline due to combined negative impact of: a) natural factors including long-term climatic changes, habitat succession, and short-term weather anomalies; b) anthropogenic factors that include broad impact of industrialization and butterfly over-collecting; and c) intrapopulation factors that include genetic erosion and behavioural changes in small demes. Habitat loss is undoubtedly the most destructive for Apollo’s long-term survival. In this review we describe all these reasons in detail. Subsequently, various protective measures that were, are or should be undertaken to stop further decline are discussed.