



**Report of Rapid Biodiversity Assessments at
Bawangling National Nature Reserve and
Wangxia Limestone Forest, Western Hainan,
3 to 8 April 1998**

Kadoorie Farm and Botanic Garden
in collaboration with
Hainan Provincial Forestry Department
South China Institute of Botany
South China Normal University
South China Institute of Endangered Animals

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Report of Rapid Biodiversity Assessments at Bawangling National Nature Reserve and Wangxia Limestone Forest, Western Hainan, 3 to 8 April 1998

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Background

The present report details the findings of a trip to Hainan by members of Kadoorie Farm and Botanic Garden (KFBG) in Hong Kong and their colleagues, as part of KFBG's South China Biodiversity Conservation Programme. The overall aim of the programme is to minimise the loss of forest biodiversity in the region, and the emphasis in the first two years is on gathering up-to-date information on the distribution and status of fauna and flora.

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Common geographical descriptions and their Chinese phonetics

English meaning	Chinese phonetics (pinyin)
East	dong
South	nan
West	xi
North	bei
mountain	shan
range	ling
peak	feng, ding
valley	keng, gu
island	dao
river	he, chuan, jiang
stream	xi, chong
lake	hu, chi
sea	hai
harbour	gang
bay	wan
outlet	kou
city	shi
county	xian
village	xiang, cun
hamlet	tun
the Chinese system of geomancy	feng shui

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Objectives

The first aim of the survey was to update previous information on the biota of Bawangling National Nature Reserve. This will facilitate identification of the components of the Hainan biota currently secure in the Reserve, the components still under threat and the components which are unprotected by the Reserve. The second aim was to investigate the biota of the limestone forest of Wangxia, approximately 20 km from Bawangling. This area has been proposed as a possible extension to the National Nature Reserve (Anon., 1998).

Methods

On 3 April the KFBG team (LC, JRF, BH, ML, LKS and GTR), joined by specialists from the South China Institute of Botany in Guangzhou (CBH, LZX and WRJ), the South China Institute for Endangered Animals in Guangzhou (GYR) and the South China Normal University in Guangzhou (LZC and YZS), drove from Haikou to Changjiang County in western Hainan to begin surveys of forests. Biologists from Hainan Normal College were invited to join the team, but were unable to attend due to teaching commitments. The team left Haikou at 09.00 and travelled, via Nada, Taibo and Changjiang towns, to Bawangling town (140 m), which was reached at 15.15. Rapid faunal and floral surveys were conducted from 3 to 8 April at Bawangling National Nature Reserve and the nearby Wangxia limestone forest. On 7 April the team was joined by a member (FJP) of the Hainan Provincial Forestry Department.

During fieldwork visual searching for plants, mammals, birds, reptiles, amphibians, fish, ants, butterflies and dragonflies was conducted. In addition, recordings of the calls of Hainan Hill Partridge and Hainan Peacock Pheasant were played to elicit the calls of any wild birds. Estimates of the status of large and medium-sized mammals (excluding Erinaceidae, Talpidae, Soricidae, Muridae and Chiroptera) at Bawangling were largely based on interviews with three local people, with reference to colour pictures, and on the Reserve's specimen collection. For purposes of these interviews a list of South China mammals was compiled from various sources including Chu *et al.* (1987), Corbet & Hill (1992) and Zhang Y. *et al.* (1997).

Plant records in this survey were made by field observation, with very few specimens collected. All vascular plant species encountered were noted and a checklist compiled by CBH, and edited by NSC. In the case of orchids, records were compiled by GS and listed separately, aided by more detailed information obtained in the field by an orchid specialist (LC). Mammal records were made by LKS, BH, GTR, ML or JRF. Records of birds were made or verified by LKS or GYR, reptiles and amphibians by ML or LZC, fish by BC and CXL, ants by JRF, butterflies by GTR, dragonflies by KW of Hong Kong, and rove beetles by GDR, formerly of Hong Kong.

Nomenclature in the report is standardised based, unless otherwise stated, on the following references:

- Flora (Pteridophyta, Gymnospermae and Angiospermae excluding Orchidaceae): Anon. (1996b-2000); Anon. (2001a); Anon. (1959-2000); and Anon. (2001b);
- Orchids (Angiospermae: Orchidaceae): Chen *et al.* (1999); Tsi *et al.* (1999) and Lang *et al.* (1999);
- Mammals (Mammalia): D.E. Wilson & Reeder (1993); D.E. Wilson & Cole (2000);
- Birds (Aves): Inskipp *et al.* (1996);
- Reptiles and Amphibians (Reptilia and Amphibia): Zhao *et al.* (2000), supplemented with Fei (1999);

- Fish (Actinopterygii): Nelson (1994); Wu *et al.* (1999);
- Ants (Insecta: Hymenoptera: Formicidae): named species according to Bolton (1995); unnamed species with reference numbers according to the collection currently held by KFBG.
- Dragonflies (Insecta: Odonata): Bridges (1994); Schorr *et al.* (2001a, 2001b); K.D.P. Wilson & Reels (2001);
- Butterflies (Insecta: Lepidoptera): Bascombe (1995);
- Rove Beetles (Insecta: Coleoptera: Staphylinidae): G. de Rougemont (unpublished).

Information on the global status of species is from IUCN publications, notably Hilton-Taylor (2000) and IUCN Species Survival Commission (2001). National status of orchids is based on Wang *et al.* (in press). Protected status in China is based on Hua & Yan (1993) for animals and Anon. (1999a) for plants. Certain taxa, including orchids, reptiles, amphibians, fish and invertebrates, have yet to be properly assessed for global status.

Location and management

Bawangling National Nature Reserve is in Changjiang and Baisha counties, West Hainan. It is listed at 19°02'-19°08'N by 109°02'-109°13'E (MacKinnon *et al.*, 1996); however, based on the use of a Global Positioning System in 1999, the correct coordinates should be 19°08'-19°15'N by 109°17'-109°25'E (W.V. Bleisch, pers. comm.). The reserve was established in 1980 with the major objective of protecting Crested Gibbon *Hylobates concolor*, Kalij Pheasant *Lophura leucomelana*, Grey Peacock Pheasant *Polyplectron bicalcaratum* and their habitats (MacKinnon *et al.*, 1996). Bawangling is listed as a National-level Wild Animal Nature Reserve (Zhang W., 1998), and is under the management of the provincial Forestry Department. It has three branch stations and 13 staff, including five police officials and four technicians (Anon., 1999b). The reserve size has been listed as 56 km² (MacKinnon *et al.*, 1996; Zhang W., 1998; Anon., 1999c). The altitudinal range is 300 to 1,438 m. Bawangling contains five townships, one farm and 15 villages, with a population of 30,000. Most of the residents are Li farmers, with an annual income of about RMB 700 (Anon., 1999b).

The rich timber resources in Bawangling have been exploited since the early 1950s. Due to historical reasons and recent economic development, the intensity of commercial logging has been increasing every year. Up to 1977, 27,000 m³ of timber were harvested, which significantly impacted the biological resources of Bawangling. After the 1980s the State Council changed the policy on native tropical forests in Hainan and in 1994 a complete ban on logging natural forest was imposed by the Hainan People's Congress. Thus the flora and fauna are now under a certain degree of protection.

Results

Vegetation

Bawangling and Wangxia have a tropical monsoon climate with a distinct wet and dry season. The floristic composition of Bawangling is dominated by tropical species but temperate species also occur at high altitudes. The dominant plant families include Papilionaceae, Euphorbiaceae, Rubiaceae, Myrtaceae, Sapindaceae, Lauraceae, Fagaceae, Dipterocarpaceae and Sapotaceae. The vegetation at Bawangling can be classified into ravine rainforest, mountain rainforest, mountain evergreen monsoon forest and mountain dwarf forest at higher altitude. At Wangxia, the floristic composition is dominated by tropical evergreen species and deciduous species. The vegetation at Wangxia is mainly composed of ravine rainforest at lower altitude in valleys, and semi-deciduous broadleaf forest on hills.

Flora

Table 1 lists the species of pteridophytes, gymnosperms and angiosperms (excluding Orchidaceae) found in the present survey. Table 2 lists Orchidaceae.

In total the survey recorded 322 species of angiosperms in 94 families (including 42 species of orchids), 12 species of gymnosperms in six families, and 18 species of ferns in 13 families. Due to an error in data storage, the plant inventories of Bawangling and Wangxia could not, with the exception of orchids, be separated.

Of the species recorded, the orchid *Phalaenopsis hainanensis* is Critically Endangered in China, and endemic to Hainan. *Pinus massoniana* var. *hainanensis* is globally Endangered, and four orchids (*Cymbidium sinense*, *Renanthera coccinea*, *Rhynchostylis gigantea* and *Vanda subconcolor*) are Endangered in China. *Calocedrus macrolepis*, *Alseodaphne hainanensis*, *Firmiana hainanensis*, *Amoora dasyclada* and *Aquilaria sinensis* are globally Vulnerable and Class II protected nationally; *Hydnocarpus hainanensis*, *Cephalotaxus mannii*, *Saccopetalum prolificum*, *Litchi chinensis* var. *euspontanea* and *Illicium ternstroemioides* are globally Vulnerable, and two orchids (*Anoectochilus roxburghii* and *Dendrobium densiflorum*) are Vulnerable in China. *Pinus fenzeliana*, *Pinus latteri* and *Dimocarpus longan* are Lower Risk (Near-threatened) globally. *Cycas taiwaniana* is a Class I protected species. *Alsophila spinulosa*, *Gymnosphaera podophylla*, *Sphaeropteris hainanensis*, *Cibotium barometz*, *Keteleeria hainanensis*, *Merrillanthus hainanensis* and *Cinnamomum camphora* are Class II protected. National protection status of orchids is currently under review, but all species recorded are listed under CITES Appendix II.

In addition to these threatened and protected species, 25 species that are endemic to Hainan (*Championella maclurei*, *Staurogyne sinica*, *Polyalthia consanguinea*, *Begonia peltatifolia*, *Sinosenecio hainanensis*, *Chirita heterotricha*, *Manglietia hainanensis*, *Aspidopterys obcordata* var. *hainanensis*, *Amoora tsangii*, *Stephenia hainanensis*, *Ardisia crassinervosa*, *Ardisia ordinata*, *Syzygium stenocladum*, *Pertusadina hainanensis*, *Hedyotis cryptantha*, *H. hainanensis*, *Saprosma hainanensis*, *S. merrillii*, *Populus qionghaoensis*, *Nephelium topengii*, *Tutcheria ovalifolia*, *Microcos chungii*, *Amomum chinense*, *Ceratostylis hainanensis* and *Dendrobium changjiangense*) were found.

Most of the above species occurred at Bawangling. Although the full list of species at Wangxia could not be separated, it included some of the above species of conservation concern, namely *Cephalotaxus mannii*, *Cycas taiwaniana*, *Amoora dasyclada*, *Chirita heterotricha*, *Dimocarpus longan*, *Firmiana hainanensis*, *Hydnocarpus hainanensis*, *Litchi chinensis* var. *euspontanea*, and *Saccopetalum prolificum*, as well as the 18 orchid species found. At least eight Hainan endemic species were recorded at Wangxia: *Ardisia crassinervosa*, *Amoora tsangii*, *Chirita heterotricha*, *Begonia peltatifolia*, *Firmiana hainanensis*, *Phalaenopsis hainanensis*, *Saprosma hainanense* and *Nephelium topengii*. A new record for Hainan, *Tropidia angulosa*, the primitive orchid, was also found at Wangxia. It is often found in well-protected limestone forests areas in Yunnan and Guangxi (Lang *et al.*, 1999)

Good forest indicators at Bawangling and Wangxia included *Alseodaphne hainanensis*, *Castanopsis hystrix*, *Dacrycarpus imbricatus* var. *patulus*, *Dacrydium pectinatum*, *Schima superba*, *Ficus altissima*, *Pinus massoniana* var. *hainanensis*, *Lannea coromandelica* and *Pentaphylax euryoides*. Among the 30 species of native orchids recorded in Bawangling, 83% of species (in 16 genera) were epiphytic; at Wangxia too, 83% of the 18 species (in 13 genera) were epiphytes. Such a high proportion of epiphytes is characteristic of tropical forests.

