Report of Rapid Biodiversity Assessments at Jianfengling Nature Reserve, Southwest Hainan, 1998 and 2001

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

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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 three 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, yong
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 aim of the surveys was to update previous information on the biota of Jianfengling Nature Reserve. This will facilitate identification of the components of the Hainan biota currently secure in the Reserve, the components still under threat in the Reserve and the components which are unprotected by the Reserve.

Methods

In January 1998, two KFBG representatives (LC and BH) had made a brief visit to Jianfengling. They spent one day (19 January) at the Nature Reserve and made some casual observations of the habitat and wild fauna and flora around the survey area. Records of orchids were made, which are included in this report.

On 8 April the full survey team, including members from Hainan Provincial Forestry Department (FJP), Kadoorie Farm and Botanic Garden in Hong Kong (BH, JRF, ML, GTR, LKS), South China Institute of Botany in Guangzhou (CBH, LZX, WRJ), South China Institute of Endangered Animals in Guangzhou (GYR) and South China Normal University in Guangzhou (LZC and YZS), drove from Changjiang County to Jianfeng Town in Ledong County. From 8 to 12 April rapid faunal and floral surveys were conducted at Jianfengling Nature Reserve, concentrating on one spot.

In February 2001, a small team (LKS, Yu Yat Tung and Zou Fa Sheng) went to Jianfengling to conduct a bird study. All birds and mammals encountered were recorded. Full details of methods and findings will be reported elsewhere (Zou F.S., in prep.).

In August 2001, three members of KFBG (BC, LKS, NSC) made a brief visit to Jianfengling, with FJP and Olivier Pineau of Tour du Valat Biological Station, France. They arrived at Jianfeng town on 4 August, and at Tianchi, joining Station Director Mr. Guo Ning. An evening survey and a night survey were conducted. On 5 August they conducted fieldwork before adjourning to Datian Nature Reserve.

During fieldwork visual searching for plants, mammals, birds, reptiles, amphibians, fish, ants, butterflies and dragonflies was conducted. The calls of birds and amphibians were also used to survey these groups. 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 Jianfengling were largely based on interviews with local people, with reference to colour pictures, and on the Reserve's specimen collection. For purposes of interviewing residents about the status of mammal species, 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 the 1998 survey were made or verified by CBH or LZX, and edited by NSC, except in the case of orchids, which were verified by GS or LC. Plant records in 2001 were made by NSC. Mammal records were made by LKS, BH, BC, JRF, ML or GTR. 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. (1959-2000); Wu *et al*. (1994); Anon. (1996-2000); Anon. (2001a); and Anon. (2001b);
Orchids (Angiospermae: Orchidaceae): Chen *et al*. (1999); Tsi *et al.* (1999) and Lang *et al.* (1999);

- Mammals (Mammalia): Wilson & Reeder (1993); Wilson & Cole (2000);
- Birds (Aves): Inskipp *et al*. (1996);
- Reptiles and Amphibians (Reptilia and Amphibia): Zhao *et al.* (2000), supplemented with Fei *et al.* (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); Wilson & Reels (2001), and references therein;
- 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 conservation 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

Jiangfengling Nature reserve is in Ledong and Dongfang Counties, southwest Hainan, at 18°37'-18°47'N by 108°45'-108°56'E. The reserve was established in 1976 with the major objective of protecting the tropical rainforest and the rare fauna. It is listed as a Provincial-level Forest Ecosystem Nature Reserve (Zhang W., 1998). It is under the management of the Forestry Department and has 19 staff, including ten police, three technicians and six management staff (Anon., 1999b). It has an area of 78 km^2 including two core areas totalling 16 km^2. The altitudinal range is 100 to 1,412 m. Jianfengling contains four forest farms, at Tianchi, Nanya, Weidong and Nanwang, and a total population of about 2,000; many of these are former loggers, who now make an average income from growing plants of about 1,000 yuan per year (Anon., 1999b).

Results

Vegetation

The Jianfengling area has a seasonal tropical climate, with a distinct wet and dry season; the zonal vegetation should be tropical seasonal rain forest. Under this zonal vegetation, the following vegetation types have been identified:

(1) Tropical semi-deciduous monsoon forest on hill slopes below 400 m. The dominant species are deciduous trees such as *Terminalia nigrovenulosa, Lannea coromandelica, Albizia odoratissima* and *Cratoxylum cochinchinense*.
(2) Tropical evergreen monsoon forest in valleys and basins between 400 and 700 m. This is the dominant vegetation in part of the nature reserve. The dominant species include *Canarium album, Amesiodendron chinense, Engelhardtia roxburgiana, Koilodepas hainanense, Saurauia tristyla and Schefflera octophylla.*
(3) Tropical hill rainforest between 700 and 1,200 m. This is the dominant vegetation type within the main core area. The dominant species are Fagaceae spp., *Nephelium topengii, Altingia chinensis, Endospermum chinense, Livistona saribus* and Cyatheaceae spp. Forest structure is well-developed, with a prominent liana layer dominated by *Gnetum montanum* and *Millettia pachyloba.*

(4) Mossy dwarf montane forest above 1,200 m. The dominant species are *Pentaphylax euryoides, Gordonia axillaris, Rhaphiolepis indica and Rhodomyrtus tomentosa.*

Flora

The flora of Jianfengling has been studied for over 30 years, and some 2,817 species of vascular plants (including cultivated ones), in 1,213 genera and 239 families, have been recorded (Zeng *et al.*, 1995). The flora is composed mainly of tropical families including Euphorbiaceae, Papilionaceae, Rubiaceae, Moraceae, Sterculiaceae, Sapindaceae, Annonaceae and Apocynaceae. Table 1 lists the species of pteridophytes, gymnosperms and angiosperms (excluding Orchidaceae) found in the present survey. Table 2 lists Orchidaceae.

The surveys in 1998 and 2001 recorded 236 species of angiosperms (including 21 species of orchids) in 84 families, four species of gymnosperms in two families and 25 species of pteridophytes in 17 families at Jianfengling (Table 1, Table 2). An additional 11 species were found at another location on 4 August 2001. The most frequently encountered species included *Castanopsis fissa, Pentaphylax euryoides, Thysanolaena maxima, Melastoma sanguineum, Miscanthus floridulus, Rhodomyrtus tomentosa, Schefflera octophylla, Gironniera subaequalis, Diplopterygium blotiana, Mallotus paniculatus, Blechnum orientale, Pseudodrynaria coronans, Gnetum montanum, Gymnosphaera podophylla, Trema orientalis, Evodia glabrifolia, Alniphyllum fortunei, Pteridium revolutum, Nephrolepis auriculata, Dianella ensifolia, Mussaenda erosa, Ficus fulva* and *Alocasia macrorrhiza*.

