BIOPARKS: INTEGRATED PRODUCTION/RECREATIONAL SYSTEMS

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Summary

Ecotourism has created many opportunities for rural recreational enterprises in the tropics. Beyond conventional parks and nature reserves, well-designed bioparks can conserve biodiversity and be integrated with other land uses such as reclamation of industrial sites. Bioparks serve to integrate nature conservation, education, animal production, and reclamation. They require careful planning and management based on a sound understanding of interactions of humans with plant and animal communities.

1. Introduction

As a resource and an environmental stabilizer, tropical humid forests are one of the most important ecosystems. They provide timber, non-timber products, tourism income, plant genetic material, raw materials for biotechnology, medicines, pharmaceuticals, food, and shelter for its people. They prevent erosion, maintain soil fertility, regulate water runoff, moderate climate, reduce stream and river sedimentation that kills fish, stop nutrient wash-out that pollutes waterways, and fix carbon dioxide. Their very importance as a "goldmine" of biodiversity may yet be the cause of their destruction.
Malaysia and most tropical countries are rich in biodiversity and by utilizing appropriate natural resources, technology, and, together with knowledge of wildlife management, animal science, ecology, and landscape, a unique biopark can be developed for the purpose of biodiversity conservation, "edu-entertainment," research and development, and ecotourism.

2. Processes

We rely on wildlife and plants more than most people would think. Huge monetary losses as well as long-term ecosystem damage may result from wildlife population reductions. For example, loss of some plant species may result in loss of some pollinators and herbivorous animals. Thus interrelationships between both plants and animals can not be neglected or ignored. Whether in their natural habitat or in farmland, animals and plants are interconnected. In rainforests, plants and animals interact with each other in an enormous variety of ways. Many of the interactions benefit the animals and are neutral or deleterious to plants—as is usually the case when animals use plants for food or shelter. Some relationships are mutually beneficial—as are many relationships between flowering plants and their pollinators—and some benefit the plant and are neutral or deleterious to animals.

There are four general types of possible interactions between organisms. These are mutualism and commensalism (regarded as positive interactions), and competition and predation (regarded as negative interactions). *Mutualism* occurs when both species benefit from the association, whereas *commensalism* is where one organism benefits, but at no cost to or gain from another organism. *Competition* involves cost to either or both organisms, whilst *predation* imparts a cost to one organism and a benefit to another.

For ungulates (animals with hoofs), the most commonly described interaction appears to be competition. Feeding on plant tissue presents a formidable evolutionary hurdle that most groups of insects have not been able to overcome; the difficulties of adopting a plant-feeding lifestyle are equally great for other kinds of animals. The main problem is the quality of the food that plants provide. Different kinds of plant tissue present different problems; some worse than others.

Foliage feeders may include a relatively narrow taxonomic range, but wood feeders are narrower again; those groups that have solved nutritional challenges have been enormously successful, in rainforests as elsewhere. It has been noted that fruits provide a relatively low-quality food source, high in carbohydrate and low in protein, in terms of quality food source, even though it is often to the plant's advantage that the fruit is consumed. Leaves are nutritionally more difficult than fruit: not only are they low in protein but, unlike most fruit, they are often well-defended against herbivore attack. Defense mechanisms include physical defenses such as tough or waxy cuticles, hooks, or spines, and other structures, as well as various noxious chemicals. The low nutrient quality of foliage may itself be a form of defense. Herbivorous ungulate species vary in their impacts on forest environments, with different tree species, ground floras, growth structures, and, ultimately, different forest types being favored by each.

Herbivory has a pervasive influence on the structure and functioning of ecosystems. It modifies the amount of energy that moves through ecosystems, changes the pathways that energy follows, and affects the composition and nutrient cycling of the plant communities. Studies conducted in many parts of the world have demonstrated the importance of herbivory in both natural ecosystems and those dominated by livestock. In grassland and savanna ecosystems, herbivores above and below the soil surface

consume between 10% and 90% of the net primary production. Energy and materials are thus diverted from detrital food webs into herbivorous ones, many of which provide nutrition for humans.