Although there had been several earlier botanical surveys of Bawangling and Wangxia, none of them have resulted in a published checklist. Thus it was not possible to compare the results of this and earlier surveys. In the case of orchids, there was a comprehensive account of

Orchidaceae in the Flora Hainanica Vol. 4 (Tang & Chen 1977), with some supplements subsequently (Chen 1980, Tang & Cheng 1982, Ding 1991 and Tsi *et al.* 1995). However, it is difficult to evaluate trends in plant occurrence based on rapid surveys such as the present one. Rather low numbers of orchids were recorded on the present survey; this could be due to its brevity, but might also reflect the results of over-collection of species with high ornamental value. For instance, *Dendrobium densiflorum* used to be widespread and common in Hainan (Tsi Z.H. & Xing F.W., pers. comm.), but is now vulnerable due to over-collection; most of the plants encountered were small clumps at a young stage, and it is now difficult to find large clumps with more than 12 mature stems in the wild. Similarly *Phalaenopsis hainanensis*, *Renanthera coccinea*, *Rhynchostylis gigantea* and *Cymbidium sinense* have all become endangered by over-collecting

Table 1. Vascular plant species recorded at Bawangling National Nature Reserve and Wangxia limestone forest from 4 to 8 April 1998. Species which are Nationally Protected (Class I or II) (Anon., 1999a), globally Threatened or Lower Risk (Near-threatened) (IUCN, 2001) or endemic to Hainan are indicated.

Family	Scientific name	Notes
PTERIDOPHYTA		
Aspleniaceae	<i>Neottopteris nidus</i> (L.) J. Sm.	epiphytic
	<i>Neottopteris phyllitidis</i> (D. Don) J. Sm.	
Blechnaceae	<i>Blechnum orientale</i> L.	
Cheiropleuriaceae	<i>Cheiropleuria bicuspis</i> (Blume) C. Presl	
Cyatheaceae	<i>Alsophila spinulosa</i> (Wall. ex Hook.) R.M. Tryon	Protected II
	<i>Gymnosphaera podophylla</i> (Hook.) Copel	Protected II
	<i>Sphaeropteris hainanensis</i> (Ching) R.M. Tryon	Protected II, endemic to Hainan
Dicksoniaceae	<i>Cibotium barometz</i> (L.) J. Sm.	Protected II
Drynariaceae	<i>Pseudodrynaria coronans</i> (Wall. ex Mett.) Ching	
Gleicheniaceae	<i>Dicranopteris ampla</i> Ching et P.C. Chiu	
	<i>Diplopterygium blotiana</i> (C. Chr.) Nakai	
Lindsaeaceae	<i>Lindsaea heterophylla</i> Dryand.	
Lycopodiaceae	<i>Palhinhaea cernua</i> (L.) Franco et Vasc.	
	<i>Phlegmariurus phlegmaria</i> (L.) Rauschert	
Lygodiaceae	<i>Lygodium digitatum</i> C. Presl	
Oleandraceae	<i>Nephrolepis cordifolia</i> (L.) C. Presl	
Pteridaceae	<i>Pteris ensiformis</i> Burm. f.	
Selaginellaceae	<i>Selaginella doederleinii</i> Hieron	
GYMNOSPERMAE		
Cephalotaxaceae	<i>Cephalotaxus mannii</i> Hook. f.	Vulnerable (IUCN)
Cupressaceae	<i>Calocedrus macrolepis</i> Kurz	Protected II, Vulnerable (IUCN)
Cycadaceae	<i>Cycas taiwaniana</i> Carruth.	Protected I
Gnetaceae	<i>Gnetum montanum</i> Markgr.	also seeds in civet scat (Viverridae)
Pinaceae	<i>Keteleeria hainanensis</i> Chun et Tsiang	Protected II, endemic to Hainan
	<i>Pinus fenzeliana</i> Hand.-Mazz.	Lower Risk (IUCN)
	<i>Pinus latteri</i> Mason	Lower Risk (IUCN)
	<i>Pinus massoniana</i> Lamb. var. <i>hainanensis</i> W.C. Cheng et L.K. Fu	Endangered (IUCN), endemic to Hainan
Podocarpaceae	<i>Dacrycarpus imbricatus</i> de Laub. var. <i>patulus</i> de Laub.	
	<i>Dacrydium pectinatum</i> de Laub.	
	<i>Nageia fleuryi</i> (Hickel) de Laub.	
	<i>Podocarpus nerrifolius</i> (Thunb.) Sweet	
ANGIOSPERMAE		
Dicotyledonae		
Acanthaceae	<i>Championella maclurei</i> (Merr.) C.Y. Wu et H.S. Lo	endemic to Hainan
	<i>Staurogyne sinica</i> C.Y. Wu et H.S. Lo	endemic to Hainan
Aceraceae	<i>Acer fabri</i> Hance	
Actinidiaceae	<i>Actinidia latifolia</i> (Gardner et Champ.) Merr.	
Alangiaceae	<i>Alangium salviifolium</i> (L. f.) Wangerin	
Anacardiaceae	<i>Buchanania microphylla</i> Engl.	
	<i>Lannea coromandelica</i> (Houtt.) Merr.	
	<i>Toxicodendron succedaneum</i> (L.) Kuntze	

Family	Scientific name	Notes
Ancistrocladaceae	<i>Ancistrocladus tectorius</i> (Lour.) Merr.	
Annonaceae	<i>Fissistigma polyanthum</i> (Hook. f. et Thomson) Merr. <i>Oncodostigma hainanense</i> (Merr.) Tsiang et P.T. Li <i>Polyalthia cerasoides</i> (Roxb.) Benth. et Hook. f. ex Bedd. <i>Polyalthia consanguinea</i> Merr. <i>Saccopetalum prolificum</i> (Chun et F.C. How) Tsiang <i>Uvaria microcarpa</i> Champ. ex Benth.	endemic to Hainan Vulnerable (IUCN)
Apocynaceae	<i>Hunteria zeylanica</i> (Retz.) Gardner ex Thwaites <i>Urceola micrantha</i> (Wall. ex G. Don) D.J. Middleton <i>Wrightia laevis</i> Hook. f. <i>Wrightia pubescens</i> R. Br.	
Aquifoliaceae	<i>Ilex ficoidea</i> Hemsl. <i>Ilex hainanensis</i> Merr.	
Araliaceae	<i>Aralia armata</i> (Wall.) Seem. <i>Heteropanax fragrans</i> (D. Don) Seem. <i>Schefflera arboricola</i> Hayata <i>Schefflera octophylla</i> (Lour.) Harms	
Aristolochiaceae	<i>Aristolochia hainanensis</i> Merr.	
Asclepiadaceae	<i>Dischidia chinensis</i> Champ. ex Benth. <i>Dregea volubilis</i> (L. f.) Benth. ex Hook. f. <i>Graphistemma pictum</i> (Champ. ex Benth.) Benth. et Hook. f. ex Maxim. <i>Marsdenia tinctoria</i> R. Br. <i>Merrillanthus hainanensis</i> Chun et Tsiang <i>Pentasachme caudatum</i> Wall. ex Wight <i>Sarcostemma acidum</i> (Roxb.) Voigt <i>Tylophora leptantha</i> Tsiang	Protected II
Asteraceae	<i>Dichrocephala auriculata</i> (Thunb.) Druce <i>Eupatorium odoratum</i> L. <i>Sinosenecio hainanensis</i> (C.C. Chang et Y.Q. Tseng) C. Jeffrey et Y.L. Chen <i>Vernonia solanifolia</i> Benth.	endemic to Hainan
Balsaminaceae	<i>Impatiens hainanensis</i> Y.L. Chen	
Begoniaceae	<i>Begonia peltatifolia</i> H.L. Li	endemic to Hainan
Betulaceae	<i>Betula alnoides</i> Buch.-Ham. ex D. Don <i>Carpinus londoniana</i> H.J.P. Winkl. var. <i>lanceolata</i> (Hand.-Mazz.) P.C. Li	
Bignoniaceae	<i>Radermachera frondosa</i> Chun et F.C. How <i>Radermachera hainanensis</i> Merr.	
Boraginaceae	<i>Ehretia longiflora</i> Champ. ex Benth.	
Burseraceae	<i>Canarium album</i> (Lour.) Raeusch.	
Caesalpiniaceae	<i>Peltophorum tonkinense</i> (Pierre) Gagnep.	
Campanulaceae	<i>Pratia nummularia</i> (Lam.) A. Br. et Aschers.	
Caprifoliaceae	<i>Lonicera macrantha</i> (D. Don) Spreng. <i>Viburnum odoratissimum</i> Ker Gawl.	
Caryophyllaceae	<i>Drymaria cordata</i> (L.) Willd. ex Roem. et Schult.	
Clusiaceae	<i>Cratoxylum cochinchinense</i> (Lour.) Blume <i>Garcinia multiflora</i> Champ. ex Benth.	
Connaraceae	<i>Connarus paniculatus</i> Roxb.	
Convolvulaceae	<i>Erycibe hainanensis</i> Merr. <i>Neuropeltis racemosa</i> Wall.	
Cucurbitaceae	<i>Solena amplexicaulis</i> (Lam.) Gandhi <i>Trichosanthes pedata</i> Merr. et Chun	
Dilleniaceae	<i>Dillenia pentagyna</i> Roxb. <i>Dillenia turbinata</i> Finet et Gagnep. <i>Tetracera asiatica</i> (Lour.) Hoogland (<i>T. sarmentosa</i> var. <i>asiatica</i>)	
Elaeocarpaceae	<i>Elaeocarpus sphaericus sphaericus</i> (Gaertn.) K. Schum. <i>Sloanea sinensis</i> (Hance) Hemsl.	
Escalloniaceae	<i>Itea macrophylla</i> Wall. ex Roxb.	
Euphorbiaceae	<i>Alchornea rugosa</i> (Lour.) Müll. Arg. <i>Antidesma bunius</i> (L.) Spreng. <i>Antidesma maclurei</i> Merr. <i>Aporusa dioica</i> (Roxb.) Müll. Arg. <i>Bischofia javanica</i> Blume <i>Breynia fruticosa</i> (L.) Hook. f.	