Hopea hainanensis is listed by IUCN as Critically Endangered globally, and is a Class I nationally-protected species. Three orchid species recorded (*Cymbidium eburneum, C. sinense* and *Vanda subconcolor*) are Endangered in China. *Alseodaphne hainanensis* and *Madhuca hainanensis* are globally Vulnerable and Class II protected. *Illicium ternstroemioides, Ixonanthes chinensis* and *Litchi chinensis* var. *euspontanea* are globally Vulnerable, and two orchids (*Anoectochilus roxburghii* and *Dendrobium densiflorum*) are Vulnerable in China. *Gymnosphaera podophylla, G. giganthea, Sphaeropteris brunoniana, S. hainanensis, Cibotium barometz* and *Merrillanthus hainanensis* are Class II nationally-protected species. National protected status for orchids is still under review, but all species recorded are listed under CITES Appendix II. Among these endangered or protected species, *S. hainanensis* and *Madhuca hainanensis* are also endemic to Hainan.

In addition to these threatened species, 15 species endemic to Hainan were encountered in these surveys: *Angiopteris oblanceolata, Manglietia hainanensis, Engelhardtia hainanense, E. unijuga, Ardisia densilepidotula, Syzygium fluviatile, S. stenocladum, Argostemma discolor, Hedyotis communis, Mycetia hainanensis, Nephelium topengii, Microcos chungii, Parapyrenaria multisepala, Arisaema hainanense* and *Ceratostylis hainanensis*.

Table 1. Vascular plants of Jianfengling Nature Reserve and nearby forested areas. Including all plant species recorded on 9 to 11 April 1998. Not including Orchidaceae (see Table 2). 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 in notes.

Family	**Species name**	**Notes**
PTERIDOPHYTA		
Antrophyaceae	*Antrophyum callifolium* Blume	
Aspleniaceae	*Neottopteris nidus* (L.) J. Sm.	
Athyriaceae	*Allantodia virescens* (Kunze) Ching	
Blechnaceae	*Blechnum orientale* L.	
Cyatheaceae	*Gymnosphaera giganthea* (Wall. ex Hook.) Ching	Protected II
	Gymnosphaera podophylla (Hook.) Copel	Protected II
	Sphaeropteris brunoniana (Hook.) R.M. Tryon	Protected II
	Sphaeropteris hainanensis (Ching) R.M. Tryon	Protected II, endemic to Hainan
Dicksoniaceae	*Cibotium barometz* (L.) J. Sm.	Protected II

Family	Species name	Notes
Drynariaceae	*Pseudodrynaria coronans* (Wall. ex Mett.) Ching	
Gleicheniaceae	*Dicranopteris pedata* (Houtt.) Nakaike	
	Dicranopteris splendida (Hand.-Mazz.) Ching	
	Diplopterygium chinensis (Rosenst.) DeVol	
	Diplopterygium blotiana (C. Chr.) Nakai	
	Diplopterigium cantonensis (Ching) Nakai	
	Sticherus laevigatus Presl	
Lindsaeaceae	*Stenoloma chusanum* Ching	
Marattiaceae	*Angiopteris oblanceolata* Ching & Chu H. Wang	endemic to Hainan
Nephrolepidaceae	*Nephrolepis auriculata* (L.) Trimen	
Osmundaceae	*Osmunda vachellii* Hook.	
Pteridaceae	*Pteris vittata* L.	
Pteridiaceae	*Pteridium revolutum* (Blume) Nakai	
Selaginellaceae	*Selaginella rolandi- principis* Alston	
Thelypteridaceae	*Pronephrium simplex* (Hook.) Holttum	
Vittariaceae	*Vittaria elongata* Sw.	
GYMNOSPERMAE		
Gnetaceae	*Gnetum montanum* Markgr.	
Podocarpaceae	*Dacrydium pectinatum* de Laub.	
	Dacrycarpus imbricatus de Laub. var. *patulus* de Laub.	
	Podocarpus neriifolius D. Don	
ANGIOSPERMAE		
Dicotyledonae		
Acanthaceae	*Pteroptychia dalziellii* (W.W. Smith) H.S. Lo	
Aceraceae	*Acer decandrum* Merr.	
	Acer fabri Hance	
Actinidiaceae	*Actinidia latifolia* (Gardner et Champ.) Merr.	
	Actinidia melliana Hand.-Mazz.	
	Saurauia tristyla DC	
Anacardiaceae	*Choerospondias axillaris* (Roxb.) B.L. Burtt et. A.W. Hill	
	Toxicodendron succedaneum (L.) Kuntze	
Ancistrocladaceae	*Ancistrocladus tectorius* (Lour.) Merr.	
Annonaceae	*Fissistigma polyanthum* (Hook. f. & Thomson) Merr.	
	Uvaria grandiflora Roxb.	
Apocynaceae	*Alstonia rostrata* C.E.C. Fisch.	
	Hunteria zeylanica (Retz.) Gardner ex Thwaites	
Aquifoliaceae	*Ilex ficoidea* Hemsl.	
Araliaceae	*Schefflera octophylla* (Lour.) Harms	
Aristolochiaceae	*Aristolochia hainanensis* Merr.	
Asclepiadaceae	*Merrillanthus hainanensis* Chun et Tsiang	Protected II
Asteraceae	*Ageratum conyzoides* L.	introduced
	Elephantopus scaber L.	
	Tithonia diversifolia (Hemsl.) A. Gray	introduced
Boraginaceae	*Ehretia longiflora* Champ. ex Benth.	
Burseraceae	*Canarium album* (Lour.) Raeusch.	
Capparidaceae	*Stixis suaveolens* (Roxb.) Pierre	
Caprifoliaceae	*Lonicera macrantha* (D. Don) Spreng.	
	Viburnum odoratissimum Ker Gawl.	
Celastraceae	*Celastrus monospermus* Roxb.	
Clusiaceae	*Calophyllum membranaceum* Gardner & Champ.	
	Garcinia oblongifolia Champ. ex Benth.	
	Hypericum japonicum Thunb. ex Murray	
Connaraceae	*Rourea microphylla* (Hook. & Arn.) Planch.	
Convolvulaceae	*Erycibe hainanensis* Merr.	
	Erycibe obtusifolia Benth.	
Daphniphyllaceae	*Daphniphyllum calycinum* Benth.	
Dichapetalaceae	*Dichapetalum gelonioides* (Roxb.) Engl.	
Dilleniaceae	*Dillenia pentagyna* Roxb.	
Dipterocarpaceae	*Hopea hainanensis* Merr. et Chun	Protected I, Critically Endangered (IUCN)
Ebenaceae	*Diospyros eriantha* Champ. ex Benth.	
Elaeocarpaceae	*Elaeocarpus sphaericus* (Gaertn.) K. Schum.	
	Elaeocarpus sylvestris (Lour.) Poir.	
	Elaeocarpus japonicus Siebold & Zucc.	
	Sloanea sinensis (Hance) Hemsl.	
Escalloniaceae	*Itea macrophylla* Wall. ex Roxb.	

