

A STUDY ON THE FLORA AND VEGETATION OF CAT DUA ISLAND, NORTHEASTERN VIETNAM

XIN-SHENG QIN^{1*}, RONG-JING ZHANG² AND FU-WU XING³

¹College of Forestry, South China Agricultural University, Guangzhou, China

²College of Life Sciences, South China Agricultural University, Guangzhou, China

³South China Botanical Garden, Chinese Academy of Sciences, Guangzhou, China

*Corresponding author's e-mail: xinfw@scbg.ac.cn

Abstract

Cat Dua Island (namely Monkey Island) is situated in the Gulf of Tonkin, belonging to the Quang Ninh Province in Vietnam. A total vascular flora of 88 species belonging to 44 families and 76 genera was recorded from the island. The dominant families of the flora are Euphorbiaceae, Papilionaceae, Moraceae, Rutaceae and Rubiaceae etc. Most of the genera in the flora are tropical characteristic. In the island, there are few endemic species, which may be due to its young flora in geological respect. The vegetation are mainly classified as the evergreen broad-leaved forests, scrub forests and beach vegetation. It is urgent to protect biodiversity in limestone regions and how to deal with the relationship between development and protection is still a difficult task.

Introduction

Karst landscape is one kind of specific habitat distributed widely in the world. Because of the great diversity of edaphic conditions and topography, vegetation types on karst are extremely diverse and rich in endemic taxa. However, limestone area is a very fragile habitat and is being threatened by human activities, therefore plants those are endemic to this kind of habitat are at a high risk of extinction. Due to inconsiderate pursuit for development, ex-situ conservation is a next best alternative for species survival. There are large limestone areas in Southeast Asia, including China, Vietnam, Thailand, and Philippine etc. Furthermore, in some Asian countries such as Vietnam and China, limestone vegetation is poorly studied and collections of herbarium specimens are few, therefore there is a possibility of disappearance of unnamed species (Clements *et al.*, 2006). Vietnam is the country in Asia which has about 18% area of limestone mountains (Furey & Infield, 2007), mainly occurring in the north, including Long Son, Hoa Binh, Quang Ninh and Ninh Binh provinces etc.. Ha Long Bay, a World Heritage Site, is a famous karst landscape in Vietnam. It has an area of 1,553 sq. km with thousands of eccentric isles emerging above the sea surface (Anon., 2003). The biodiversity are very rich there. However, there is no adequate inventory of plants so far in Ha Long Bay area, so the rich and fascinating flora remains unknown to most people. Cat Dua Island is one island nearby Ha Long Bay. We investigated the flora and vegetation of Cat Dua Island in September 2004 when we attended the International Transdisciplinary Conference on Development and Conservation of Karst Regions in Vietnam. A primary analysis of the flora and vegetation of Cat Dua Island is given by us in this paper.

Materials and Methods

Cat Dua Island lies in the Northeast of Vietnam and belongs to the Quang Ninh province. It is located about 150km to the Southeast of Hanoi, on the west side of the

Gulf of Tonkin. Geologically it is closely attached to the Hainan Island in South China. It can be accessed very conveniently by boat or canoe from Hai Phong or Quang Ninh. The Island is composed of limestone, it has an area of about 12 sq. km, in which the elevation of the highest peaks is about 100 m. It is a part of the 'Quang Ninh anticlinorium' (Tri, 2003). This structure occupies most of Quang Ninh province and the southern margin of Hai Phong city. The climate of Cat Dua Island is monsoon tropical, being hot and wet from May to October with temperatures averaging between 27-29°C but cool and dry in the winter (Hiep & Kiew, 2000).

The information including number, height and habitat of each species were recorded in the field. Plants were identified with the help of some botany monographs of Vietnam (Lecomte, 1907-1951; Aubreville *et al.*, 1960-1994; Pham, 1991-1993).