Family	Scientific name	Notes
Fagaceae	<i>Claoxylon hainanense</i> Pax et K. Hoffm.	
	<i>Croton cascarilloides</i> Raeusch.	
	<i>Endospermum chinense</i> Benth.	
	<i>Epiprinus siletianus</i> (Baill.) Croizat	
	<i>Excoecaria formosana</i> (Hayata) Hayata	
	<i>Glochidion lanceolarium</i> (Roxb.) Voigt	
	<i>Koilodepas hainanense</i> (Merr.) Airy Shaw	
	<i>Macaranga denticulata</i> (Blume) Müll. Arg.	
	<i>Mallotus hookerianus</i> (Seem.) Müll. Arg.	
	<i>Mallotus paniculatus</i> (Lam.) Müll. Arg.	
	<i>Phyllanthus emblica</i> L.	
	<i>Sapium discolor</i> (Champ. ex Benth.) Müll. Arg.	
	<i>Castanopsis fabri</i> Hance	
	<i>Castanopsis fissa</i> (Champ. ex Benth.) Rehder et E.H. Wilson	
	<i>Castanopsis hystrix</i> Miq.	
<i>Castanopsis tonkinensis</i> Seemen		
<i>Cyclobalanopsis championii</i> (Benth.) Oerst.		
<i>Cyclobalanopsis fleuryi</i> (Hickel et A. Camus) Chun ex Q.F. Zheng		
<i>Cyclobalanopsis hui</i> (Chun) Chun		
<i>Lithocarpus corneus</i> (Lour.) Rehder		
Flacourtiaceae	<i>Homalium paniculiflorum</i> F.C. How et W.C. Ko	
	<i>Hydnocarpus hainanensis</i> (Merr.) Sleumer	Vulnerable (IUCN)
Gesneriaceae	<i>Chirita heterotricha</i> Merr.	endemic to Hainan
Hamamelidaceae	<i>Exbucklandia tonkinensis</i> (Lecomte) Steenis	
	<i>Liquidambar formosana</i> Hance	
Icacinaceae	<i>Apodytes dimidiata</i> E. Mey. ex Arn.	
Illiciaceae	<i>Illicium ternstroemioides</i> A.C. Sm.	Vulnerable (IUCN)
Juglandaceae	<i>Engelhardtia spicata</i> Lesch. ex Blume var. <i>colebrookeana</i> (Lindl. ex Wall.) Koord. et Valetton	
	<i>Engelhardtia roxburghiana</i> Wall.	
Labiatae	<i>Scutellaria formosana</i> N.E. Brown var. <i>pubescens</i> C.Y. Wu et H.W. Li	
Lauraceae	<i>Alseodaphne hainanensis</i> Merr.	Protected II, Vulnerable (IUCN)
	<i>Beilschmiedia intermedia</i> C.K. Allen	
	<i>Cinnamomum camphora</i> (L.) J. Presl	Protected II
	<i>Cinnamomum porrectum</i> (Roxb.) Kosterm.	
	<i>Cryptocarya concinna</i> Hance	seeds in scat of civet (Viverridae)
	<i>Lindera metcalfiana</i> C.K. Allen	
	<i>Litsea baviensis</i> Lecomte	
	<i>Litsea cubeba</i> (Lour.) Pers.	
	<i>Machilus velutina</i> Champ. ex Benth.	
	<i>Phoebe hungmoensis</i> S.K. Lee	
Loganiaceae	<i>Buddleja asiatica</i> Lour.	
Loranthaceae	<i>Scurrula parasitica</i> L.	
Magnoliaceae	<i>Magnolia paenetalaua</i> Dandy	
	<i>Manglietia hainanensis</i> Dandy	endemic to Hainan
	<i>Michelia balansae</i> (Aug. DC.) Dandy	
	<i>Michelia mediocris</i> Dandy	
	<i>Parakmeria lotungensis</i> (Chun et C. H. Tsoong) Y. W. Law	
Malpighiaceae	<i>Aspidopterys obcordata</i> Hemsl. var. <i>hainanensis</i> Arènes	endemic to Hainan
Marantaceae	<i>Phrynium oliganthum</i> Merr.	
Melastomataceae	<i>Allomorphia balansae</i> Cogn.	
	<i>Blastus cochinchinensis</i> Lour.	
	<i>Melastoma sanguineum</i> Sims	
	<i>Memecylon ligustrifolium</i> Champ. ex Benth.	
	<i>Sonerila cantonensis</i> Stapf var. <i>strigosa</i> C. Chen	
Meliaceae	<i>Amoora dasyclada</i> (F.C. How et T. Chen) C.Y. Wu	Protected II, Vulnerable (IUCN)
	<i>Amoora tsangii</i> (Merr.) X.M. Chen	endemic to Hainan
	<i>Dysoxylum binectariferum</i> (Roxb.) Hook. f. ex Bedd.	
	<i>Walsura robusta</i> Roxb.	

Family	Scientific name	Notes
	<i>Canthium dicoccum</i> (Gaertn.) Teysmann et Binnedijk	
	<i>Geophila herbacea</i> (Jacq.) K. Schum.	
	<i>Hedyotis cryptantha</i> Dunn	endemic to Hainan
	<i>Hedyotis hainanensis</i> (Chun) S. C. Ko	endemic to Hainan
	<i>Lasianthus curtisii</i> King et Gamble	
	<i>Mussaenda erosa</i> Champ. ex Benth.	
	<i>Ophiorrhiza cantonensis</i> Hance	
	<i>Prismatomeris tetrandra</i> (Roxb.) K. Schum.	
	<i>Psychotria asiatica</i> L.	
	<i>Psychotria serpens</i> L.	epiphytic
	<i>Catunaregam spinosa</i> (Thunb.) Tirveng.	
	<i>Tarennoidea wallichii</i> (Hook. f.) Tirveng. et Sastre	
	<i>Saprosma hainanensis</i> Merr.	endemic to Hainan
	<i>Saprosma merrillii</i> H.S. Lo	endemic to Hainan
Rutaceae	<i>Evodia lepta</i> (Spreng.) Merr.	
	<i>Evodia glabrifolia</i> (Champ. ex Benth.) C.C. Huang	
	<i>Glycosmis craibii</i> Tanaka var. <i>glabra</i> (Craib) Tanaka	
	<i>Murraya euchrestifolia</i> Hayata	
	<i>Paramignya confertifolia</i> Swingle	
Sabiaceae	<i>Meliosma angustifolia</i> Merr.	
Salicaceae	<i>Populus qionghaoensis</i> T. Hong et P. Luo	endemic to Hainan
Sapindaceae	<i>Dimocarpus longan</i> Lour.	Lower Risk (IUCN)
	<i>Dodonaea viscosa</i> (L.) Jacq.	
	<i>Litchi chinensis</i> Sonn. var. <i>euspontanea</i> Hsue	Vulnerable (IUCN)
	<i>Nephelium topengii</i> (Merr.) H.S. Lo	endemic to Hainan
Schisandraceae	<i>Kadsura coccinea</i> (Lem.) A.C. Sm.	
Solanaceae	<i>Solanum lasiocarpum</i> Dunal	
Staphyleaceae	<i>Euscaphis konishii</i> Hayata	
Sterculiaceae	<i>Firmiana hainanensis</i> Kosterm.	Protected II, Vulnerable (IUCN)
	<i>Erythropsis pulcherrima</i> (H.H. Hsue) H.H. Hsue	
	<i>Kleinhovia hospita</i> L.	
	<i>Pterospermum heterophyllum</i> Hance	
	<i>Pterospermum lanceifolium</i> Roxb.	
	<i>Pterygota alata</i> (Roxb.) R. Br.	
	<i>Reevesia longipetiolata</i> Merr. et Chun	
	<i>Sterculia hainanensis</i> Merr. et Chun	
Styracaceae	<i>Alniphyllum fortunei</i> (Hemsl.) Makino	bark eaten by Sambar <i>Cervus unicolor</i>
Symplocaceae	<i>Symplocos anomala</i> Brand	
	<i>Symplocos glauca</i> (Thunb.) Koidz.	
	<i>Symplocos poilanei</i> Guill.	
Theaceae	<i>Adinandra hainanensis</i> Hayata	
	<i>Camellia assamica</i> (J.W. Mast.) H.T. Chang	
	<i>Cleyera obscurinervia</i> (Merr. et Chun) H.T. Chang	
	<i>Gordonia axillaris</i> (Roxb. ex Ker Gawl.) Dietr.	
	<i>Schima superba</i> Gardner et Champ.	
	<i>Tutcheria ovalifolia</i> H.L. Li	endemic to Hainan
Thymelaeaceae	<i>Aquilaria sinensis</i> (Lour.) Spreng.	Protected II, Vulnerable (IUCN)
Tiliaceae	<i>Microcos chungii</i> (Merr.) Chun	endemic to Hainan
Ulmaceae	<i>Gironniera subaequalis</i> Planch.	epiphytic
	<i>Trema orientalis</i> L. (Blume)	
	<i>Ulmus tonkinensis</i> Gagnep.	
Urticaceae	<i>Oreocnide integrifolia</i> (Gaudich.) Miq. ssp. <i>subglabra</i>	
	C.J. Chen	
	<i>Pellionia repens</i> (Lour.) Merr.	
	<i>Procris wightiana</i> Wall. ex Wedd.	
Verbenaceae	<i>Callicarpa rubella</i> Lindl.	
	<i>Stachytarpheta jamaicensis</i> (L.) Vahl	
	<i>Vitex negundo</i> L.	
Violaceae	<i>Viola hossei</i> W. Becker	
Viscaceae	<i>Viscum ovalifolium</i> DC.	
Vitaceae	<i>Cissus hexangularis</i> Thorel ex Planch.	
	<i>Tetrastigma planicaule</i> (Hook.) Gagnep.	

Family	Scientific name	Notes
Monocotyledonae		
Acoraceae	<i>Acorus gramineus</i> Sol. ex Aiton	
Agavaceae	<i>Dracaena cambodiana</i> Pierre ex Gagnep.	
Araceae	<i>Alocasia macrorrhiza</i> (L.) Schott	
	<i>Amorphophallus dunnii</i> Tutcher	
	<i>Anadendrum montanum</i> (Blume) Schott	
	<i>Pothos repens</i> (Lour.) Druce	
Areaceae	<i>Arenga pinnata</i> (Wurmb) Merr.	
	<i>Calamus tetradactylus</i> Hance	
	<i>Caryota mitis</i> Lour.	
	<i>Daemonorops margaritae</i> (Hance) Becc.	
	<i>Licuala fordiana</i> Becc.	
	<i>Livistona saribus</i> (Lour.) Merr. ex A. Chev.	
Commelinaceae	<i>Cyanotis arachnoidea</i> C.B. Clarke	
Cyperaceae	<i>Gahnia tristis</i> Nees	
	<i>Scleria terrestris</i> (L.) Fassett	
Liliaceae	<i>Aspidistra elatior</i> Blume	
	<i>Curculigo capitulata</i> (Lour.) Kuntze	
	<i>Dianella ensifolia</i> (L.) DC.	
	<i>Disporum sessile</i> D. Don	
	<i>Paris polyphylla</i> Sm. var. <i>chinensis</i> (Franch.) H. Hara	
	<i>Heterosmilax japonica</i> Kunth	
Poaceae	<i>Thysanolaena maxima</i> (Roxb.) Kuntze	
Taccaceae	<i>Tacca chantrieri</i> André	
Zingiberaceae	<i>Alpinia brevis</i> T. L. Wu et S. J. Chen	
	<i>Alpinia hainanensis</i> K. Schum.	
	<i>Alpinia maclurei</i> Merr.	
	<i>Amomum chinense</i> Chun	endemic to Hainan

Table 2. Orchids recorded in Bawangling National Nature Reserve and Wangxia limestone forest in April, 1998.

Scientific name	Habitat	Remarks
<i>Acampe rigida</i> (Buch.-Ham. ex Sm.) P.F. Hunt	on rock in exposed area	epiphytic
<i>Anoectochilus roxburghii</i> (Wall.) Lindl.	on forest floor with rich humus	terrestrial, Vulnerable in China
<i>Appendicula cornuta</i> Blume	on rock beside the stream	epiphytic
<i>Bulbophyllum ambrosia</i> (Hance) Schltr.	on tree trunk in forest	epiphytic
<i>Bulbophyllum delitescens</i> Hance	on tree trunk in forest	epiphytic
<i>Bulbophyllum</i> sp.1	on tree trunk in forest	epiphytic
<i>Bulbophyllum</i> sp.2	on tree trunk in sparse forest	epiphytic
<i>Calanthe triplicata</i> (Willemet) Ames	on the forest floor with rich humus	terrestrial
<i>Calanthe</i> sp.	on the forest floor with rich humus	terrestrial
<i>Cerastostylis hainanensis</i> Z.H. Tsi	on tree trunk in forest	epiphytic, endemic to Hainan
<i>Cleisostoma birmanicum</i> (Schltr.) Garay	on tree trunk in forest	epiphytic
<i>Cleisostoma parishii</i> (Hook.f.) Garay	on tree trunk in forest	epiphytic
<i>Cleisostoma simondii</i> (Gagnep.) Seidenf.	on rock in forest	epiphytic
<i>Cleisostoma</i> sp.	on tree trunk in forest	epiphytic
<i>Coelogyne fimbriata</i> Lindl.	on tree trunk in forest	epiphytic
<i>Cymbidium bicolor</i> Lindl. subsp. <i>Obtusum</i> Du Puy et Cribb	on tree trunk in forest	epiphytic
<i>Cymbidium lancifolium</i> Hook.	on forest floor with rich humus	terrestrial
<i>Cymbidium sinense</i> (Andr.) Willd.	on forest floor with rich humus	terrestrial, Endangered in China
<i>Cymbidium</i> c.f. <i>dayanum</i> Rchb. f.	on tree trunk in forest	epiphytic
<i>Dendrobium changjiangense</i> S.J. Cheng et C.Z. Tang	on rock and on tree trunk in forest	epiphytic, endemic to Hainan
<i>Dendrobium densiflorum</i> Lindl. ex Wall.	on tree trunk and on rock in forest	epiphytic, Vulnerable in China

