

Conserving the Biodiversity of Kenting National Park, Taiwan: Present Status and Future Challenges

MINNA J. HSU¹

GOVINDASAMY AGORAMOORTHY²

¹ Department of Biological Sciences, National Sun Yat-sen University

² Department of Wildlife Conservation, National Pingtung University of Science and Technology

Abstract

Taiwan is an island dominated by rugged mountainous terrain. It is located on the Tropic of Cancer and is separated from the mainland by the Taiwan Strait. Taiwan's rapid economic and industrial growth has put heavy pressure on natural environment over the last three decades. Till date, 6 national parks, 18 nature reserves and 24 nature protected areas have been designated to ensure protection for wildlife and their habitats. The protected area covers 12.2% of the total land area of Taiwan. Kenting was the first national park of Taiwan, which was established in January 1984 to give exclusive protection to 17,731 hectares of terrestrial lowland rainforest and 14,900 hectares of adjacent ocean. The marine conservation area of Kenting has coral reefs. Kenting's terrestrial ecosystems range from grassland to rainforest with high diversity of fauna and flora including several rare and endangered species. Moreover, there are numerous limestone caves that provide shelter to six species of bats. The threat to terrestrial and marine habitat of Kenting continues due to habitat destruction, expansion of agricultural activities, encroachment of forestland for construction of houses, and pollution. Steps must be taken to decelerate human-induced habitat destruction on Kenting's delicate ecosystem. Strict enforcement of conservation policies is vital for managing the national park in the future.

Introduction

Taiwan covers an area of 36,000 km² and is located at the fringe of the Asian continental shelf at the western rim of the Pacific basin. The mainland separates it by a narrow strait, just 130 km at its nearest point. It rose from the sea floor of the Asian continental shelf approximately 4 million years ago (Hsu 1990). It has been rising at an average rate of 5mm per year above sea level even today. The mountainous terrain of Taiwan harbors over 4,000 vascular plants in six forest types (Boufford et al. 1996).

Wildlife resources are also abundant with 61 species of mammals, 400 species of birds, 92 species of reptiles, 30 species of amphibians, 140 species of fresh-water fish, and an estimated 50,000 species of insects including 400 species of butterflies (Hsu & Agoramoorthy 1997). The unusually rich diversity of fauna and flora in a small island like Taiwan attracted lots of attention of naturalists. Even Alfred Wallace who wrote more than a century ago: "Among recent continental islands there is probably none that surpasses in interest and instructiveness the Chinese island named by the Portuguese, Formosa..." (Wallace 1880). About two thirds of Taiwan's land area is at slopes over 10% and almost half is at slopes over 40%. Taiwan certainly is an ecological microcosm and one can travel from a mountain peak to coral reef in a single day. Taiwan's rapid economic and industrial growth has put heavy pressure on the natural environment over the last three decades. To date, 6 national parks, 18 nature reserves and 24 nature-protected areas have been designated to ensure protection for wildlife and their habitats (Hsu & Agoramoorthy 1997). Although the protected area covers 440,290 ha, which is 12.2% of the total land area of Taiwan, the pressure on forest and marine resources is on the increase in recent years.

Kenting National Park was the first national park of Taiwan and it was established in January 1984 to give exclusive protection to 17,731 hectares of terrestrial lowland rainforest and 14,900 hectares of adjacent ocean (Hsu 1997). Kenting is the only national park that has a marine conservation area. Since September 1994, the authors have been conducting long-term research on the conservation status and ecology of flora and fauna in Kenting National Park. This paper outlines the diversity of terrestrial and marine organisms of Kenting National Park and also examines the extent of threats to wildlife and their environment caused by increasing human population growth and uninterrupted habitat destruction. Management recommendations are also given in terms of balancing human needs and biodiversity conservation in Taiwan.