Results

Flora: There were 88 vascular plants belonging to 44 families and 76 genera in the island according to the authors' investigation. The largest families more than 4 species were Euphorbiaceae, Papilionaceae, Moraceae, Rutaceae and Rubiaceae. The most common genera were *Capparis*, *Croton*, *Dunbaria*, and *Ficus*. Within these families, about 81.8% of the total families are tropical (Annonaceae, Moraceae, Euphorbiaceae and Rubiaceae), 11.4% are cosmopolitan (Hypericaceae, Rhamnaceae and Compositae), and the rest are temperate (Ranunculaceae and Boraginaceae). In terms of genera, about 93.3% of the total genera are tropical elements (*Ficus*, *Scaevola*, and *Rinorea*), 4% are cosmopolitan (*Clematis*, *Bidens*, and *Sophora*), and the rest being temperate (*Vitis* and *Rhus*). About 43.2% species belong to Pantropic, and 22.7% belong to Old World Tropics. It is obvious that the flora character of Cat Dua Island are tropical. Many species have adapted to the xerothermic and rainy climate. Endemic species are few in the island. All the plants come from the near mainlands or islands. Some plants are transmitted by human or animals such as *Bidens alba* and *Cassytha filiformis*. Some are transmitted by sea water

such as *Cocos nucifera* and *Pandanus tectorius*. Some are transmitted by wind such as *Chromolaena odoratum* and *Clematis uncinata*.

According to phytogeographical distribution and their habit, these plants can be divided into four types, viz. eurytopic plants, accidental plants, preferential plants and endemic plants.

Eurytopic plants: They distribute widely, not only in limestone regions, but also in other bedrock regions such as granite regions. They need no special soil during their growth, so they have no special association with limestone. They are mainly some species of Lauraceae, Euphorbiaceae, Moraceae, Compositae, and Rutaceae, including *Bridelia tomentosa*, *Ficus virens* var. *sublanceolata*, and *Murraya alata*.

Accidental plants: These plants are found only occasionally on limestone or strangers to limestone such as *Murraya microphylla* and *Clerodendrum inerme*.

Preferential plants: They are dominant on limestone. Although these plants distribute both in limestone regions and in granite regions, they prefer to grow in the former. Many species of them are dominant species in the limestone communities. They are mainly some species of Euphorbiaceae, Papilionaceae and Sterculiaceae, including *Pterospermum heterophyllum*, *Mallotus repandus*, *Croton cascarilloides*, *Sarcostemma brevistigma*, and *Dracaena cambodiana*.

Endemic plants: They grow only in the limestone regions or they are only found in limestone regions so far. The characters of these plants are calciphilous, and drought-tolerant. They are always thorny and pileous on their stems and leaves. They are mainly some species of Euphorbiaceae, Gesneriaceae, Balsaminaceae, and Urticaceae, such as *Triadica rotundifolium* and *Impatiens verrucifer*.

Vegetation: The vegetation of the region as a whole is dominated by low shrubs. According to the distributional elevation and habitat of these plants, they can be divided into several types.

Seashore plant community: There are some kinds of grasses and trees on sandy shores. Nearby the sea, most plants are creeping and rooting. The dominant species are *Canavalia maritima*, *Vitex trifolia* var. *simplicifolia*, *Sophora tomentosa*, and *Cajanus scarabaeoides*. There are some typical seashore plants such as *Pandanus tectorius*, *Scaevola sericea*, and *Cerbera manghas*. Just like other islands, some alien species which come from tropical American invaded the seashore first, such as *Bidens alba* and *Chromolaena odoratum*. In some regions the alien plants spread widely. It seems that sparse forests are easier to be invaded by alien plants than dense forests. Some plants were planted by fishers or villagers for food or resisting the wind, such as *Casuarina equisetifolia*, *Annona squamosa*, and *Cocos nucifera*.

Slope plant community: On the slope of the rocky island there are usually some shrubs and liane including the evergreen trees with a height of 2-4 m such as *Hibiscus tiliaceus*, *Triadica rotundifolium*, and *Arytera littoralis*. Beside the wooden trees the climbers can be found here such as *Cassytha filiformis*, *Tetrastigma tonkinense*, and *Vitis balanseana*.