Scientific name	Habitat	Remarks
<i>Dendrobium hainanensis</i> Rolfe	on tree trunk and on rock in forest	epiphytic
<i>Dendrobium lindleyi</i> Steud.	on tree trunk in forest	epiphytic
<i>Dendrobium williamsonii</i> Day et Rchb. f.	on tree trunk in forest	epiphytic
<i>Dendrobium</i> c.f. <i>aduncum</i> Lindl.	on tree trunk in forest	epiphytic
<i>Diploprora championi</i> (Lindl. ex Benth.) Hook. f.	on rock in sparse forest	epiphytic
<i>Eria pannea</i> Lindl.	on tree trunk in forest	epiphytic
<i>Eria thao</i> Gagnep.	on tree trunk in forest	epiphytic
<i>Eria</i> c.f. <i>obvia</i> W.W. Smith	on tree trunk in forest	epiphytic
<i>Flickingeria fimbriata</i> (Blume) A.D. Hawkes	on tree trunk in forest	epiphytic
<i>Goodyera procera</i> (Ker Gawl.) Hook.	on mossy rock beside the stream	terrestrial
<i>Liparis luteola</i> Lindl.	on mossy rock beside the stream in forest	epiphytic
<i>Liparis</i> c.f. <i>bootanensis</i> Griff.	on mossy rock in forest	epiphytic
<i>Malaxis latifolia</i> Sm.	on forest floor with rich humus	terrestrial
<i>Oberonia</i> sp.	on tree trunk in forest	epiphytic
<i>Phalaenopsis hainanensis</i> T. Tang et F.T. Wang	on tree trunk in forest	epiphytic, endemic to Hainan, Critically Endangered in China
<i>Pholidota chinensis</i> Lindl.	on tree trunk in forest	epiphytic
<i>Renanthera coccinea</i> Lour.	in margin of the forest, exposed	epiphytic, Endangered
<i>Rhynchostylis gigantea</i> (Lindl.) Ridl.	on tree trunk in sparse forest	epiphytic, Endangered in China
<i>Robiquetia spathulata</i> (Blume) J.J. Sm.	on tree trunk in forest	epiphytic
<i>Tropidia angulosa</i> (Lindl.) Blume	on forest floor with rich humus	terrestrial, new record for Hainan
<i>Vanda subconcolor</i> T. Tang et F.T. Wang	on tree trunk and on rock in forest	epiphytic, Endangered in China

Mammals

Six individuals of Maritime Striped Squirrel *Tamiops maritimus*, three Pallas's Squirrel *Callosciurus erythraeus* and one Red-hipped Squirrel *Dremomys pyrrhomerus* were seen (Table 3). A dead Indian Muntjac *Muntiacus muntjak* was brought to Bawangling town on 8 April by a hunter.

A giant flying squirrel was seen on 7 April 1998 at 20.50. It appeared to be Indian Giant Flying Squirrel *Petaurista philippensis*. This is referred to as *P. hainana* in Chinese literature (e.g. Liao *et al.*, 1983); Corbet & Hill (1992) regarded *P. hainana* as a synonym of *P. philippensis*.

The most striking record made in this trip was Crested Gibbon *Hylobates concolor*. On 7 April 1998, LC, JRF, LKS, BH and Chen Qing (the local guide who acted as the field assistant of Prof. Liu Zhenhe, South China Institute of Endangered Animals, for a 7-year research study on Crested Gibbon) heard a male call at about 7 a.m. The next morning Chen Qing, JRF, LKS, ML and GTR came to a site and found a group of five gibbons. The group comprised one adult male, two adult females, one infant and a black juvenile. The black juvenile could either be a male or an immature female. The gibbons were foraging on the same fruiting tree. The team observed the gibbons for about half an hour before being spotted by the adult male. The female and the juvenile gibbons left the tree first, and the adult male left about two minutes after the others.

Table 3. Direct records of mammals made in Bawangling, 3-8 April 1998.

Scientific name	English name	Date	Time	Observers	Notes
<i>Hylobates concolor</i>	Crested Gibbon	07/04	08.30	LC, BH, LKS, JRF, Chen Q.	the male's call was heard several times
		08/04	07.00	LKS, GTR, ML, JRF, Chen Q.	foraging on a fruiting <i>Ficus altissima</i>
<i>Muntiacus muntjak</i>	Indian Muntjac	08/04	14.00	BH	brought by a local hunter to a restaurant at Bawangling town
<i>Callosciurus erythraeus</i>	Pallas's Squirrel	07/04	09.15	BH, LKS, JRF	foraging on a fruiting <i>Ficus altissima</i>
		07/04	12.50	LKS	foraging on a tree
		07/04	16.00	LKS	foraging on a banana tree
<i>Dremomys pyrrhomerus</i>	Red-hipped Squirrel	07/04	18.25	LKS	foraging on a tree
<i>Tamiops maritimus</i>	Maritime Striped Squirrel	06/04	17.00	GTR	running along stream bank
		05/04	10.15	BH, LKS, JRF, GTR, ML	foraging on a tree about 25m tall
		07/04	08.30	BH, LKS, JRF	foraging on a fruiting <i>Ficus altissima</i>
<i>Petaurista philippensis</i> (<i>P. hainana</i>)	Indian Giant Flying Squirrel	07/04	18.25	LKS	foraging on a tree
		07/04	20.50	Chen Q., ML, LKS, BH, GTR, JRF	in the canopy of a tall (20m) tree

The grunt of a large mammal was heard at 16.20 on 4 April. The local guide Mr. Chen Xiaowei followed it and reported that it was a Sambar *Cervus unicolor*.

In addition to the direct records, a pile of civet scats was seen on the trunk of a fallen tree (about 20 cm dbh) inside one of the forests. The scats contained ten *Gnetum montanum* seeds. The scats were probably left by Masked Palm Civet *Paguma larvata* or Asian Palm Civet *Paradoxurus hermaphroditus*; however, it is also possible that they were left by Small Indian Civet *Viverricula indica*. Another pile of scats was on top of a boulder, inside another forest. The scats contained many *Cryptocarya concinna* seeds. The scats were also left by one of these three civet species.

Some claw marks were seen on a tree (about 20cm dbh) in a forest. These were two to four metres above the ground; each consisted of three parallel marks, 12 to 13 mm apart, about 15 cm in length and oriented vertically. According to the local guide Mr. Chen Xiaowei, the claw marks were made by Clouded Leopard *Neofelis nebulosa*, but according to one mammalogist they were more likely made by a young Asiatic Black Bear *Ursus thibetanus* (Wang Yingxiang, pers. comm.). Additional claw marks were seen on a tree in another forest. These comprised 3 to 4 marks, 13 mm apart, about 5 cm in length, oriented diagonally or almost horizontally. According to the local guide Mr. Chen Xiaowei, the claw marks were made by Asiatic Black Bear. Mr Chen also reported seeing a black bear in 1991.

Three local people were interviewed about the status of mammals in Bawangling using colour pictures (Table 4). They included Mr. Chen Xiaowei, Reserve Warden, Mr. Chen Qing, Nature Warden and Mr. Yu Dequn, former field assistant to GYR. Mr. Chen Qing appeared to be the most familiar with the mammals, and could correctly name almost all of the species on the list. Table 4 includes species reported to occur at Bawangling, with an indication of local status based on the interviews and on specimens held at the reserve.

Table 4. The status of mammals (excluding Erinaceidae, Talpidae, Soricidae, Muridae and Chiroptera) at Bawangling National Nature Reserve, Hainan based on interviewing Mr. Chen Xiawei, Mr. Chen Qing, and Mr. Yu Dequn. Mammal specimens collected from the reserve area and stored in the reserve's specimen room were also noted. Species names and sequence follow D.E. Wilson & Cole (2000), synonyms and names commonly used by Chinese scientists are included in brackets.

Scientific name	English name	Specimen	Probable status
<i>Tupaia belangeri</i>	Northern Tree Shrew		present
<i>Macaca mulatta</i>	Rhesus Monkey		insecure
<i>Hylobates concolor</i>	Crested Gibbon	✓	insecure
<i>Manis pentadactyla</i>	Chinese Pangolin	✓	insecure
<i>Prionailurus bengalensis</i> (= <i>Felis bengalensis</i>)	Leopard Cat	✓	insecure
<i>Neofelis nebulosa</i> (= <i>Neofelis nebulosa</i>)	Clouded Leopard		insecure
<i>Herpestes javanicus</i> (= <i>H. auropunctatus</i>)	Javan Mongoose	✓	insecure
<i>Amblyonyx cinereus</i>	Oriental Small-clawed Otter		insecure
<i>Melogale moschata</i>	Chinese Ferret-badger	✓	present
<i>Mustela kathiah</i>	Yellow-bellied Weasel		present
<i>Ursus thibetanus</i>	Asiatic Black Bear		insecure
<i>Paguma larvata</i>	Masked Palm Civet	✓	present
<i>Paradoxurus hermaphroditus</i>	Asian Palm Civet	✓	present
<i>Viverra zibetha</i>	Large Indian Civet		insecure
<i>Viverricula indica</i>	Small Indian Civet		present
<i>Sus scrofa</i>	Wild Boar		present
<i>Cervus unicolor</i>	Sambar		present
<i>Muntiacus muntjak</i>	Indian Muntjac	✓	present
<i>Callosciurus erythraeus</i>	Pallas's Squirrel	✓	present
<i>Dremomys pyrrhomerus</i>	Red-hipped Squirrel	✓	present
<i>Ratufa bicolor</i>	Black Giant Squirrel	✓	insecure
<i>Tamiops maritimus</i> (= <i>T. swinhoei hainanus</i>)	Maritime Striped Squirrel	✓	present
<i>Belomys pearsonii</i>	Hairy-footed Flying Squirrel	✓	insecure
<i>Petaurista philippensis</i> (= <i>P. hainana</i>)	Indian Giant Flying Squirrel	✓	insecure
<i>Atherurus macrourus</i>	Asiatic Brush-tailed Porcupine		insecure
<i>Hystrix brachyura</i> (= <i>H. hodgsoni</i>)	Chinese Porcupine		insecure
<i>Lepus hainanus</i>	Hainan Hare		present

Of the highest concern is Crested Gibbon, listed as a globally Endangered species by IUCN and Class I protected in China. The Hainan subspecies is now entirely confined to Bawangling. Recent evidence indicates that this may be a separate species from *H. concolor*; it has been termed the Eastern Black Crested Gibbon *Nomascus cf. nasutus* sp. (Geissmann *et al.*, 2000). Populations of crested gibbons east of the Red River in Vietnam may also belong to this species, but it is uncertain whether any of them survive; the species is thought to be the most endangered primate in the world (Geissman *et al.*, 2000). According to Chen Qing, there were four groups and a total of 17 individuals of Crested Gibbon in the reserve. This is also the official figure cited by the reserve management and the Forestry Department.

Of other species reported to occur, Clouded Leopard is considered globally Vulnerable, and Category I protected in China. Asiatic Black Bear and Hainan Hare *Lepus hainanus* are globally Vulnerable, and Category II protected in China. Chinese Porcupine *Hystrix brachyura* is listed as globally Vulnerable. Rhesus Monkey *Macaca mulatta*, Chinese Pangolin *Manis pentadactyla* and Oriental Small-clawed Otter *Amblyonyx cinerea* are considered globally Lower Risk (Near-threatened), and Category II protected in China. Large Indian Civet *Viverra zibetha*, Small Indian Civet, Black Giant Squirrel *Ratufa bicolor* and Sambar are Category II protected species in China.