Family	Species name	Notes
Euphorbiaceae	*Antidesma montanum* Blume	
	Breynia fruticosa (L.) Hook. f.	
	Bridelia insulana Hance (*B. balansae* Tutch.)	
	Endospermum chinense Benth.	
	Glochidion sphaerogynum (Müll. Arg.) Kurz	
	Koilodepas hainanense (Merr.) Airy Shaw	
	Macaranga denticulata (Blume) Müll. Arg.	
	Macaranga hemsleyana Pax & K. Hoffm.	
	Mallotus hookerianus (Seem.) Müll. Arg.	
	Mallotus paniculatus (Lam.) Müll. Arg.	
	Sapium discolor (Champ. ex Benth.) Müll. Arg.	
Fagaceae	*Castanopsis carlesii* (Hemsl.) Hayata	
	Castanopsis chinensis (Spreng.) Hance	
	Castanopsis fabri Hance	
	Castanopsis fissa (Champ. ex Benth.) Rehder	
	Castanopsis hystrix Miq.	
	Cyclobalanopsis fleuryi (Hickel et A. Camus) Chun ex Q.F. Zheng	
	Cyclobalanopsis hui (Chun) Chun ex Y.C. Hsu & H.W. Jen	
	Cyclobalanopsis neglecta Schottky	
	Lithocarpus harlandii (Hance ex Walp.) Rehder	
	Lithocarpus longipedicellatus (Hickel & A. Camus) A. Camus	
Flacourtiaceae	*Homalium hainanense* Gagnep.	
Gesneriaceae	*Rhynchotechum ellipticum* (Wal. ex D. Dietr.) A. DC.	
Hamamelidaceae	*Altingia chinensis* (Champ. ex Benth.) Oliv. ex Hance	
Icacinaceae	*Mappianthes iodoides* Hand.-Mazz.	
Illiciaceae	*Illicium ternstroemioides* A.C. Sm.	Vulnerable (IUCN)
Ixonanthacaea	*Ixonanthes chinensis* Champ.	Vulnerable (IUCN)
Juglandaceae	*Engelhardtia hainanensis* Chen	endemic to Hainan
	Engelhardtia roxburghiana Wall.	
	Engelhardtia unijuga Chun ex P.Y. Chen	endemic to Hainan
Lardizabalaceae	*Stauntonia chinensis* DC.	
Lauraceae	*Alseodaphne hainanensis* Merr.	Protected II, Vulnerable (IUCN)
	Cinnamomum porrectum (Roxb.) Kosterm.	
	Cryptocarya chinensis (Hance) Hemsl.	
	Litsea variabilis Hemsl.	
	Litsea verticillata Hance	
	Machilus velutina Champ. ex Benth.	
	Neolitsea cambodiana Lecomte	
Loganiaceae	*Buddleja asiatica* Lour.	
	Strychnos cathayensis Merr.	
Loranthaceae	*Scurrula parasitica* L.	
	Taxillus chinensis (DC.) Danser	
Magnoliaceae	*Magnolia paenetalauma* Dandy	
	Manglietia hainanensis Dandy	endemic to Hainan
	Michelia balansae (Aug. DC.) Dandy	
	Michelia mediocris Dandy	
Melastomaceae	*Blastus cochinchinensis* Lour.	
	Melastoma sanguineum Sims	
Menispermaceae	*Hypserpa nitida* Miers	
Mimosaceae	*Adenanthera pavonina* L. var. *microsperma* (Teijsm. et Binn.) Nielsen	
	Pithecellobium clypearia (Jack) Benth.	
	Pithecellobium lucidium Benth.	
	Pithecellobium utili Chun et F.C. How	
Moraceae	*Artocarpus styracifolius* Pierre	
	Ficus esquiroliana H. Lév.	
	Ficus fistulosa Reinw. ex Blume	
	Ficus hirta Vahl	
	Ficus subulata Blume	
	Ficus variegata Blume var. *chlorocarpa* (Benth.) King	
	Streblus indica (Bureau) Corner	
Myrsinaceae	*Ardisia crenata* Sims	

Family	Species name	Notes
	Ardisia densilepidotula Merr.	endemic to Hainan
	Ardisia villosa Roxb.	
	Ardisia mamillata Hance	
Myrtaceae	*Cleistocalyx operculatus* (Roxb.) Merr. et L. M. Perry	
	Rhodomyrtus tomentosa (Aiton) Hassk.	
	Syzygium brachyantherum Merr. & L.M. Perry	
	Syzygium fluviatile (Hemsl.) Merr. & L.M. Perry	endemic to Hainan
	Syzygium stenocladum Merr. & L.M. Perry	endemic to Hainan
	Syzygium tsoongii Merr. et L. M. Perry	
Oleaceae	*Chionanthus ramiflorus* Roxb.	
	Jasminum lanceolarium Roxb.	
	Jasminum nervosum Lour.	
	Osmanthus marginatus (Champ. ex Benth.) Hemsl.	
	Osmanthus matsumuranus Hayata	
Papillionaceae	*Dalbergia benthami* Prain	
	Dalbergia hancei Benth.	
	Dalbergia millettii Benth.	
	Millettia nitida Benth.	
	Millettia oosperma Dunn	
	Millettia pachyloba Drake	
	Uraria lagopodioides (L.) Desv. ex DC.	
Pentaphylaceae	*Pentaphylax euryoides* Gardner & Champ.	
Plantaginaceae	*Plantago major* L.	introduced
Polygalaceae	*Xanthophyllum hainanense* Hu	
Proteaceae	*Helicia cochinchinensis* Lour.	
	Helicia formosana Hemsl.	
	Heliciopsis lobata (Merr.) Sleumer	
Ranunculaceae	*Clematis crassifolia* Benth.	
Rosaceae	*Rhaphiolepis indica* (L.) Lindl.	
	Rubus alceaefoilus Poir.	
Rubiaceae	*Aidia canthioides* (Champ. ex Benth.) Masam.	
	Argostemma discolor Merr.	endemic to Hainan
	Canthium dicoccum (Gaertn.) Teysmann et Binnedijk	
	Chasalia curviflora Thwaites	
	Diplospora dubia (Lindl.) Masam.	
	Hedyotis auricularia L.	
	Hedyotis communis W.C. Ko	endemic to Hainan
	Ixora nienkui Merr. & Chun	
	Lasianthus hirsutus (Roxb.) Merr.	
	Mussaenda erosa Champ. ex Benth.	
	Mycetia hainanensis H.S. Lo	endemic to Hainan
	Psychotria asiatica L. *(P. rubra*)	
	Psychotria tutcheri Dunn	
	Richardia scabra L.	
	Uncaria scandens (Sm.) Hutch.	
	Wendlandia uvariifolia Hance	
Rutaceae	*Acronychia pedunculata* (L.) Miq.	
	Evodia glabrifolia (Champ. ex Benth.) C.C. Huang	
	Evodia lepta (Spreng.) Merr.	
	Fortunella hindsii (Champ. ex Benth.) Swingle	
	Micromelum integerrimum Roem.	
	Zanthoxylum avicennae (Lam.) DC.	
Sabiaceae	*Meliosma angustifolia* Merr.	
	Meliosma dumicola W.W. Sm.	
	Meliosma laui Merr.	
	Sabia limoniacea Wall. ex Hook. f. & Thomson	
Santalaceae	*Dendrotrophe frutescens* (Benth.) Danser	
	Scleropyrum wallichianum (Wight & Arn.) Arn.	
Sapindaceae	*Litchi chinensis* Sonn. *var. euspontanea* H.H. Hsue	Vulnerable (IUCN)
	Nephelium topengii (Merr.) H.S. Lo	endemic to Hainan
Sapotaceae	*Madhuca hainanensis* Chun & F.C. How	Protected II, Vulnerable (IUCN), endemic to Hainan
	Sarcosperma laurinum (Benth.) Hook. f.	
Schisandraceae	*Kadsura coccinea* (Lem.) A.C. Sm.	
Solanaceae	*Atropa belladonna* L.	introduced