Cliff plant community: The habitat of these plants is very dicky. Their roots penetrate in the cracks firmly to prevent the trees from falling down and to take nutrition. Only some species can survive on such severe conditions. Typical species include *Sarcostemma brevistigma* and *Dracaena cambodiana*.

Hill top flora community: Some summits (hill tops) are covered by a thin layer of soil or uncovered entirely. The small, bushy, thorny and climbing species grow there. Some typical species include *Clematis uncinata*, *Pilea peltata*, *Impatiens verrucifer*, *Mallotus repandus* and *Celtis philippensis*.

Discussion

The richness of the flora, both in the variety of different communities and the number of species, contribute to the area's biodiversity, and some problems on utilization and conservation are urgent to be studied and resolved (Chaghtai & Yusaf, 1976; Khan *et al.*, 2011). Most species of Cat Dua Island are similar to those of the neighbouring regions and countries such as the Ha Long Bay, Cat Ba Island in Vietnam, and Hainan Island in South China. Cat Ba Island, Ha Long Bay and Cat Dua Island are parts of Quangninh anticlinorium. Tri (2003) considered they are parts of the Vietnam-China composite territory that has experienced a common evolution of rifting, drifting, collision and subsequent modification since the Late Pre-Cambrian throughout the whole Phanerozoic era. So almost all the species in Cat Dua Island can be found in Ha Long Bay or Cat Ba Island. Although Cat Dua Island and Hainan Island are separated by the Gulf of Tonkin, their flora are very similar. The limestone regions of Hainan Island is mainly distributed in Changjiang County and Baoting County, which lie on the east side of the Gulf of Tonkin. The authors had studied the flora of limestone in Hainan Island for several years. According to the present investigation, most species of Cat Dua Island are the same as those of Hainan Island, such as *Pterospermum heterophyllum*, *Mallotus repandus*, *Croton cascarilloides*, *Atalantia sessiliflora*, and *Murraya alata*. However, there are still some species of Cat Dua Island which can not be found in limestone areas in Hainan Island, such as *Triadica rotundifolium*, *Sarcostemma brevistigma*, *Chirita hamosa*, and the other seashore plants. It is interesting that the similar species in Cat Dua Island and in Hainan Island are used different scientific names, such as the *Impatiens verrucifer* in Vietnam is very similar to *I. hainanensis* in China in the wild. It is possible that they are the same species, and they should be studied carefully in the future. Maybe there are still some taxonomic problems in these species. According to our field survey in Cat Dua Island and Hainan Island, there are many alien plants in limestone

regions. They even invade the inside of forest and have the trend to spread. In some severely destroyed regions, the alien plants appear first and become the dominant species, such as *Chromolaena odoratum* and *Bidens alba*. Why the ecosystem in limestone areas seems to be more easily invaded than in non-limestone areas? Maybe there is some relationship between alien plants and calcareous soil.

Now environment worsening has become the global problem and this is particularly serious in karst areas. It's known that economic development in most karst areas has been relatively slow compared to that of urban areas. The high rate of population growth and a rapid economic development have caused a strong pressure on the environment in general and on karst ecosystems in particular. The biodiversity on the island should be protected for future generations. Encroachment of forest for establishment of farmland and plantation leads to destruction of the forest habitat. Unsustainable harvesting of forest products have caused gradual degradation of the ecosystem. Increasing human activities resulted from such harvesting activities and tourisms will lead to indirect impact, such as invasion of alien species. It is very important especially in developing countries that public education program should be launched to raise awareness of protecting the biodiversity. Participatory approach to regulate the utilization of forest resources and tourist activities would ensure sustainable development and conservation of the limestone ecosystems. In conclusion, some suggestions on efficient management in limestone areas defined by the Cat Dua Island are as follows:

- It has to have policies and regulations with regard to acceptable activities around the protected area. It is important to educate visitors' environmental awareness and determine the number of visitors. The number of visitors should be limited in different seasons.
- Advisory groups could be established to obtain some managerial advices. Scientific advisory groups could include members from international agencies and from local experts. The international cooperation and communion between experts and governments should be strengthened through holding international meetings periodically or carrying out some cooperative projects. It is necessary to make more and more people especially local people to attend the protection activities in karst regions.
- It has to strengthen the scientific researches in karst regions. Only if we have known what and where the plants are, we can decide to how to protect them efficiently. Some basic information such as the species number, distribution, endangered reasons of rare and endangered plants should be collected, which will provide a scientific basis for future policy-making.
- It is very important to prevent environment from being polluted. Waste disposal and treatment of visitors and staff should be considered and pollution of the underground water resources should be avoided. The correlative rules should be enacted and performed faithfully.

Appendix

Checklist of Plants on the Cat Dua Island

Families are arranged by Hutchinson System, dicotyledons 1926, monocotyledons 1934; genus and species are arranged alphabetically

Annonaceae

Annona squamosa L.

Dasymaschalon rostratum Merr. et Chun

Polyalthia petelotii Merr.

Lauraceae

Cassytha filiformis L.

Litsea glutinosa (Lour.) C.B.Rob.

Ranunculaceae

Clematis uncinata Champ. et Benth.

Menispermaceae

Stephania rotunda Lour.

Tinospora sinensis (Lour.) Merr.

Aristolochiaceae

Aristolochia pierrei Lecomte

Piperaceae

Piper sintenense Hatusima

Capparidaceae

Capparis floribunda Wight

Capparis hainanensis Oliv.

Violaceae

Rinorea anguifera (Lour.) O. Ktze.

Balsaminaceae

Impatiens verrucifer Hook.f.

Cucurbitaceae

Zehneria indica (Lour.) Keraudren

Hypericaceae

Cratoxylum cochinchinense (Lour.) Bl.

Sterculiaceae

Pterospermum heterophyllum Hance

Malvaceae

Hibiscus tiliaceus L.

Euphorbiaceae

Bridelia tomentosa Bl.

Croton cascarilloides Raeusch.

Croton laevigatus Vahl

Mallotus repandus (Willd.) Müll. Arg.

Triadica rotundifolia (Hemsley) Esser

Dichapetalaceae

Dichapetalum helferianum Pierre.

Caesalpinaceae

Bauhinia oxysepala Gagn.

Papilionaceae

Cajanus scarabaeoides (L.) Thouars

Canavalia maritima (Aubl.) Thou.

Dalbergia pinnata (Lour.) Prain

Dalbergia sp.

Derris marginata Benth.

Dunbaria henryi Y. C. Wu

Sophora tomentosa L.

Casuarinaceae

Casuarina equisetifolia L.

Ulmaceae

Celtis philippensis Blanco

Moraceae

Ficus amplissima Sm.

Ficus saxophila Bl.

Ficus superba var. *alongensis* (Gagn.) Corner

Ficus virens var. *sublanceolata* (Miq.) Corner

Urticaceae

Boehmeria zollingeriana Wedd.

Pilea peltata Hance

Pouzolzia zeylanica (L.) Benn. et R. Br.

Celastraceae

Euonymus tonkinensis Loes.

Maytenus diversifolia (Maxim.) D. Hou.

Rhamnaceae

Colubrina asiatica (L.) Brongn.

Vitaceae

Tetrastigma tonkinense Gagnep.

Tetrastigma pachyphyllum (Hemsl.) Chun

Vitis balansaeana Planch.

Rutaceae

Atalantia acuminata Huang

Atalantia sessiliflora Guill.

Glycosmis pentaphylla Corrêa

Murraya alata Drake

Murraya exotica L.

Murraya microphylla (Merr. et Chun) Swingle

Simaroubaceae

Picrasma chinensis P.Y. Chen

Sapindaceae

Allophylus viridis Radlk.