Some of the species reported, notably Crested Gibbon and Clouded Leopard, are believed to be largely confined to primary forest in South China. Others, such as Asiatic Black Bear and the flying squirrels, are probably dependent on primary or high-integrity secondary forest.

Birds

One hundred and three bird species were recorded from the Bawangling area between 3 and 8 April (Table 5). Seventy-nine species were recorded inside the National Nature Reserve. The most frequently-encountered species at Bawangling were Black-browed Barbet *Megalaima oorti*, Mountain Bulbul *Hypsipetes mccllellandii*, Black Bulbul *Hypsipetes leucocephalus*, Thick-billed Pigeon *Treron curvirostra*, Grey-cheeked Fulvetta *Alcippe morrisonia*, Grey-chinned Minivet *Pericrocotus solaris*, Crested Goshawk *Accipiter trivirgata*, Hainan Blue Flycatcher *Cyornis hainanus* and Fork-tailed Swift *Apus pacificus*. The most frequently encountered species at Wangxia were Black-browed Barbet, Large Hawk Cuckoo *Hierococcyx sparverioides*, Grey-cheeked Fulvetta, Chestnut Bulbul *Hemixos castanonotus*, Rufous-capped Babbler *Stachyris ruficeps* and Puff-throated Bulbul *Alophoixus pallidus*. Most frequent at Mingwanghe were Shikra *Accipiter badius*, Light-vented Bulbul *Pycnonotus sinensis*, Olive-backed Sunbird *Nectarinia jugularis* and Chinese Francolin *Francolinus pintadeanus*.

Table 5. Birds recorded at Bawangling and Wangxia in the present survey on 3-8 April 1998, and other species recorded between 1987 and 1999 (^A King & Liao, 1988; ^B Hornskov, 1989; ^C Ho, in litt.; ^D Gao, in press). Birds occurring in the reserve's specimen collection are also noted. Sequence based on Clements (2000).

Scientific name	English name	Literature record	Specimen
<i>Milvus migrans</i>	Black Kite		
<i>Spilornis cheela</i>	Crested Serpent Eagle		
<i>Accipiter trivirgatus</i>	Crested Goshawk		✓
<i>Accipiter badius</i>	Shikra		
<i>Accipiter soloensis</i>	Chinese Sparrowhawk		
<i>Accipiter nisus</i>	Eurasian Sparrowhawk	C	✓
<i>Ictinaetus malayensis</i>	Black Eagle	A	
<i>Spizaetus nipalensis</i>	Mountain Hawk Eagle		
<i>Falco tinnunculus</i>	Common Kestrel	C	
<i>Francolinus pintadeanus</i>	Chinese Francolin		
<i>Arborophila ardens</i>	Hainan Partridge		
<i>Lophura nycthemera</i>	Silver Pheasant		✓
<i>Polyplectron katsumatae</i>	Hainan Peacock Pheasant	B D	
<i>Scolopax rusticola</i>	Eurasian Woodcock	B	
<i>Streptopelia chinensis</i>	Spotted Dove		
<i>Macropygia unchall</i>	Barred Cuckoo Dove	B	
<i>Chalcophaps indica</i>	Emerald Dove		
<i>Treron curvirostra</i>	Thick-billed Green Pigeon		✓
<i>Ducula badia</i>	Mountain Imperial Pigeon		✓
<i>Psittacula alexandri</i>	Red-breasted Parakeet	B	
<i>Hierococcyx sparverioides</i>	Large Hawk Cuckoo		
<i>Hierococcyx fugax</i>	Hodgson's Hawk Cuckoo		
<i>Cuculus micropterus</i>	Indian Cuckoo		
<i>Cuculus poliocephalus</i>	Lesser Cuckoo	B	
<i>Surniculus lugubris</i>	Drongo Cuckoo		
<i>Centropus sinensis</i>	Greater Coucal		✓
<i>Centropus bengalensis</i>	Lesser Coucal	B	
<i>Otus spilocephalus</i>	Mountain Scops Owl		
<i>Otus bakkamoena</i>	Collared Scops Owl		
<i>Strix leptogrammica</i>	Brown Wood Owl	A B	
<i>Glaucidium brodiei</i>	Collared Owlet		
<i>Glaucidium cuculoides</i>	Asian Barred Owlet		
	unidentified large owl sp.		
	unidentified owl sp.		
<i>Caprimulgus indicus</i>	Grey Nightjar		
<i>Caprimulgus macrurus</i>	Large-tailed Nightjar	A	
<i>Hirundapus caudacutus</i>	White-throated Needletail		

Scientific name	English name	Literature record	Specimen
<i>Hirundapus cochinchinensis</i>	Silver-backed Needletail		
<i>Cypsiurus balasiensis</i>	Asian Palm Swift		
<i>Apus pacificus</i>	Fork-tailed Swift		
<i>Apus affinus</i>	House Swift		
<i>Harpactes erythrocephalus</i>	Red-headed Trogon		
<i>Alcedo atthis</i>	Common Kingfisher	B	
<i>Halcyon pileata</i>	Black-capped Kingfisher		
<i>Halcyon smyrnensis</i>	White-throated Kingfisher	A	
<i>Nyctornis athertoni</i>	Blue-bearded Bee-eater	C	✓
<i>Eurystomus orientalis</i>	Dollarbird		
<i>Megalaima oorti</i>	Black-browed Barbet		✓
<i>Dendrocopos canicapillus</i>	Grey-capped Pygmy Woodpecker		
<i>Picus chlorolophus</i>	Lesser Yellownape		
<i>Picus flavinucha</i>	Greater Yellownape	A B	
<i>Blythipicus pyrrhotis</i>	Bay Woodpecker		✓
<i>Serilophus lunatus</i>	Silver-breasted Broadbill		
<i>Pitta soror</i>	Blue-rumped Pitta	B	
<i>Hirundo rustica</i>	Barn Swallow		
<i>Motacilla alba</i>	White Wagtail		
<i>Motacilla cinerea</i>	Grey Wagtail		
<i>Anthus hodgsoni</i>	Olive-backed Pipit		
<i>Coracina macei</i>	Large Cuckooshrike		
<i>Coracina melaschistos</i>	Black-winged Cuckooshrike		
<i>Pericrocotus flammeus</i>	Scarlet Minivet		✓
<i>Pericrocotus solaris</i>	Grey-chinned Minivet		
<i>Pycnonotus sinensis</i>	Light-vented Bulbul		
<i>Alophoixus pallidus</i>	Puff-throated Bulbul		
<i>Hypsipetes leucocephalus</i>	Black Bulbul		
<i>Hemixos castanonotus</i>	Chestnut Bulbul		
<i>Hypsipetes mcclllandii</i>	Mountain Bulbul		
<i>Chloropsis hardwickii</i>	Orange-bellied Leafbird		
<i>Monticola solitarius</i>	Blue Rock Thrush		
<i>Zoothera citrina</i>	Orange-headed Thrush	A	
<i>Turdus merula</i>	Eurasian Blackbird		✓
<i>Turdus obscurus</i>	Eyebrowed Thrush		
<i>Cisticola juncidis</i>	Zitting Cisticola		
<i>Prinia flaviventris</i>	Yellow-bellied Prinia		
<i>Prinia inornata</i>	Plain Prinia	B	
<i>Orthotomus cuculatus</i>	Mountain Tailorbird		
<i>Phylloscopus fuscatus</i>	Dusky Warbler		
<i>Phylloscopus proregulus</i>	Pallas's Leaf Warbler	C	
<i>Phylloscopus inornatus</i>	Yellow-browed Warbler		
<i>Phylloscopus hainanus</i>	Hainan Leaf Warbler		
<i>Phylloscopus ricketti</i>	Sulphur-breasted Warbler	A B	
<i>Abroscopus albogularis</i>	Rufous-faced Warbler		
<i>Ficedula mugimaki</i>	Mugimaki Flycatcher		
<i>Cyanoptila cyanomelana</i>	Blue and White Flycatcher	C	
<i>Cyornis hainanus</i>	Hainan Blue Flycatcher		
<i>Cyornis unicolor</i>	Pale Blue Flycatcher		
<i>Tarsiger cyanurus</i>	Red-flanked Bluetail		
<i>Copsychus saularis</i>	Magpie Robin	B	✓
<i>Copsychus malabaricus</i>	White-rumped Shama	A B	
<i>Myiomela leucura</i>	White-tailed Robin		
<i>Enicurus schistaceus</i>	Slaty-backed Forktail		
<i>Enicurus leschenaulti</i>	White-crowned Forktail		
<i>Rhipidura albicollis</i>	White-throated Fantail		
<i>Terpsiphone atrocaudata</i>	Japanese Paradise-flycatcher		
<i>Hypothymis azurea</i>	Black-naped Monarch	A	
<i>Garrulax monileger</i>	Lesser Necklaced Laughingthrush	A	
<i>Garrulax pectoralis</i>	Greater Necklaced Laughingthrush		✓
<i>Garrulax maesi</i>	Grey Laughingthrush		
<i>Garrulax canorus</i>	Hwamei	A	
<i>Pomatorhinus hypoleucos</i>	Large Scimitar Babbler		
<i>Pomatorhinus ruficollis</i>	Streak-breasted Scimitar Babbler		
<i>Napothera epilepidota</i>	Eye-browed Wren-babbler	A	

Scientific name	English name	Literature record	Specimen
<i>Stachyris ruficeps</i>	Rufous-capped Babbler		
<i>Stachyris striolata</i>	Spot-necked Babbler	A	
<i>Pteruthius flaviscapis</i>	White-browed Shrike Babbler		
<i>Pteruthius aenobarbus</i>	Chestnut-fronted Shrike Babbler		
<i>Minla cyanouroptera</i>	Blue-winged Minla	B	
<i>Alcippe brunnea</i>	Dusky Fulvetta		
<i>Alcippe morrisonia</i>	Grey-cheeked Fulvetta		
<i>Yuhina zantholeuca</i>	White-bellied Yuhina		
<i>Paradoxornis gularis</i>	Grey-headed Parrotbill		
<i>Parus major</i>	Great Tit		
<i>Parus spilonotus</i>	Yellow-cheeked Tit		
<i>Melanochlora sultanea</i>	Sultan Tit		
<i>Sitta solangiae</i>	Yellow-billed Nuthatch		
<i>Nectarinia jugularis</i>	Olive-backed Sunbird		
<i>Aethopyga christinae</i>	Fork-tailed Sunbird	A	
<i>Dicaeum ignipectus</i>	Fire-breasted Flowerpecker		
<i>Dicaeum cruentatum</i>	Scarlet-backed Flowerpecker	A	
<i>Zosterops japonicus</i>	Japanese White-eye		
<i>Oriolus chinensis</i>	Black-naped Oriole	C	
<i>Oriolus traillii</i>	Maroon Oriole		
<i>Lanius cristatus</i>	Brown Shrike		✓
<i>Lanius schach</i>	Long-tailed Shrike		
<i>Tephrodornis gularis</i>	Large Woodshrike		
<i>Dicrurus macrocercus</i>	Black Drongo		
<i>Dicrurus leucophaeus</i>	Ashy Drongo	A	
<i>Dicrurus annectans</i>	Crow-billed Drongo		
<i>Dicrurus aeneus</i>	Bronzed Drongo		
<i>Dicrurus paradiseus</i>	Greater Racket-tailed Drongo		
<i>Urocissa whiteheadi</i>	White-winged Magpie		✓
<i>Cissa chinensis</i>	Common Green Magpie		✓
<i>Cissa hypoleuca</i>	Indochinese Green Magpie		
<i>Dendrocitta formosae</i>	Grey Treepie		✓
<i>Sturnus sinensis</i>	White-shouldered Starling	A	
<i>Passer montanus</i>	Eurasian Tree Sparrow	A	
<i>Lonchura striata</i>	White-rumped Munia	A	
<i>Lonchura punctulata</i>	Scaly-breasted Munia		
<i>Emberiza pusilla</i>	Little Bunting		

Two new records for Hainan were made during this survey: Slaty-backed Forktail *Enicurus schistaceus* and Mountain Tailorbird *Orthotomus cuculatus*.