The people of Kenting National Park

The name Kenting means ploughman and this word is derived from the practice of recruiting farmers in the area to establish agriculture during the Ching Dynasty in 1800's. Anthropologists have found ten different prehistorical human residues within the park suggests that the early human activities began some six thousands years ago (Tseng 1986). There are three native tribal communities namely, Paiwan, Ami and Pingpu lived in the national park before the immigrants from mainland China appeared during the 1600s. The Pingpu tribe eventually mixed with the Chinese immigrants while small communities of Paiwan and Ami tribes still live in the eastern part of the park. There are several villages, both small and large exist in the national park (Fig. 1). There is a highway system that runs in the park making easy access for people to move in and around. When the park was created in 1984, about 67% of the land area belonged to the government and the rest were

private land. The landowners have been permitted to continue their land use practices such as; expanding houses, agriculture, fisheries, cemeteries and livestock grazing. However, the local people are not allowed to change the landscape on a larger form that currently creates major conflicts between people and park administrators.

The location of park and its management system

Kenting National Park (21° 90'N, 120° 80'E) is located on the southernmost tip of Taiwan. The park is bordered on three sides by water, the Pacific Ocean to the east, the Bashi Channel to the south, and the Taiwan Strait to the west. Coral tableland cover Kenting National Park and tropical rainforest thrive well on the coral land intercepted with cliffs. The climate of the park is tropical with dry winters and humid summers. The mean monthly temperatures range from 29.8°C (July) to 21.5°C (January), without a cold winter (Hsu & Lin 1993, 1994, 1997). Precipitation is usually concentrated from May through August and the dry season lasts for about nine months.

The national park has five management divisions. i.) Division of Interpretation and Education is responsible to plan and execute education programs to public that visit the park. This division also informs local people about the regulations of National Park towards hunting, poaching and habitat destruction. II). Division of Conservation and Research is designed to supervise research activities, field research stations, and endangered species programs. III). Division of Planning and Management supervises all the land use developments within the park. The division has also purchased some private lands and leased some public lands to preserve waterfowls in two wetlands. IV). Division of Construction and Maintenance designs coastal forest restoration and also build and maintain build watching and animal viewing towers. V). Division of Tourism and Recreation coordinates all recreational activities within the park.

Diversity of life in terrestrial and marine habitats

Kenting National Park contains both subtropical and tropical flora. Out of the 2,200 species of flora that occur in Kenting, nearly 1000 are vascular plants, which is one fourth of the total flora of Taiwan. The ecosystems range from grassland to rainforest harboring rare plant species such as: *Actinostachys digitata*, *Schizaea digitata*, *Acrostichum aureum*, *Goniothalamus amuyon*, *Cassia garambiensis*, and *Crotalaria similis* that are protected in the park (Chen 1994). There are about 15 species of mammals, 200 species of birds including 110 species of migrants, 24 species of reptiles, and 12 species of amphibians occur in the national park. Kenting also has a high diversity of butterflies and a total of 204 species divided into families such as: Papilionidae (22 species), Pieridae (27 species), Danaidae (19 species), Satyridae (17 species), Nymphalidae (43 species), Libytheidae (2 species), Lycaenidae (41 species), Hesperidae (32 species), and Amathusiidae (1 species) have been recorded. Local biologists from southern Taiwan have established permanent plots for

monitoring the population status of plants and animals in Kenting National Park (eg: Hsu 1997; Hsu & Lin 1993, 1994, 1997). The national park has 17 touristic sites including an observatory tower, 27 m in height, which opens a general view of the forest and adjoining ocean.

A total of 257 species of corals represents four orders and 22 families in reefs around Kenting (Table 1). However, virtually nothing is known about the ecology and population status of coral species. The threat to Kenting's marine ecosystem however continues since non-degradable materials, silt and pesticides from neighboring agricultural farms and residential areas reaching the coastline regularly. People also periodically harvest corals, which threatens the survival of the reef. Several souvenir shops in Kenting exhibit varieties of corals for sale. Commercial fishing is also active along the marine conservation area, though the impact of the non-regulated fishing to coral reefs is not clearly known. The park receives about 3 million tourists annually. Local tourists often explore the marine conservation area for pleasure using motor boats, power surfers and diving equipment that disturb the coral reef community. During 1996, the Chinese Coral Reef Society was established for the first time in Taiwan. This society with members from scientific communities has general public plans to educate local people about the importance of coral reefs in the marine ecosystem.