The effect a particular herbivorous ungulate species has on a forest ecosystem will depend on its feeding ecology and the degree and type of physical disturbance that it causes. Browsers (e.g. sambar deer, *Cervus unicolor*) feed selectively on the most digestible plant materials, such as tree leaves, seedlings, and forbs (herbaceous plants other than grasses), whilst grazers (e.g. cattle, *Bos* spp.) are less discriminate feeders of large quantities of abundant but less digestible material such as grasses. Species such as the sambar and rusa (*Cervus timorensis*) are classed as intermediate feeders and fall between these extremes, behaving as both browsers and grazers. The relative numbers of browsers and grazers can influence forest plant species composition, and it has been suggested than an excess of browsing over grazing ungulates may in the long term tip the balance in a forest by conifers dominating over broad-leaved trees and vice versa. Different feeding strategies have been explained in terms of both morpho-physiological adaptations, and as a consequence of body size. The effects of direct herbivory are compounded by those of physical disturbance, which affects plant dynamics and tree growth and depends on the size and behavior of the ungulate. For example, wild boar (*Sus scrofa*) have a major impact on forest floors through rooting behavior, and roe deer damage saplings by fraying with their antlers.

In urban societies, people lack opportunities to know and learn about this interaction. This may be related to how nature is experienced, separating basic elements such as fauna in zoological parks (zoos) and flora in botanical parks or gardens. Displaying both elements together could help the public to understand better the importance of both and their role in our lives.

3. Components

In recognition of the inseparable relationship between animals, plants, and humans, the concept of a biological park, or biopark, has been developed. A biopark is a living interaction of the seen and unseen worlds that constitute our reality, a dynamic interactive place where life evolves. The biopark is a concept of integrating fauna, flora, and humans in a non-barriered area of a balanced ecosystem.

The theory is to portray life in all its interconnectedness for both unseen and seen relationships within one bio-exhibit in ecologically balanced ecosystems. Thus, a biopark is the new idea in animal production and wildlife conservation with the introduction of recreational activities besides education and entertainment that will give better return to investors. This type of edu-entertainment will promote better biology understanding among children and researchers. Not only promoting recreation and entertainment, a biopark is a venue that reinforces the principles of wildlife conservation. The biopark is dedicated to reestablishing the natural balance that best supports the life of our planet by honoring the interdependent nature of the relationships of all life forms and reeducating humanity to the unique responsibility that we share.

Thorough study of plant–animal interactions is essential. This is because animals and plants will be put together in one exhibit to portray and simulate animals' natural habitat. Conflict may occur between these two elements when animals cause plant damage through browsing, grazing, or debarking and plants may cause animal death through their secondary metabolites. The effect of animals on the plants in relation to their biology and ecology and also the effects of plants on animals caused by feeding on the plant parts that will cause toxicity and allelopathy, and also their symbiotic relationship must be considered. The effect of plants on animals should not be looked at with respect only to the feeding effect, but also to the behavior of animals stimulated towards the plant. This is essential because plants are not only used to give esthetic values to biopark but also to give the animals protection and fulfill their biological and physiological requirements.

Before the decision is made on the integration of the fauna and fauna for the purpose of conservation or commercialization, the biological requirements of the newly introduced fauna and fauna should be known. Their compatibility, their suitability, and their adaptability should be known. Therefore, the objectives of biopark development are to:

- develop and study the suitability of native flora as forage and shelter in relation to the animal assemblage;
- evaluate biocompatibility between the tested fauna and flora in relation to herbivory;
- determine the suitable combination of fauna-fauna and fauna-flora;
- evaluate the success of the application of the concept of biopark for conservation, recreational and edu-entertainment.

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Biographical Sketch

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