Arytera littoralis Bl.

Anacardiaceae

Pistacia weinmannifolia Poiss. ex Franch.

Rhus chinensis Mill.

Alangiaceae

Alangium salviifolium (L.f.) Wanger.

Sapotaceae

Sinosideroxylon pedunculatum (Hemsl.) H. Chung

Sinosideroxylon bonii Aubr.

Myrsinaceae

Embelia rudis Hand.-Mazz.

Oleaceae

Jasminum microcalyx Hance

Apocynaceae

Cerbera manghas L.

Asclepiadaceae

Sarcostemma brevistigma Wight & Arn.

Secamone elliptica R. Br.

Rubiaceae

Canthium umbellatum Wight

Mussaenda glabra Vahl

Mussaenda pilosissima Val.

Pavetta hongkongensis Bremek.

Spiradiclis sp.

Wendlandia sp.

Compositae

Bidens alba (L.) DC.

Chromolaena odoratum (L.) R. M. King & H. Rob.

Gynura divaricata (L.) DC.

Goodeniaceae

Scaevola sericea Vahl

Gesneriaceae

Chirita hamosa R. Br.

Verbenaceae

Callicarpa nudiflora Hook. et Arn.

Clerodendrum inerme (L.) Gaertn.

Vitex trifolia var. *simplicifolia* Cham.

Agavaceae

Dracaena cambodiana Pierre ex Gagnep.

Palmaceae

Cocos nucifera L.

Pandanaceae

Pandanus tectorius Sol.

Poaceae

Bothriochloa pertusa (L.) A. Cam.

Oplismenus compositus (L.) Beauv.

Stenotaphrum micranthum (Desv.) C. E. Hubb.

Acknowledgements

The work is supported by the National Natural Science Foundation of China (grant numbers 30270122), the Key Laboratory of Protection and Development Utilization of Tropical Crop Germplasm Resources, Ministry of Education, China (grant numbers 2010hckled-11), and the Natural Science Foundation of Hainan Province, China (grant numbers 311058).

References

- Anonymous. 2003. Halong bay Management Board. Ha Long Bay-a Natural World Heritage. HaLong, Quang Ninh: Vietnam, 74.
- Aubreville, A., N.L. Tardieu-Blot and J.E. Vidal. 1960-1994. *Flora du Cambodge, du Laos et du Vietnam* [M]. Paris: Museum national d'histoire naturelle (French).
- Chaghtai, S.M. and M. Yusaf. 1976. The ecology of the native vegetation of Kohat, NWFP, Pakistan. *Pak. J. Bot.*, 8: 27-36.
- Clements, R., N.S. Sodhi, M. Schilthuizen and P.K.I. Ng. 2006. Limestone karsts of Southeast Asia: Imperiled arks of biodiversity. *Bioscience*, 56(9): 733-742
- Furey, N. and M. Infield. 2007. Conservation of Limestone Karst Ecosystems in Vietnam: Challenges and Opportunities. *Tropical Forestry*, 35(S1): 57-67.
- Hiep, N.T. and R. Kiew. 2000. *Wild plants of Ha Long Bay*. Thanh Nien Publishing House: Tien Bo Printing Co., 4.
- Khan, S.M., D. Harper, S. Page and H. Ahmad. 2011. Residual value analyses of the medicinal flora of the Western Himalayas: the Naran Valley, Pakistan. *Pak. J. Bot.*, 43(S1): 97-104.
- Lecomte, H. 1907-1951. *Flora Générale de l'Indochine* [M]. Tome 1-7. Paris: Masson et. Cie Editeurs. (French).
- Pham, H.H. 1991-1993. *An Illustrated Flora in Vietnam* [M]. Ho Chi Minh City: Montreal.
- Tri, T.V. 2003. *Geology of Vietnam*. The North part. Sci. Tech. Publish House: Ha Noi: 353. (Vietnamese).