Reintroduction of an extinct species

Sika deer, the most glamorous of all three species of deer in Taiwan, once roamed around Kenting and the coastal plains during the 1600s. These deer were hunted intensively during the Dutch occupation between 1624 and 1661 for their attractive hide. The unscrupulous exploitation continued on until the Japanese occupation of Taiwan between 1895 and 1945 which resulted in the extinction of the elegant deer during the 1960s ((Hsu & Agoramoorthy 1997). A decade ago, a restoration project was initiated to revive the deer population in captivity. By 1990, the captive deer population raised to 60 individuals. The first group was reintroduced in Kenting National Park (Wang 1991). The sika deer is the most popular wild animal now in Kenting National Park which encourages domestic tourism.

Caves and bats

Kenting harbors several lime stone caves and these were formed as dripping underground waters minutely shifting calcium carbonate deposits over the millennia. These caves support many cave-dwelling organisms such as; bats, snakes, frogs, and several species of invertebrates. Bats species such as; the horseshoe bat, *Rhinolophus monoceros*, woolly horseshoe bat, *R. luctus formosae* (Rhinolophidae), Himalayan leaf-nosed bat, *Hipposideros armiger terasensis*, tailless leaf-nosed bat, *Coelops frithi formosanus* (Hipposideridae), common bent-wing bat *Miniopterus schreibersii*, and large-footed myotis, *Myotis taiwanensis*

(Vespertilionidae) are the most common residents of the caves in Kenting. A few caves namely, Stalagmite, Fairy and Silver Dragon are opened for public viewing. Several of the caves in Kenting are closer to farms and farmers periodically expand their agricultural fields often resulting in the closure of caves. For example, seven caves in Kenting have been fully buried by farmers to expand their agricultural fields over the last few years, which wiped out all cave faunas. Furthermore, limestone is periodically removed from the caves by people and then sold at souvenir shops in Kenting.

Migratory birds

Kenting National Park is located at a merging point of two flyways for the migratory birds in Eastern Asia. Out of the total 200 species of birds recorded in the national park, 50% or more are migratory species such as; brown shrikes, egrets, geese, ducks, waders, plovers and raptors. The migratory birds fly along the coastal areas of Mainland China and cross over the Taiwan Strait to Taiwan when the cold fronts in Serbia move during August-September every year. The two predominant migrant species, which visit Kenting every year, are, gray-faced buzzard-eagle, *Butastur indicus* and brown shrike, *Lanius cristatus leucionensis*. Local people once for food had extensively harvested these species during the last several decades. The buzzard-eagle is a forest species while the brown shrike inhabits open country and woodland edges. After the wildlife conservation law of the government of the Republic of China on Taiwan was passed in 1989, capturing migratory birds became illegal (WCL 1989). Despite legal protection for the migratory birds in Taiwan, exploitation of these birds continues in Kenting. The staffs of National Park periodically collect large number of snares, nets and traps from the forest which are placed by local people for trapping birds. The uninterrupted conversion of forestland and expansion of agriculture practices in and around the national park are contributing factors for easier trapping of migratory birds in the park.

Discussion

Coral reefs around the world are at risk due to over exploitation and pollution. The IVth World Congress on National Parks and Protected Areas suggested to designate 20% of the global coastal zone protected by the year 2000 under agreed management plans (IUCN 1992). Therefore Taiwan must expand the marine conservation area around Kenting. It is also vital to establish newer protected areas for the coral reefs in northern and eastern coastlines. Marine biologists with support from the Council of Agriculture the government agency responsible for the conservation of protected previously established artificial reefs in order to increase the carrying capacity of coastal waters for commercial fishing. To some extent, these reefs benefited coral reef fish population (Chang et al. 1989), but more data are needed. It is also necessary to regulate commercial fishing around Kenting and along the