Family	Species name	Notes
	Solanum virginianum L.	introduced
Staphyleaceae	*Turpinia montana* (Blume) Kurz	
Sterculiaceae	*Sterculia hainanensis* Merr. & Chun	
	Sterculia lanceolata Cav.	
Styraceae	*Alniphyllum fortunei* (Hemsl.) Makino	
	Styrax agrestis (Lour.) G. Don	
Symplocaceae	*Symplocos adenophylla* Wall. ex G. Don	
	Symplocos wikstroemiifolia Hayata	
Theaceae	*Adinandra hainanensis* Hayata	
	Camellia japonica L.	
	Eurya ciliata Merr.	
	Gordonia axillaris (Roxb. ex Ker Gawl.) F. Dietr.	
	Parapyrenaria multisepala (Merr. et Chun) H.T. Chang	endemic to Hainan
	Schima superba Gardner et Champ.	
Tiliaceae	*Microcos chungii* (Merr.) Chun	endemic to Hainan
Ulmaceae	*Gironniera subaequalis* Planch.	
	Trema orientalis (L.) Blume	
Umbelliferae	*Centella asiatica* (L.) Urb.	
Verbenaceae	*Callicarpa formosana* Rolfe	
	Lantana camara L.	introduced
	Vitex quinata (Lour.) F.N. Williams	
Violaceae	*Viola betonicifolia* Sm.	
Vitaceae	*Cayratia japonica* (Thunb.) Gagnep.	
Monocotyledonae		
Acoraceae	*Acorus gramineus* Sol. ex Aiton	
Amaryllidaceae	*Curculigo capitulata* (Lour.) Kuntze	
Araceae	*Alocasia macrorrhiza* (L.) Schott	
	Arisaema hainanense C.Y. Wu	endemic to Hainan
	Pothos repens (Lour.) Druce	
	Rhaphidophora hongkongensis Schott	
Areaceae	*Arenga pinnata* (Wurmb) Merr.	
	Calamus tetradactylus Hance	
	Caryota ochlandra Hance	
	Daemonorops margaritae (Hance) Becc.	
	Licuala spinosa Thunb.	
	Livistona saribus (Lour.) Merr. ex A. Chev.	
	Pinanga discolor Burret	
Cyperaceae	*Carex cryptostachys* Brongn.	
	Carex nemostachys Steud.	
	Gahnia tristis Nees	
	Hypolytrum nemorum (Vahl) Spreng.	
	Scleria terrestris (L.) Fassett	
Liliaceae	*Aspidistra elatior* Blume	
	Dianella ensifolia (L.) Redouté	
	Disporum sessile D. Don	
	Peliosanthes teta Andrews	
	Smilax corbularia Kunth	
	Smilax lanceifolia Roxb.	
Musaceae	*Musa balbisiana* Colla	
Orchidaceae	(see Table 2)	
Pandanaceae	*Pandanus austrosinensis* T.L. Wu	
Poaceae	*Arundo donax* L.	
	Miscanthus floridulus (Labill.) Warb. ex K. Schum. & Lauterb.	
	Miscanthus sinensis Andersson	
	Neyraudia arundinacea (L.) Henr.	
	Pogonatherum crinitum (Thunb.) Kunth	
	Setaria palmifolia (J. König) Stapf	
	Thysanolaena maxima (Roxb.) Kuntze	
Zingiberaceae	*Alpinia chinensis* (J. König) Roscoe	
	Alpinia hainanense K. Schum.	
	Alpinia strobiliformis T. L. Wu & S. J. Chen var. *glabra* T. L. Wu	

Table 2. Orchids recorded at Jianfengling in January and April, 1998.

Scientific name	Habitat	Remarks
Anoectochilus roxburghii (Wall.) Lindl.	on forest floor with rich humus	terrestrial, Vulnerable
Appendicula cornuta Blume	on rock beside the stream	epiphytic
Arundina graminifolia (D. Don) Hochr.	on slope along the road	terrestrial
Bulbophyllum ambrosia (Hance) Schtr.	on tree trunk in forest	epiphytic
Bulbophyllum affine Lindl.	on tree trunk in forest	epiphytic
Bulbophyllum sp.	on tree trunk in forest	epiphytic
Calanthe sp.	on forest floor with rich humus	terrestrial
Ceratostylis hainanensis Z.H. Tsi	on tree trunk in forest	epiphytic, endemic to Hainan
Ceratostylis subulata Blume	on tree trunk in forest	epiphytic
Cymbidium dayanum Rchb.f.	on tree trunk in forest	epiphytic
Cymbidum eburneum Lindl.	on tree trunk in forest	epiphytic, Endangered
Cymbidum sinense (Andr.) Willd.	on forest floor with rich humus	terrestrial, Endangered
Cymbidum c.f. *kanran* Makino	on forest floor with rich humus	terrestrial
Dendrobium densiflorum Lindl. ex Wall.	on tree trunk in forest	epiphytic, Vulnerable
Dendrobium hainanensis Rolfe	on tree trunk in forest	epiphytic
Dendrobium williamsonii Day et Rchb. f.	on tree trunk in forest	epiphytic
Eria thao Gagnap.	on tree trunk/ or on rock in forest	epiphytic
Liparis luteola Lindl.	on mossy rock beside the stream in forest	epiphytic
Phaius tankervilliae (Banks ex L'He'r)Blume	on forest floor beside the stream	terrestrial
Pholidota chinensis Lindl.	on tree trunk in forest	epiphytic
Vanda subconcolor T. Tang et F.T. Wang	on mossy rock with humus beside the stream	epiphytic, Endangered

Mammals

A few direct sightings of mammals were made at Jianfengling during these visits (Table 4). The record of Indochinese Flying Squirrel *Hylopetes phayrei* was unusual in view of the very short survey period.