The following species were recorded in Bawangling from the 1960s to the 1980s (Liao *et al.*, 1983), but have not been reported in recent years: Yellow-legged Buttonquail *Turnix tanki*, Barred Buttonquail *Turnix suscitator*, White-breasted Waterhen *Amaurornis phoenicurus*, Greater Painted-snipe *Rostratula benghalensis*, Little Ringed Plover *Charadrius dubius*, Green Sandpiper *Tringa ochropus*, Common Sandpiper *Actitis hypoleucos*, Common Snipe *Gallinago gallinago*, Red Collared Dove *Streptopelia tranquebarica*, Green-billed Malkoha *Phaenicophaeus tristis*, Eurasian Hoopoe *Upupa epops*, Rufous Woodpecker *Celeus brachyurus*, Grey-headed Woodpecker *Picus canus*, Great Spotted Woodpecker *Dendrocopos major*, Asian House Martin *Delichon dasypus*, Red-throated Pipit *Anthus cervinus*, Japanese Thrush *Turdus cardis*, Eurasian Blackbird *Turdus merula*, Pale-footed Bush Warbler *Cettia pallidipes*, Brown Bush Warbler *Bradypterus luteoventris*, Lanceolated Warbler *Locustella lanceolata*, Radde's Warbler *Phylloscopus schwarzi*, Greenish Warbler *Phylloscopus trochiloides*, Asian Brown Flycatcher *Muscicapa dauurica*, Rufous-tailed Robin *Luscinia sibilans*, Plumbeous Water Redstart *Rhyacornis fuliginosus*, Brown Shrike, Plain Flowerpecker *Dicaeum concolor*, Large-billed Crow *Corvus macrorhynchus*, Crested Myna *Acridotheres cristatellus* and Hill Myna *Gracula religiosa*. Further surveys would be required to confirm the continued occurrence of these species.

Among the species recorded, the endemic Hainan Partridge *Arborophila ardens* is listed as globally Vulnerable, and Category II protected in China. Another Hainan endemic, Hainan Leaf Warbler *Phylloscopus hainanus*, is listed as globally Vulnerable. Blue-rumped Pitta *Pitta soror* is Category II protected in China. Japanese Paradise-flycatcher *Terpsiphone atrocaudata* and Yellow-billed Nuthatch *Sitta solangiae* are Lower Risk (Near-threatened) species globally. Hainan Peacock Pheasant *Polyplectron katsumatae*, Silver Pheasant *Lophura nycthemera*, Black Kite *Milvus migrans*, Shikra, Chinese Goshawk *Accipiter soloensis*, Eurasian Sparrowhawk *Accipiter nisus*, Mountain Hawk Eagle *Spizaetus nipalensis*, Black Eagle *Ictinaetus malayensis*, Crested Serpent Eagle *Spilornis cheela*, Common Kestrel *Falco tinnunculus*, Thick-billed Green Pigeon, Mountain Imperial Pigeon *Ducula badia*, Barred Cuckoo Dove *Macropygia unchall*, Red-breasted Parakeet *Psittacula alexandri*, Greater Coucal *Centropus sinensis*, Lesser Coucal *Centropus bengalensis*, Mountain Scops Owl *Otus spilocephalus*, Brown Wood Owl *Strix leptogrammica*, Collared Scops Owl *Otus bakkamoena*, Collared Owlet *Glaucidium brodiei*, Asian Barred Owlet *Glaucidium cuculoides*, Silver-backed Needletail *Hirundapus cochinchinensis* and Silver-breasted Broadbill *Serilophus lunatus* are all Class II protected species in China.

Reptiles and Amphibians

A total of 19 species of amphibians, nine species of lizards, six species of snakes and one species of terrapin were found at Bawangling (Table 6). The most frequently encountered species were *Amolops torrentis* (a Hainan endemic) and *Philautus ocellatus*. Hainan endemics such as *Amolops hainanensis*, *Rana fragilis* and *Buergeria oxycephala* were also present. At Wangxia, four species of amphibians and five species of lizards were found.

Table 6. Amphibians and reptiles of Bawangling and neighbouring sites in each major habitat. Sequence follows Zhao & Adler (1993).

Species	Habitat
AMPHIBIA	
<i>Leptobranchium hainanensis</i>	stream forest
<i>Bufo melanostictus</i>	stream village plantation
<i>Amolops hainanensis</i>	stream
<i>Amolops torrentis</i>	stream
<i>Occidozyga martensii</i>	stream
<i>Rana fragilis</i>	stream
<i>Rana guentheri</i>	stream
<i>Rana livida</i>	stream
<i>Rana limnocharis</i>	pond stream abandoned field plantation
<i>Rana spinulosa</i>	stream
<i>Rana taipehensis</i>	stream
<i>Buergeria oxycephala</i>	stream
<i>Philautus ocellatus</i>	forest forest edge
<i>Philautus odontotarsus</i>	stream forest
<i>Polypedates megacephalus</i>	pond stream
<i>Polypedates mutus</i>	forest
<i>Microhyla heymonsi</i>	stream forest
<i>Microhyla ornata</i>	pond
<i>Microhyla pulchra</i>	abandoned field pond
REPTILIA	
<i>Platysternon megacephalum</i>	stream
<i>Gehyra mutilata</i>	village

Species	Habitat
<i>Hemidactylus bowringi</i>	village
<i>Hemidactylus frenatus</i>	village
<i>Acanthosaura lepidogaster</i>	forest
<i>Calotes versicolor</i>	shrubland
	orchard
	logged forest
<i>Draco maculatus</i>	forest
<i>Eumeces quadrilineatus</i>	orchard
	logged forest
<i>Mabuya multifasciata</i>	grassland
<i>Scincella reevesii</i>	forest edge
	logged forest
<i>Dendrelaphis pictus</i>	stream
	logged forest
<i>Enhydris chinensis</i>	stream
<i>Sinonatrix percarinata</i>	stream
<i>Xenochrophis piscator</i>	stream
<i>Naja atra</i>	logged forest
<i>Ophiophagus hannah</i>	logged forest

The specimen room at the reserve has the following species which were not found during this survey: *Chirixalus vittatus*, *Kaloula pulchra*, *Pyxidea mouhotii*, *Leiolepis reevesii*, *Ramphotyphlops braminus*, *Boiga multomaculata*, *Psammodynastes pulverulentus*, *Elaphe mandarinus*, *Lycodon subcinctus*, *Rhabdophis adleri* and *Trimeresurus stejnegeri*. The record of *Elaphe mandarinus* is interesting because it constitutes the first record of this snake from Hainan.

The presence of *Leptobrachium hainanensis*, *Amolops hainanensis*, *A. torrentis*, *Rana fragilis* and *Buergeria oxycephala* indicates that the streams and the surrounding forest at Bawangling are in a healthy state. *Philautus ocellatus* and *Acanthosaura lepidogaster* are indicative of well-established forest.

Fish

Thirteen species of freshwater fish were recorded from Bawangling (Table 7), after rather low sampling effort. Some of the specimens await specialist verification. The most frequently encountered species were *Schistura fasciolata*, *Schistura incerta* and *Channa gachua*.

Table 7. Freshwater fish species of Bawangling and Mingwanghe. Sequence of genera follows Nelson (1994).

Species	Habitat
<i>Opsariichthys bidens</i>	stream
<i>Capoeta semifasciolata</i>	stream
<i>Spinibarbus hollandi</i>	stream
<i>Onychostoma leptura</i>	stream
<i>Microphysogobio labeoides</i>	stream
<i>Micronemacheilus pulcher</i>	stream
<i>Liniparhomaloptera disparis qiongzhongensis</i>	stream
<i>Schistura fasciolata</i>	stream
<i>Schistura incerta</i>	stream
<i>Pterocryptis gilberti</i>	stream
<i>Philypnus chalmersi</i>	stream
<i>Rhinogobius</i> (cf. <i>giurinus</i>) sp.	stream
<i>Channa gachua</i>	stream

Liniparhomaloptera disparis qiongzhongensis is endemic to Hainan Island. The geographically widespread *Spinibarbus hollandi* is becoming rare due to overfishing.

The presence of species such as *Spinibarbus hollandi* and *Onychostoma leptura* indicated that the streams at Wangxia and Bawangling were ecologically healthy.

Ants

At least 58 species were recorded, with 44 at Bawangling, 21 at Wangxia, and eight at Mingwanghe (Table 8). Most frequently recorded in the forest at Bawangling were *Leptogenys kitteli*, *Pachycondyla* sp. 2, *Technomyrmex albipes*, *Odontomachus monticola*, *Crematogaster* sp. 3, *Odontoponera* sp. 1 and *Polyrhachis halidayi*. Most frequently recorded in forest at Wangxia were *Pachycondyla* sp. 2, *Crematogaster* sp. 3, *Diacamma* sp. 1, *Pristomyrmex pungens* and *Technomyrmex albipes*.

Table 8. Ants of Bawangling and Wangxia.

Species	Habitat
<i>Aenictus (laeviceps group)</i> sp. 2	forest
<i>Anochetus risii</i>	open low shrubland
<i>Anoplolepis gracilipes</i>	agricultural fields, forest edge
<i>Aphaenogaster (cf. beccarii)</i> sp. 1	forest
<i>Aphaenogaster (cf. exasperata)</i> sp. 2	forest
<i>Aphaenogaster (cf. hunanensis)</i> sp. 3	dense-canopy forest
<i>Camponotus rufoglaucus</i>	agricultural fields
<i>Camponotus (cf. parius)</i> sp. 29	forest
<i>Camponotus (cf. anningensis)</i> sp. 39	forest
<i>Cardiocondyla</i> sp.	forest
<i>Cerapachys sulcinodis</i>	forest
<i>Crematogaster (cf. travancorensis)</i> sp. 2	open shrubland
<i>Crematogaster (cf. dohrni)</i> sp. 8	forest, grassland
<i>Crematogaster (cf. laboriosa)</i> sp. 3	forest
<i>Diacamma (nr. rugosum)</i> sp. 1	forest, grassland
<i>Dolichoderus</i> sp. 10	forest
<i>Gnamptogenys binghami</i>	forest
<i>Hypoponera (cf. excoecata)</i> sp. 2	forest
<i>Hypoconera</i> sp. 3	forest
<i>Kartidris (cf. galos)</i> sp. 1	forest
<i>Leptogenys kitteli</i>	forest
<i>Leptogenys (cf. kraepelini)</i> sp. 7	forest
<i>Leptogenys</i> sp. 19	forest
<i>Monomorium chinense</i>	agricultural fields
<i>Monomorium</i> sp. 12	agricultural fields
<i>Myrmecina</i> sp. 1	forest
<i>Myrmoteras (cf. cuneinodum)</i> sp. 1	forest
<i>Odontomachus monticola</i>	dense-canopy forest
<i>Odontoponera (cf. denticulata)</i> sp. 1	forest, open shrubland
<i>Pachycondyla (cf. luteipes)</i> sp. 2	forest
<i>Paratrechina (cf. bourbonica)</i> sp. 4	agricultural fields
<i>Paratrechina longicornis</i>	town
<i>Paratrechina</i> sp. 33	forest
<i>Pheidole</i> sp. 28	forest
<i>Pheidole (cf. yeensis)</i> sp. 40-A	forest, shrubland
<i>Pheidole</i> sp.	open shrub/grassland
<i>Pheidole (cf. noda)</i> sp. 1	forest
<i>Pheidole</i> sp. 11	forest
<i>Pheidole gatesi</i>	forest
<i>Pheidole</i> sp. 39	forest
<i>Pheidole</i> sp. 7-C	forest
<i>Pheidole (cf. rinae)</i> sp. 9	forest
<i>Pheidologeton melasolenus</i>	forest
<i>Polyrhachis halidayi</i>	forest
<i>Polyrhachis tyrannica</i>	forest
<i>Polyrhachis vigilans</i>	forest
<i>Prenolepis emmae</i>	forest
<i>Pyramica canina</i>	forest
<i>Pristomyrmex pungens</i>	forest
<i>Recurvidris (cf. recurvispinosa)</i> sp.	forest
<i>Strumigenys</i> sp. A	forest

Species	Habitat
<i>Strumigenys</i> sp. B	broadleaf/fir forest
<i>Tapinoma</i> sp. 1	forest, shrubland, fields
<i>Technomyrmex albipes</i>	forest
<i>Tetramorium bicarinatum</i>	forest, grassland
<i>Tetramorium</i> (cf. <i>guangxiensis</i>) sp. 16	forest
<i>Vollenhovia</i> sp. 5	forest
<i>Vollenhovia</i> sp. 7	dense-canopy forest

Several species are possibly new to science, and await further investigation. Believed to be new records for Hainan are the genera *Anochetus*, *Cerapachys*, *Dolichoderus*, *Gnamptogenys*, *Hypoconera*, *Kartidris*, *Myrmecina*, *Myrmoteras*, *Prenolepis*, *Pyramica*, *Recurvidris*, *Strumigenys* and *Vollenhovia*, and the species *Monomorium chinense*, *Polyrhachis tyrannica* and *P. vigilans*.