coastlines. The existing Fisheries Law stipulates a permit system for commercial fishing and regulates fishing equipment, but does not deal issues related to conservation and management of marine resources including fish. The national park is heavily used for tourism, which has to be controlled. Furthermore, long-term ecological projects to monitor the coral reefs need to be established for understanding the human impact on the reef ecosystem and to develop wise conservation strategies. Furthermore, the rate of disappearance of coastal vegetation due to human activities has been alarming over the last decade and the primary forest in Kenting National Park is increasingly degraded and fragmented. Along the coast, the sand-dunes plant species such as: *Vitex trifolia*, *Zeuxine strateumatica*, *Scaevola hainanensis* and *Ipomoea stolonifera* need immediate protection as pointed out earlier by Chen (1994).

The sika deer reintroduction project brought immense publicity and public awareness in Taiwan on wildlife conservation. However, conflict between human inhabitants and sika deer may arise in the future since local people use the forest for grazing buffalo, sheep and goat. The park management authorities should monitor the population growth of deer which have no natural enemies with the exception of man, and develop realistic management plans for maintaining the deer population within the carrying capacity and protect the forest habitat from shrinking (Hsu & Agoramoorthy 1997). Community-based conservation programs and projects bringing economic incentives to local people are vital for the establishment and implementation of wildlife conservation and migratory bird conservation policies.

Six out of the total eight bat species recorded in Kenting and seven out of the total twenty species that occur in Taiwan are known to depend on caves for roosting (Hsu 1996, 1997). Similarly, it has been reported that majority of the microchiroptera in the United States and Mexico depend on caves for roosting (McCracken 1989; Arita 1993). The main threats to bats in Kenting are the closure of roosting caves as a result of habitat alterations. Steps must be taken to restore the caves buried by soil, to decelerate the expansion of encroachment by local villagers and increase public education to save the bat habitats. Infra-red video cameras can be established in caves around Kenting for public viewing of colonial roosting and maternity colonies of bats which would promote the understanding the ecology of less known flying mammals for visiting domestic tourists (Hsu 1997).

Animosity among local residents and park authorities are also in the increase in recent years. Last year, while we were checking a cave roosting colony of bats in the national park, a local resident who occupies park property illegally approached our car and broke the windshield using a cutlass. He thought we were from the parks' office that gave him a reason to initiate a fight. When we reported the case to the parks' police, they hesitated to register a case, but warned the violator not to repeat the same mistake. There are several cases of land encroachment by local people pending a verdict from local court. It is not always easy for the staffs of National Park to manage the boundaries without antagonizing

local people. The park authorities must develop strategies to include local people in their nature protection and educational programs. Although government regulations restrict employment only for qualified under or post-graduates, who can pass a competitive examination, the park should consider providing at least temporary employment opportunities for local people who live in the park.

Habitat disturbance pressure on Kenting's terrestrial habitat is increasing and local people is still creating intentional forest fires during each dry season which destroy natural forest. The forest areas are being fragmented therefore corridors need to be established which would allow wild animals to utilize the whole park. Livestock grazing must be minimized in the park. The agricultural land use patterns must be thoroughly surveyed and strategies should be developed for sustainable development without sacrificing natural habitat. Forest, grassland and agricultural areas in the park have suffered erosion and steps must be taken to arrest degradation and restore areas to productivity. Luxury hotels and housing complexes have increased in recent years close to forest areas and all developmental projects must be kept under control. The human-induced disturbance to terrestrial and marine biodiversity of Kenting National Park can be arrested if the park authorities impose strict management policies. However, without a good management system, the future for Kenting's diversified marine and terrestrial ecosystems look grim.