In addition to these direct sightings, diggings and tracks of Wild Boar *Sus scrofa* were frequently encountered. Scats believed to be of Asiatic Black Bear *Ursus thibetanus* were found and photographed in mature forest.

Table 4. Direct records of mammals made at Jianfengling, 9-12 April 1998, 16-20 February 2001 and 5 August 2001.

Scientific name	English name	Date	Recorder	Notes
Tupaia belangeri	Northern Tree Shrew	12 Apr 1998	LKS	
Sus scrofa	Wild Boar	19 Jan 2001	LKS	
Muntiacus muntjak	Indian Muntjac	19 Jan 2001	LKS	
Callosciurus erythraeus	Pallas's Squirrel	11 Apr 1998	LKS, BH	
Dremomys pyrrhomerus	Red-hipped Squirrel	daily, 16 to 20 Feb 2001	LKS	
Ratufa bicolor	Black Giant Squirrel	18 Feb 2001	LKS	
Tamiops maritimus	Maritime Striped Squirrel	5 Aug 2001	BC, LKS	
Hylopetes phayrei	Indochinese Flying Squirrel	11 Apr 1998	GTR, BH, LKS	photographed

Two local people were interviewed about the status of mammals in Jianfengling. They were Mr. Zhang, Reserve Station Director, and Mr. Jiang, Forestry Warden. Table 5 shows the status of mammals at Jianfengling, based on available evidence including these interviews and on the specimen collection at the reserve.

Table 5. The status of mammals (excluding Erinaceidae, Talpidae, Soricidae, Muridae and Chiroptera) at Jianfengling Nature Reserve based on interviews with reserve staff Mr. Zhang and Mr. Jiang. Mammal specimens collected from the reserve area and stored in the reserve's specimen room are also noted. Species names and sequence follow Wilson & Cole (2000); synonyms and names commonly used by Chinese scientists are included in brackets.

Scientific name	English name	Zhang	Jiang	Specimens	Probable status
Tupaia belangeri	Northern Tree Shrew	++	+		present
Macaca mulatta	Rhesus Monkey	++	++	2	present
Hylobates concolor	Crested Gibbon	–*	–		extirpated
Prionailurus bengalensis (Felis bengalensis)	Leopard Cat	++	+	1	present
Neofelis nebulosa	Clouded Leopard	+	+		insecure
Herpestes javanicus (H. auropunctatus)	Javan Mongoose	++	–		present
Herpestes urva	Crab-eating Mongoose	++	–		present
Lutra lutra	European Otter	++	–		insecure
Martes flavigula	Yellow-throated Marten	++	–		present
Melogale moschata	Chinese Ferret-badger	++	–	1	present
Mustela kathiah	Yellow-bellied Weasel	++	+		present
Ursus thibetanus	Asiatic Black Bear	+	+	1	insecure
Paguma larvata	Masked Palm Civet	++	++		present
Paradoxurus hermaphroditus	Asian Palm Civet	–	+		insecure
Viverra zibetha	Large Indian Civet	+	–		insecure
Viverricula indica	Small Indian Civet	+	–		insecure
Sus scrofa	Wild Boar	++	++		present
Muntiacus muntjak	Indian Muntjac	++	++	1	present
Cervus unicolor	Sambar	++	+	1	present
Manis pentadactyla	Chinese Pangolin	++	++		present
Callosciurus erythraeus	Pallas's Squirrel	++	++	1	present
Dremomys pyrrhomerus	Red-hipped Squirrel	++	–	2	present
Ratufa bicolor	Black Giant Squirrel	++	–		present
Tamiops maritimus (T. swinhoei hainanus)	Maritime Striped Squirrel	++	++	1	present
Belomys pearsonii	Hairy-footed Flying Squirrel	–	–	1	insecure
Hylopetes alboniger	Particolored Flying squirrel	+	–		insecure
Hylopetes phayrei (Petinomys electilis)	Indochinese Flying squirrel	–	–		present (see Table 4)
Petaurista philippensis (P. hainana)	Indian Giant Flying Squirrel	–	–	1	insecure
Atherurus macrourus (Hystrix macrourus)	Asiatic Brush-tailed Porcupine	+	–		insecure
Malayan Porcupine (H. hodgsoni)	Chinese Porcupine	++	++		present

* Crested Gibbon reportedly occurred in Jianfengling in the 1980s

Particolored Flying Squirrel *Hylopetes alboniger* is considered Endangered globally. Clouded Leopard *Neofelis nebulosa* is listed as globally Vulnerable, and is Class I protected in China. Asiatic Black Bear is globally Vulnerable, and Class II protected in China. Chinese Porcupine *Malayan Porcupine* is considered globally Vulnerable. Rhesus Monkey *Macaca mulatta* and Chinese Pangolin *Manis pentadactyla* are considered globally Lower Risk (Near-threatened), and are Class II protected in China. Yellow-throated Marten *Martes flavigula,* European Otter *Lutra lutra*, Large Indian Civet *Viverra zibetha*, Small Indian Civet *Viverricula indica*, Indian Giant Flying Squirrel *Petaurista philippensis* and Sambar *Cervus unicolor* are also Class II protected nationally.

Some of the species reported, such as Clouded Leopard, Asiatic Black Bear, Yellow-throated Marten and the flying squirrels, are probably dependent on primary or high-integrity secondary forest in South China.

Birds

Ninety-five bird species were recorded from the Jianfengling Nature Reserve area during the 1998 and 2001 surveys (Table 6). The most frequently recorded species included Black-browed Barbet *Megalaima oorti*, Bronzed Drongo *Dicrurus aeneus*, Rufous-faced Warbler *Abroscopus gularis*, Mountain Bulbul *Hypsipetes mcclellandii*, Grey-cheeked Fulvetta *Alcippe morrisonia*, Greater Yellownape *Picus flavinucha*, Crested Goshawk *Accipiter trivirgatus*, Black-throated Laughingthrush *Garrulax chinensis*, Yellow-browed Warbler *Phylloscopus inornatus*, Puff-throated Bulbul *Criniger pallidus*, Scarlet Minivet *Pericrocotus flammeus*, Grey-chinned Minivet *Pericrocotus solaris*, Asian Palm Swift *Cypsiurus parvus* and Red-headed Trogon *Harpactes erythrocephalus*.