Some species, including *Anochetus risii*, *Camponotus* sp. 39, *Dolichoderus* sp. 10, *Leptogenys* sp. 19, *Monomorium* sp. 12, *Myrmecina* sp. 1, *Myrmoteras* sp. 1, *Paratrechina* sp. 33, *Pheidole* sp. 28, *Pheidole* sp. 39, *Tetramorium* sp. 16 and *Vollenhovia* sp. 7, appear to be highly rare or restricted within South China. *Anoplolepis gracilipes* and *Paratrechina longicornis* are exotic species, from Africa.

Dragonflies

Thirty-one species of odonates were encountered in the Bawangling area during the period 4 to 8 April 1998 (Table 9). *Mnais mneme*, *Pseudolestes mirabilis* and *Drepanosticta zhoui* were the most commonly encountered odonates in the forest of Bawangling. The ubiquitous libellulid *Pantala flavescens* was the most abundant species encountered during the study period. Of the 31 species, several are awaiting identification, and one – *Drepanosticta zhoui* – is new to science (K.D.P. Wilson & Reels, 2001). A further two species could not be identified or collected in the field. Other species of interest include *Anax immaculifrons* and *Polycanthagyna erythromelas*, which are new records for Hainan.

Table 9. Dragonflies: species encountered. Sequence follows K.D.P. Wilson & Reels (2001).

Species	Habitat	Notes
<i>Neurobasis chinensis</i>	river	
<i>Mnais mneme</i>	forest stream and riparian woodland	
<i>Rhinocypha perforata perforata</i>	river	
<i>Rhinocypha fenestrella</i>	river	
<i>Libellago lineata lineata</i>	river	
<i>Agriomorpha fusca</i>	forest	
<i>Pseudolestes mirabilis</i>	forest stream	endemic to Hainan
<i>Copera marginipes</i>	tall shrub	
<i>Drepanosticta zhoui</i>	forest	new species, endemic to Hainan
<i>Sinosticta hainanense</i>	forest	new species, endemic to Hainan; genus endemic to South China
<i>Prodasineura autumnalis</i>	limestone forest	
<i>Anax immaculifrons</i>	river	new record for Hainan
<i>Polycanthagyna erythromelas</i>	river	new record for Hainan
<i>Gynacantha subinterrupta</i>	forest	
<i>Periaeschna magdalena</i>	river	
<i>Leptogomphus celebratus</i>	river	endemic to Hainan
<i>Macromia</i> sp.	forest	not collected
<i>Brachydiplax chalybea</i>	marsh	
<i>Orthetrum chrysis</i>	marsh	
<i>Orthetrum luzonicum</i>	river	
<i>Orthetrum pruinosum</i>	orchard, shrub	
<i>Orthetrum sabina</i>	forest, tall shrub	
<i>Potamarcha congener</i>		
<i>Neurothemis fulvia</i>	orchard	
<i>Neurothemis</i> sp.	river	not collected
<i>Trithemis aurora</i>	orchard, river	

Species	Habitat	Notes
<i>Trithemis festiva</i>	river	
<i>Diplacodes trivialis</i>	shrub, orchard, limestone forest	
<i>Pantala flavescens</i>	ubiquitous	
<i>Zygonyx iris insignis</i>	tall shrub	known only from Hainan and Hong Kong
<i>Sympetrum</i> sp.	limestone forest	not collected

Three species (*Pseudolestes mirabilis*, *Sinosticta hainanense* and *Leptogomphus celebratus*) are endemic to Hainan, while *Zygonyx iris insignis* is known only from Hainan and Hong Kong. *Agriomorpha fusca* is a monotypic genus considered of high conservation priority (Moore, 1997).

Only eight species were found in the forest at Bawangling, of which two (*Pseudolestes mirabilis* and *Drepanosticta zhoui*) are probably restricted to primary forest. No major streams were encountered during the rapid survey of this forest. The apparent paucity of the forest odonate fauna may be due to the relatively early timing of the study (probably pre-emergence for many forest species) and to the absence of a major stream from the studied area. Of the 11 species recorded at Mingwanghe, nine are common and widespread in South China. No restricted species were identified at Wangxia limestone forest. One of the forest rivers briefly surveyed in the late afternoon to evening of 6 April was extremely promising, yielding at least two new records for Hainan: *Anax immaculifrons* and *Polycanthagyna erythromelas*. Both are very large dragonflies, widely distributed in the Oriental region.

Butterflies

A total of 82 species of butterfly were encountered during the survey period (Table 10). However, a large number – 18 – could not be collected or identified in the field. The most frequently encountered butterflies at Bawangling forest were Birdwings (*Troides* sp.). Unfortunately, identification to species was not possible. *Troides helena* is apparently the only representative of the genus which has been recorded from Hainan (Chou, 1994). However, the very similar *T. aeacus* has been recorded from the neighbouring provinces of Guangdong, Guangxi and Yunnan, as well as from Indo-China (Bascombe, 1995), and may be overlooked in Hainan. Other commonly encountered species included *Papilio helenus*, the forest lycaenid *Prosotas nora*, a species of *Parantica* (probably *melaneus*), and the forest nymphalids *Faunis eumeus* and *Thaumantis diores*. *Papilio nephelus*, which closely resembles *P. helenus*, was present in a private collection from Bawangling examined by the team, and may have been overlooked during this survey. One other papilionid species has yet to be identified. Also of interest is *Celaenorrhinus choui*, an endemic Hainan species described as recently as 1994. Six species are apparently newly recorded for Hainan: *Graphium cloanthus*, *Catopsilia pomona*, *Prosotas nora*, *Cethosia cyane*, *Euthalia phemius* and *Symbrenthia lilaea*.

Table 10. Butterflies: species encountered. Sequence of families follows Bascombe (1995).

Species	Habitat	Notes
<i>Celaenorrhinus choui</i>	forest	endemic to Hainan
<i>Gerosis phisara</i>	limestone forest	
<i>Hyarotis adrastus</i>	limestone forest	
<i>Pelopidas subochracea</i>	forest	
<i>Graphium agamemnon</i>	tall shrub/orchard	
<i>Graphium cloanthus</i>	tall shrub	possibly new Hainan record
<i>Graphium sarpedon</i>	tall shrub, limestone forest	
<i>Lamproptera</i> sp.	limestone forest	
<i>Papilio (Chilasa) clytia</i>	tall shrub/orchard	
<i>Papilio (Chilasa) slateri hainanensis</i>	forest	subspecies endemic to Hainan
<i>Papilio demoleus</i>	orchard	
<i>Papilio helenus</i>	forest, tall shrub/orchard,	

Species	Habitat	Notes
<i>Papilio memnon</i>	limestone forest	
<i>Papilio paris</i>	forest, limestone forest	
<i>Papilio polytes</i>	forest, tall shrub/orchard	
<i>Papilio protenor</i>	tall shrub	
<i>Pathysa</i> sp. (<i>nomius</i> or <i>aristeus</i>)	forest	
<i>Troides</i> sp.	tall shrub/orchard	
<i>Appias indra menandrus</i>	forest	
<i>Appias nero</i>	limestone forest	subspecies endemic to Hainan
<i>Appias</i> sp.	limestone forest	
<i>Catopsilia pomona</i>	tall shrub, limestone forest	possibly new Hainan record
<i>Catopsilia pyranthe</i>	tall shrub, limestone forest	
<i>Cepora nerissa</i>	forest	
<i>Delias hyparete</i>	tall shrub/orchard	
<i>Dercas verhuelli</i>	forest	
<i>Eurema brigitta hainana</i>	forest	subspecies endemic to Hainan
<i>Hebomoia glaucippe</i>	tall shrub/orchard	
<i>Ixias pyrene</i>	tall shrub, limestone forest	
	forest, tall shrub/orchard, limestone forest	
<i>Flos areste</i>	limestone forest	
<i>Jamides alecto</i>	limestone forest	
<i>Jamides bochus</i>	forest	
<i>Lampides boeticus</i>	limestone forest	
<i>Lampides boeticus</i>	tall shrub/orchard	
<i>Paralaxita dora hainana</i>	forest	subspecies endemic to Hainan
<i>Prosotas nora</i>	forest	
<i>Zizeeria maha</i>	forest	
	tall shrub/orchard	
<i>Apatura (Rohana) parisatis</i>	tall shrub/orchard	
<i>Argyreus hyperbius</i>	tall shrub/orchard	
<i>Ariadne ariadne</i>	tall shrub/orchard	
<i>Athyma nefte</i>	tall shrub/orchard	
<i>Athyma selenophora</i>	forest	
<i>Cethosia cyane</i>	limestone forest	apparently new Hainan record
<i>Cupha erymanthis</i>	tall shrub/orchard	
	forest, tall shrub/orchard, limestone forest	
<i>Danaus chrysippus</i>	tall shrub/orchard	
<i>Dichorragia nesimachus</i>	tall shrub/orchard	
<i>Euploea core</i>	limestone forest	
<i>Euploea core</i>	tall shrub/orchard	
<i>Euploea midamus</i>	tall shrub, limestone forest	
<i>Euploea sylvester</i>	limestone forest	
<i>Euploea</i> sp.	forest	
<i>Euthalia niepelti</i>	forest	
<i>Euthalia phemius</i>	tall shrub/orchard	apparently new Hainan record
<i>Faunis eumeus</i>	forest, limestone forest	
<i>Kaniska canace</i>	forest, limestone forest	
<i>Lethe verma</i>	river bank	
<i>Lethe</i> sp.	forest	
<i>Melanitis leda</i>	limestone forest	
<i>Mycalesis mineus</i>	forest	
<i>Mycalesis sangaica</i>	forest	
<i>Neorina (Ethope) henrici</i>	limestone forest	endemic to Hainan
<i>Neptis clinia</i>	limestone forest	
<i>Neptis hylas</i>	tall shrub/orchard	
<i>Neptis</i> sp.	forest, limestone forest	
<i>Parantica aglea</i>	forest, limestone forest	
<i>Parantica sita</i>	limestone forest	
<i>Parantica</i> sp.	forest	
<i>Polyura</i> sp.	forest, limestone forest	prob. <i>melaneus</i>
<i>Precis (Junonia) hierta</i>	tall shrub/orchard	
<i>Precis (Junonia) lemonias</i>	tall shrub/orchard	
<i>Symbrenthia lilaea</i>	forest, limestone forest	apparently new Hainan record
<i>Thaumantis diores</i>	forest, limestone forest	
<i>Tirumala</i> sp.	forest, limestone forest	
	tall shrub/orchard	

Species	Habitat	Notes
<i>Vindula erota</i> (?)	tall shrub/orchard	
<i>Ypthima motschulskyi</i>	forest	

Apart from the six endemic taxa encountered – of which five (*Chilasa slateri hainanensis*, *Appias indra meandrus*, *Paralaxita dora hainana*, *Neorina henrici* and *Celaenorrhinus choui*) are forest specialists – most butterflies recorded during the study period are widely distributed in the Oriental region. Bawangling is also the type locality for the lycaenid butterfly *Tajuria gui* (Chou, 1994).