References

- Arita, H.T. (1993). Conservation biology of the cave bats of Mexico. *Journal of Mammalogy*, 74(3): 693-702.
- Boufford, D.E., Hsieh, C.F., Huang, T.C., Ohasi, H., Yang, Y.P. & Lu, S.Y., eds. (1996) *Flora of Taiwan*. Second Edition. Publication of the Editorial Committee of the Flora of Taiwan, Taipei, Taiwan, ROC.
- Chang, Y.C., Chiang, P.C., Chu, Y.P., Hsiao, .H. & Severinghaus, L.L., eds. (1989) *Taiwan 2000. Balancing Economic Growth and Environmental Protection*. Publication of the Steering Committee of the Taiwan 2000 Study, Academia Sinica, Taipei, Taiwan, ROC.
- Chen, M.Y. (1994) Plant diversity in the coastal zones of Taiwan. *International Symposium on Biodiversity and Terrestrial Ecosystems*, 1994, pp. 18. Institute of Botany, Academia Sinica, Taipei, Taiwan, ROC.
- Hsu, V. 1990. Seismicity and tectonics of a continent-island arc collision zone at the island of Taiwan. *Journal of Geophysical Research* 95(B4): 4725-4734.
- Hsu, M.J. (1997) Population status and conservation of bats (Chiroptera) in Kenting national park, Taiwan. *Oryx* 31: 295-301.
- Hsu, M.J. & Agoramorthy, G. (1997) Wildlife conservation in Taiwan. *Conservation Biology* 11: 834-836.
- Hsu, M.J. & Lin, Y.S. (1993) Morphology, sexual dimorphism and hybridization in Styan's bulbul *Pycnonotus taivanus* and Chinese bulbul *Pycnonotus sinensis formosae* in Taiwan. *Acta Zoologica Taiwanica* 4: 103-111.
- Hsu, M.J. & Lin, Y.S. (1994) The annual cycle of the Chinese bulbul *Pycnonotus sinensis formosae* in Taiwan. *Acta Zoologica Taiwanica* 5: 33-39.
- Hsu, M.J. & Lin, Y.S. (1997) Breeding ecology of Styan's bulbul *Pycnonotus taivanus* in

- Taiwan. *Ibis* 139: 518-522.
- IUCN (1992) Caracas action plan. In Plenary Session and Symposium Papers of the IVth World Congress on National Parks and Protected Areas, Caracas, Venezuela, 1992, pp. 301-10.
- World Conservation Union, Gland, Switzerland.
- McCracken, G.F. (1989). Cave conservation: special problems of bats. *Bulletin of the National Speleological Society*, 51: 47-51.
- Tseng, Y.L. (1986). Kenting national park Taiwan, Republic of China. Construction and Planning Administration, Ministry of Interior Publication, Republic of China. 39 pp.
- Wallace, A.R. (1880). *Island life*. Mac Millan & Co., London.
- Wang, Y. (1991). Current status of Formosan sika deer restoration program. In: *The Proceedings of the first international symposium on wildlife conservation*, pp. 277-288. Council of Agriculture Publication, Taipei, Taiwan.
- WCL (1989). Republic of China's Wildlife Conservation Law 1-3266. Government of the Republic of China on Taiwan.

Table 1 List of coral species recorded in Kenting marine conservation area

Class Anthozoa

Order Scleractinia

- Family Acroporidae (62 species)
- Family Thamnasteriidae (3 species)
- Family Pocilloporidae (9 species)
- Family Agariciidae (16 species)
- Family Fungiidae (21 species)
- Family Poritidae (20 species)
- Family Faviidae (38 species)
- Family Merulinidae (2 species)
- Family Pectiniidae (6 species)
- Family Mussidae (11 species)
- Family Caryophylliidae (4 species)
- Family Dendrophylliidae (7 species)

Order Stolonifera

- Family Tubiporidae (1 species)
- Family Clavulariidae (1 species)

Order Alcyonacea

- Family Xeniidae (2 species)
- Family Asteropiculariidae (1 species)
- Family Nephtheidae (4 species)
- Family Alcyoniidae (31 species)

Order Gorgonacea

- Family Subergorgiidae (3 species)
- Family Acanthigorgiidae (5 species)
- Family Plexauridae (3 species)
- Family Ellisellidae (7 species)