Table 6. Birds of Jianfengling, showing number of individuals in each encounter during the 1998 survey, 8 to 12 April 1998, and total number recorded in the 2001 surveys (including, in the February survey, both mistnetting and other records). Also indicated are species recorded in recent years (Zeng *et al.*, 1995). Sequence follows Clements (2000).

Scientific name	English name	Zeng *et al.* (1995)	Apr 1998	Feb 2001	Aug 2001
Tachybaptus ruficollis	Little Grebe	✓	✓	✓	✓
Phalacrocorax carbo	Great Cormorant	✓			
Ardea cinerea	Grey Heron	✓			
Casmerodius albus	Great Egret	✓	✓		
Ardeola bacchus	Chinese Pond Heron	✓	✓	✓	
Bubulcus ibis	Cattle Egret	✓			
Butorides striatus	Little Heron	✓	✓	✓	✓
Nycticorax nycticorax	Black-crowned Night Heron	✓	✓		
Gorsachius melanolophus	Malayan Night Heron	✓			
Ixobrychus cinnamomeus	Cinnamon Bittern	✓			
Pernis ptilorhynchus	Oriental Honey-buzzard		✓		
Milvus migrans	Black Kite	✓			
Spilornis cheela	Crested Serpent Eagle	✓	✓	✓	
Circus aeruginosus	Eurasian Marsh Harrier	✓			
Accipiter trivirgatus	Crested Goshawk	✓	✓	✓	
Accipiter badius	Shikra	✓	✓	✓	
Accipiter soloensis	Chinese Goshawk	✓			
Accipiter virgatus	Besra	✓	✓		
Accipiter nisus	Eurasian Sparrowhawk	✓			
Buteo buteo	Common Buzzard	✓			
Ictinaetus malayensis	Black Eagle	✓			
Hieraaetus fasciatus	Bonelli's Eagle	✓			
Spizaetus nipalensis	Mountain Hawk Eagle	✓	✓		
Falco tinnunculus	Common Kestrel	✓			
Francolinus pintadeanus	Chinese Francolin	✓	✓		
Arborophila ardens	Hainan Partridge	✓	✓	✓	✓
Gallus gallus	Red Junglefowl	✓			
Lophura nycthemera	Silver Pheasant	✓	✓	✓	✓
Polyplectron katsumatae	Hainan Peacock Pheasant	✓			
Turnix tanki	Yellow-legged Buttonquail	✓			
Turnix suscitator	Barred Buttonquail	✓			
Gallirallus striatus	Slaty-breasted Rail	✓			
Amaurornis phoenicurus	White-breasted Waterhen	✓	✓		
Gallinula chloropus	Common Moorhen	✓	✓	✓	✓
Rostratula benghalensis	Greater Painted-snipe	✓			
Himantopus himantopus	Black-winged Stilt	✓			
Pluvialis fulva	Pacific Golden Plover	✓			
Charadrius dubius	Little Ringed Plover	✓			

Scientific name	English name	Zeng *et al.* (1995)	Apr 1998	Feb 2001	Aug 2001
Scolopax rusticola	Woodcock	✓	✓	✓	
Gallinago stenura	Pintail Snipe	✓			
Gallinago megala	Swinhoe's Snipe	✓			
Gallinago gallinago	Common Snipe	✓			
Tringa nebularia	Common Greenshank	✓			
Tringa ochropus	Green Sandpiper	✓			
Tringa glareola	Wood Sandpiper	✓			
Actitis hypoleucos	Common Sandpiper	✓			
Streptopelia orientalis	Oriental Turtle Dove	✓			
Streptopelia tranquebarica	Red Collared Dove	✓			
Streptopelia chinensis	Spotted Dove	✓			
Macropygia unchall	Barred Cuckoo Dove	✓			
Chalcophaps indica	Emerald Dove	✓			
Treron curvirostra	Thick-billed Green Pigeon	✓			
Ducula aenea	Green Imperial Pigeon	✓			
Ducula badia	Mountain Imperial Pigeon	✓		✓	
Psittacula alexandri	Red-breasted Parakeet	✓			
Hierococcyx sparverioides	Large Hawk Cuckoo		✓		
Cuculus micropterus	Indian Cuckoo	✓	✓		
Cacomantis merulinus	Plaintive Cuckoo	✓			
Chrysococcyx maculatus	Asian Emerald Cuckoo	✓			
Surniculus lugubris	Drongo Cuckoo	✓			
Eudynamis scolopacea	Asian Koel	✓			
Phaenicophaeus tristis	Green-billed Malkoha	✓			
Centropus sinensis	Greater Coucal	✓			
Centropus bengalensis	Lesser Coucal	✓			
Otus spilocephalus	Mountain Scops Owl	✓	✓		
Otus bakkamoena	Collared Scops Owl	✓			
Ketupa zeylonensis	Brown Fish Owl	✓			
Strix leptogrammica	Brown Wood Owl	✓		✓	
Glaucidium brodiei	Collared Owlet	✓		✓	
Glaucidium cuculoides	Asian Barred Owlet	✓		✓	
Caprimulgus indicus	Grey Nightjar	✓	✓		
Caprimulgus macrurus	Large-tailed Nightjar	✓			
Caprimulgus affinis	Savanna Nightjar	✓			
Hirundapus cochinchinensis	Silver-backed Needletail	✓			
Cypsiurus balasiensis	Asian Palm Swift	✓	✓	✓	✓
Apus pacificus	Fork-tailed Swift	✓			
Harpactes erythrocephalus	Red-headed Trogon	✓	✓	✓	✓
Alcedo atthis	Common Kingfisher	✓	✓	✓	
Ceyx erithacus	Oriental Dwarf Kingfisher	✓			
Halcyon smyrnensis	White-throated Kingfisher	✓			✓
Halcyon pileata	Black-capped Kingfisher	✓			
Ceryle rudis	Pied Kingfisher	✓			
Megaceryle lugubris	Crested Kingfisher	✓			
Merops philippinus	Blue-tailed Bee-eater	✓			
Nyctyornis athertoni	Blue-bearded Bee-eater	✓		✓	✓
Eurystomus orientalis	Dollarbird	✓	✓		
Upupa epops	Hoopoe	✓			
Megalaima oorti	Black-browed Barbet	✓	✓	✓	✓
Dendrocopos canicapillus	Grey-capped Pygmy Woodpecker	✓		✓	✓
Dendrocopos major	Great Spotted Woodpecker	✓	✓		