Rove Beetles

Ten staphylinid beetle species were recorded from Bawangling, and three from Wangxia (Table 11). At least four (*Colilodion tetramerus*, *Edaphus* spp. and *Naddia qiongensis*) – and up to six – species are new to science. New records for Hainan include *Acylophorus balchhi*, two *Medon* spp., *Paederus birmanus*, *Pseudopsis* sp., *Stenus gestroi* and *Stenus ninii*.

Table 11. Rove beetles (Staphylinidae) identified from Bawangling and Wangxia.

Species	Notes
<i>Acylophorus balchhi</i>	new to Hainan; described from Assam
<i>Colilodion tetramerus</i>	new to science
<i>Drusilla</i> sp.	possibly new to science
<i>Edaphus</i> sp.	new to science
<i>Edaphus</i> sp.	new to science
<i>Medon</i> sp.	new to Hainan
<i>Medon</i> sp.	new to Hainan
<i>Naddia qiongensis</i>	possibly new to science
<i>Paederus birmanus</i>	new to Hainan
<i>Priochirus tonkinensis</i>	
<i>Pseudopsis</i> sp.	new to Hainan
<i>Stenus gestroi</i>	new to Hainan
<i>Stenus ninii</i>	new to Hainan
<i>Zyras</i> sp. nov. (?)	possibly new to science

Summary of flora and fauna

Bawangling has a primary tropical forest that is almost unrivalled in South China. The findings of this survey support the contention that it is of national significance in biodiversity conservation (MacKinnon *et al.*, 1996). Many of the trees present are confined to this and other patches of undisturbed forest; among them are *Keteleeria hainanensis*, *Dacrydium pectinatum*, *Podocarpus fleuryi*, *Oncodostigma hainanense*, *Firmiana hainanensis*, *Alseodaphne hainanensis*, *Hydnocarpus hainanensis*, *Dimocarpus longan*, *Litchi chinensis* var. *euspontanea*, *Lansea coromandelica*, *Amoora dasyclada* and *Aquilaria sinensis*. The diversity of orchids is high in Bawangling, especially among epiphytes. Many plant species at both Bawangling and Wangxia, such as *Populus qiongdaoensis*, *Sinosenecio hainanensis*, *Cymbidium sinense*, *Phalaenopsis hainanensis*, *Renanthera coccinea*, *Rhynchostylis gigantea* and *Vanda subconcolor* and are of global or national conservation concern, and many are confined to Hainan.

Bawangling also has a rich fauna, particularly in mammals, birds and butterflies. Many globally threatened taxa are known or believed to be present, including Hainan Crested Gibbon, Clouded Leopard, Asiatic Black Bear, various flying squirrels, Hainan Hare, Chinese Porcupine, Hainan Partridge, Hainan Leaf Warbler, various forest woodpeckers, owls, pigeons and babblers, and the endemic frogs *Amolops hainanensis*, *Rana fragilis* and *Buergeria oxycephala*, and a number of insect species. Several undescribed ants, dragonflies and beetles were also found during this survey, and it is likely that many more species remain to be discovered.

Wangxia has a biota somewhat similar to Bawangling, but with some distinctive features, and supported a number of rare plants (e.g. *Saccopetalum prolificum*, *Dimocarpus longan*, *Cycas taiwaniana*, *Firmiana hainanensis*, *Hydnocarpus hainanensis* and *Tropidia angulosa*). Some of its plant and animal species may not occur at Bawangling, and Wangxia contains important lower-altitude forest habitat within the degraded foothills of Hainan. Due partly to the habitats in this and surrounding areas, the nearby river valley supported a diverse bird and insect fauna despite the denuded nature of the vegetation.

Threats and problems

Many people in the villages around Bawangling possessed firearms, and illegal hunting still took place in the reserve. Grazing by domestic animals is an additional threat to vegetation (MacKinnon *et al.*, 1996). Resources currently available were inadequate to properly patrol the area and enforce a ban on hunting. Forest in the buffer zone had been logged and was generally in a poor state, while collection of wild plants was still evident. A hydroelectric plant had badly affected the stream at Yajia, which was close to the reserve and supported rare amphibian species. The demand for wild orchids also threatened the survival of many species in the reserves. In addition the forest remaining, though of excellent quality, may be too small to ensure long-term viability of populations of wide-ranging mammals such as Crested Gibbon and Clouded Leopard.

A management assessment of Bawangling by the World Conservation Union (IUCN) noted serious gaps in management, and that the reserve faced serious threats, notably hunting (Anon., 1999c). The assessment also concluded there was no management plan for the reserve, low funding, poor staffing and no local involvement.

Opportunities and recommendations

The survival of the primary forest at Bawangling to date is a major achievement of the Government, which has curbed logging and hunting in the locality. As a result Bawangling has unique potential to conserve representatives of the original Hainan biota.

Various steps are needed to eliminate conflicts between people and biodiversity. In the short term, illegal activities should be halted, through improved patrolling and enforcement. All staff should understand the objectives of biodiversity and habitat protection, and motivated to achieve them. The original objectives of the reserve may need to be reviewed and refined, giving particular attention to conserving endangered and unique elements of the current Bawangling biota, such as those highlighted in this report: gibbon habitat conservation remains one of the highest priorities. Realisation of such objectives may call for enlargement of the reserve.

It has already been recommended that the reserve should be extended to cover all neighbouring natural forests (MacKinnon *et al.*, 1996). Such areas include a good patch of forest used by the Crested Gibbon population near the reserve station at Donger, and the well-established limestone forest at Wangxia. Forest restoration should also be attempted in the buffer zone as a long-term measure to increase the size of mature forest. According to Liu Zhenhe (pers. comm., 1998), gibbons would not be expected to survive in limestone forest, as they are rainforest specialists. Although the Bawangling gibbons have territories greater than those recorded elsewhere (20 to 33 ha per group), seven or eight groups of gibbons could occur at Bawangling (Liu Z., pers comm., 1998). To allow expansion or even survival of the existing gibbon population, improved protection of both the species and the forest habitat at Bawangling is essential. In 1999 the World Bank proposed funding an extension of the Bawangling National Nature Reserve to include unprotected forests. This plan was dropped following discussions with Hainan Government officials. New initiatives are urgently needed to bring these forests into the protected area system.

For conservation to succeed in the medium- to long-term, management plans will need to be developed, which take different stakeholders and pressures into account. This will help ensure that funding is directed to achieve the objectives. Plans should incorporate the following elements:

(1) Capacity building needs and schedule. The plan should include specific needs and proposals for personnel recruitment, training and deployment. The goal must be to have well-funded, well-trained staff who are both willing and able to fulfill the reserve's objectives.

(2) Zoned management. The borders of the reserve and zones should be reviewed to ensure protection of habitats of conservation importance. An important step would be a study to allow the mapping of different animal and plant communities. This study could form a basis for the future monitoring, protection and restoration of biodiversity and ecological integrity.

(3) Building of public awareness. The reserve's potential for increasing public understanding and appreciation of nature should be harnessed. This could be facilitated by collaboration with the newly established Hainan Ecological and Environmental Education Centre at Hainan Normal College.

(4) Provision of incentives for conservation. Some of the benefits of conserving biodiversity should be returned to local residents, in accordance with the Convention on Biological Diversity. Possible mechanisms include ecological compensation, ecotourism and sustainable propagation, each of which would require exploratory assessments. Such studies might identify native plants and animals suitable for propagation without endangering wild populations.

(5) Implementation of conservation guidelines. IUCN has produced guidelines on various aspects of biodiversity conservation, including ecotourism, reintroduction and control of alien invasive species. These are a valuable resource for effective management planning.

MacKinnon *et al.* (1996) considered that an enlarged Southwest Hainan Conservation Unit including Bawangling would be of global importance in biodiversity conservation. Other important forests in such a unit might include reserves at Diaoluoshan, Jianfengling, Jiayi and Wuzhishan (Anon., 1996a), and unprotected natural broadleaf forests nearby. Together these forests support immense biodiversity. Protection of these remaining Hainan forests, with ecological restoration in degraded lowland habitats, must rate among the highest priorities for China in implementing the Convention on Biological Diversity.

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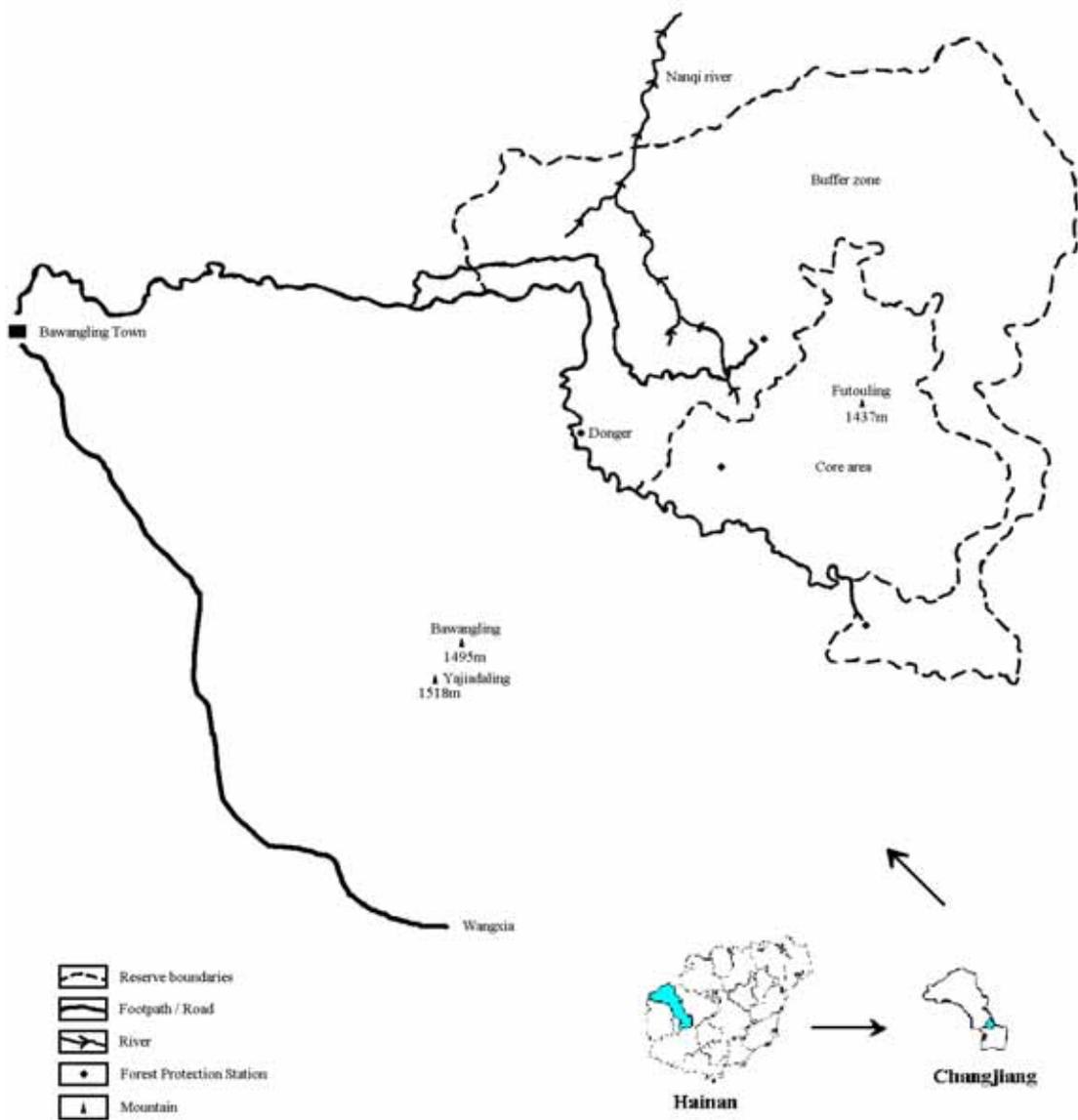


Figure 1 Bawangling National Nature Reserve, Changjiang County, Hainan