Scientific name	English name	Zeng *et al.* (1995)	Apr 1998	Feb 2001	Aug 2001
Picus chlorolophus	Lesser Yellownape	✓		✓	
Picus flavinucha	Greater Yellownape	✓	✓	✓	✓
Blythipicus pyrrhotis	Bay Woodpecker	✓	✓	✓	✓
Serilophus lunatus	Silver-breasted Broadbill	✓		✓	✓
Pitta soror	Blue-rumped Pitta	✓			
Pitta nympha	Fairy Pitta	✓			
Hirundo rustica	Barn Swallow		✓		✓
Hirundo daurica	Red-rumped Swallow	✓			
Delichon dasypus	Asian House Martin	✓			
Dendronanthus indicus	Forest Wagtail	✓			
Motacilla alba	White Wagtail	✓		✓	✓
Motacilla flava	Yellow Wagtail	✓			
Motacilla cinerea	Grey Wagtail	✓		✓	
Anthus richardi	Richard's Pipit	✓			
Anthus hodgsoni	Olive-backed Pipit	✓	✓	✓	
Anthus cervinus	Red-throated Pipit	✓			
Coracina macei	Large Cuckooshrike	✓		✓	
Coracina melaschistos	Black-winged Cuckoo Shrike	✓	✓	✓	
Pericrocotus roseus	Rosy Minivet	✓			
Pericrocotus flammeus	Scarlet Minivet	✓	✓	✓	✓
Pericrocotus solaris	Grey-chinned Minivet	✓	✓	✓	✓
Pycnonotus sinensis	Light-vented Bulbul	✓	✓	✓	✓
Criniger pallidus	Puff-throated Bulbul	✓	✓	✓	✓
Hemixos castanonotus	Chestnut Bulbul	✓	✓	✓	✓
Hypsipetes mcclellandii	Mountain Bulbul	✓	✓	✓	✓
Hypsipetes leucocephalus	Black Bulbul	✓		✓	
Chloropsis hardwickei	Orange-bellied Leafbird	✓	✓	✓	✓
Monticola solitarius	Blue Rock Thrush	✓			
Myophonus caeruleus	Blue Whistling Thrush				✓
Zoothera citrina	Orange-headed Thrush	✓			
Zoothera sibirica	Siberian Thrush	✓			
Zoothera dauma	Scaly Thrush		✓		
Turdus cardis	Japanese Thrush	✓			
Turdus merula	Eurasian Blackbird	✓			
Prinia flaviventris	Yellow-bellied Prinia	✓			
Prinia inornata	Plain Prinia	✓			
Urosphena squameiceps	Asian Stubtail	✓			
Cettia pallidipes	Pale-footed Bush Warbler	✓			
Bradypterus luteoventris	Brown Bush Warbler	✓			
Bradypterus tacsanowskius	Chinese Bush Warbler	✓			
Locustella lanceolata	Lanceolated Warbler	✓			
Phylloscopus inornatus	Yellow-browed Warbler	✓	✓	✓	
Phylloscopus trochiloides	Greenish Warbler	✓			
Phylloscopus reguloides	Blyth's Leaf Warbler	✓			
Phylloscopus hainanus	Hainan Leaf Warbler	✓	✓	✓	✓
Phylloscopus ricketti	Sulphur-breasted Warbler	✓			
Abroscopus albogularis	Rufous-faced Warbler	✓	✓	✓	✓
Muscicapa dauurica	Asian Brown Flycatcher	✓			
Ficedula mugimaki	Mugimaki Flycatcher	✓			
Ficedula parva	Red-throated Flycatcher	✓			
Ficedula hyperythra	Snowy-browed Flycatcher	✓			
Cyanoptila cyanomelana	Blue-and-white Flycatcher	✓			
Niltava davidi	Fujian Niltava			✓	

Scientific name	English name	Zeng *et al.* (1995)	Apr 1998	Feb 2001	Aug 2001
Cyornis hainana	Hainan Blue Flycatcher	✓	✓	✓	✓
Cyornis unicolor	Pale Blue Flycatcher	✓			
Erithacus akahige	Japanese Robin			✓	
Luscinia sibilans	Rufous-tailed Robin	✓		✓	
Luscinia calliope	Siberian Rubythroat	✓			
Tarsiger cyanurus	Orange-flanked Bush Robin	✓		✓	
Copsychus saularis	Magpie Robin	✓			
Copsychus malabaricus	White-rumped Shama	✓			✓
Phoenicurus auroreus	Daurian Redstart	✓			
Rhyacornis fuliginosus	Plumbeous Water Redstart	✓			
Myiomela leucura	White-tailed Robin	✓			
Enicurus leschenaulti	White-crowned Forktail	✓	✓	✓	✓
Saxicola torquata	Common Stonechat	✓			
Rhipidura albicollis	White-throated Fantail	✓		✓	
Hypothymis azurea	Black-naped Monarch	✓		✓	
Terpsiphone paradisi	Asian Paradise-flycatcher	✓			
Garrulax monileger	Lesser Necklaced Laughingthrush	✓		✓	
Garrulax pectoralis	Greater Necklaced Laughingthrush	✓	✓		
Garrulax maesi	Grey Laughingthrush	✓	✓	✓	✓
Garrulax chinensis	Black-throated Laughingthrush	✓	✓	✓	✓
Garrulax canorus	Hwamei	✓			✓
Pomatorhinus hypoleucos	Large Scimitar Babbler	✓		✓	✓
Pomatorhinus ruficollis	Streak-breasted Scimitar Babbler	✓	✓	✓	✓
Napothera epilepidota	Eyebrowed Wren Babbler	✓	✓	✓	
Stachyris ruficeps	Rufous-capped Babbler	✓	✓	✓	✓
Stachyris striolata	Spot-necked Babbler	✓			
Pteruthius flaviscapis	White-browed Shrike Babbler	✓		✓	
Minla cyanouroptera	Blue-winged Minla	✓			
Alcippe brunnea	Dusky Fulvetta	✓	✓	✓	✓
Alcippe morrisonia	Grey-cheeked Fulvetta	✓	✓	✓	✓
Yuhina zantholeuca	White-bellied Yuhina	✓	✓	✓	✓
Paradoxornis gularis	Grey-headed Parrotbill	✓		✓	✓
Parus major	Great Tit	✓			
Melanochlora sultanea	Sultan Tit	✓	✓	✓	✓
Sitta solangiae	Yellow-billed Nuthatch			✓	✓
Nectarinia jugularis	Olive-backed Sunbird	✓			
Aethopyga christinae	Fork-tailed Sunbird	✓	✓	✓	✓
Dicaeum concolor	Plain Flowerpecker	✓			
Dicaeum ignipectus	Fire-breasted Flowerpecker	✓	✓		
Dicaeum cruentatum	Scarlet-backed Flowerpecker	✓			
Zosterops japonicus	Japanese White-eye	✓		✓	✓
Oriolus chinensis	Black-naped Oriole	✓			
Oriolous traillii	Maroon Oriole	✓			
Lanius cristatus	Brown Shrike	✓			
Lanius schach	Long-tailed Shrike	✓			✓
Tephrodornis gularis	Large Woodshrike	✓		✓	✓
Dicrurus macrocercus	Black Drongo	✓			
Dicrurus leucophaeus	Ashy Drongo	✓			

Scientific name	English name	Zeng *et al.* (1995)	Apr 1998	Feb 2001	Aug 2001
Dicrurus annectans	Crow-billed Drongo	✓			
Dicrurus aeneus	Bronzed Drongo	✓	✓	✓	✓
Dicrurus paradiseus	Greater Racket-tailed Drongo	✓	✓	✓	
Artamus fuscus	Ashy Woodswallow	✓	✓		✓
Urocissa whiteheadi	White-winged Magpie	✓		✓	
Cissa hypoleuca	Indochinese Green Magpie	✓		✓	
Dendrocitta formosae	Grey Treepie	✓	✓	✓	✓
Temnurus temnurus	Ratchet-tailed Treepie	✓	✓	✓	✓
Pica pica	Black-billed Magpie	✓			
Corvus macrorhynchos	Large-billed Crow	✓			
Corvus torquatus	Collared Crow	✓			
Acridotheres cristatellus	Crested Myna	✓			
Sturnus sinensis	White-shouldered Starling	✓			
Sturnus sericeus	Red-billed Starling	✓			
Passer montanus	Eurasian Tree Sparrow	✓			
Lonchura striata	White-rumped Munia	✓			
Lonchura punctulata	Scaly-breasted Munia	✓			
Emberiza spodocephala	Black-faced Bunting			✓	

Japanese Robin *Erithacus akahige* is a new record for Hainan. New records for the reserve included Oriental Honey-buzzard *Pernis ptilorhynchus*, Large Hawk Cuckoo *Hierococcyx sparverioides*, Blue Whistling Thrush *Myophonus caeruleus*, Fujian Niltava *Niltava davidi* and Black-faced Bunting *Emberiza spodocephala*.

In addition to these firm records, a glimpse was caught (by JRF) of an unidentified medium-sized ardeid, of dull coloration, in half-light at dawn. From the size and location it was probably either a Malayan Night Heron *Gorsachius melanolophus* or a White-eared Night Heron *Gorsachius magnificus*, but firm identification was not possible.

White-eared Night Heron is an Endangered species globally, and Class II protected in China. Hainan Partridge *Arborophila ardens* and Fairy Pitta *Pitta nympha* are globally Vulnerable, and Class II protected in China. Hainan Leaf Warbler *Phylloscopus hainanus* is considered Vulnerable. Yellow-billed Nuthatch *Sitta solangiae* is Lower Risk (Near-threatened). All the recorded raptor and owl species, as well as Red Junglefowl *Gallus gallus*, Hainan Peacock Pheasant *Polyplectron katsumatae*, Silver Pheasant *Lophura nycthemera*, Barred Cuckoo Dove *Macropygia unchall*, Thick-billed Green Pigeon *Treron curvirostra*, Mountain Imperial Pigeon *Ducula badia*, Greater Coucal *Centropus sinensis*, Lesser Coucal *Centropus bengalensis*, Silver-backed Needletail *Hirundapus cochinchinensis* and Blue-rumped Pitta *Pitta soror*, are Class II protected species in China.

Jianfengling has a rich recorded bird fauna, with high diversity of raptors, owls, pigeons, woodpeckers, kingfishers, cuckoos and passerines. However not all of the recorded bird fauna was encountered during this brief survey. The lack of pigeons, in particular, may reflect a decline in populations locally due to hunting.

Reptiles and Amphibians

Eighteen species of amphibian, nine lizards, eight snakes and one terrapin were found at Jianfengling (Table 7). The most frequently encountered species were *Amolops torrentis* and *Rana spinulosa*.

Table 7. Amphibians and reptiles of Jianfengling, 8 to 12 April 1998 and 4 to 5 August 2001. Sequence follows Zhao & Adler (1993).

Species	Habitat	8-12 Apr 1998	4-5 Aug 2001
AMPHIBIA			
Tylototriton hainanensis	pool in seepage stream, 970 m (shaded in forest, with leaf litter, sandy substrate)		✓
Leptobrachium hainanensis	stream	✓, tadpoles	
Bufo galeatus	stream	✓	
Bufo melanostictus	marsh	tadpoles	
	forest	✓	✓
Amolops torrentis	stream	✓	✓
Rana fragilis	stream	✓	
	forest	✓	✓
	seep	✓	✓
Rana guentheri	forest	✓	
	forest edge	✓	
	pond	✓	✓
Rana hainanensis	stream	✓	
Rana livida	stream	✓	
Rana johnsi	forest	✓	
Rana spinulosa	stream	✓	
	forest	✓	
	pond	✓	
Rana tiannanensis	stream	✓	
Rana versabilis	stream	✓	
Philautus odontotarsus	pond	✓	
Philautus ocellatus	forest	✓	
	stream	?	
	pond	✓	
Polypedates megacephalus	pond	✓	
Polypedates mutus	pond	✓	
	stream	✓	
	plantation	✓	
Microhyla heymonsi	stream	✓, tadpoles	
	forest	✓	
	pond	✓	
REPTILIA			
Sacalia quadriocellata	stream	✓	
Gekko chinensis	forest	✓	
	village	✓	
Hemidactylus frenatus	village	✓	
Acanthosaura lepidogaster	forest	✓	✓
Calotes versicolor	forest edge	✓	
	plantation	✓	
Calotes microlepis	forest	✓	
Draco maculatus	forest	✓	
Eumeces quadrilineatus	forest	✓	
Scincella sp.	forest	✓	
Dibamus sp.	forest	✓	
Achalinus rufescens	forest	✓	
Elaphe prasina	forest	✓	
Oligodon ornatus?	forest	✓	
Rhabdophis adleri	forest	✓	✓
	stream		
Rhynchophis bouolengeri	logged forest	✓	
Sibynophis collaris	logged forest	✓	
Sinonatrix percarinata	stream	✓	
Trimeresurus stejnegeri	logged forest	✓	

A legless lizard (*Dibamus* sp.) was found, representing only the second record of this undescribed species (the first record was made at Jianfengling in the 1960s). In addition to this, one skink (*Scincella* sp.) cannot be positively identified and it may be new to China or even new to science. The records of *Rana johnsi*, *Oligodon ornatus* and *Sibynophis collaris*

are the first for Hainan. *Rana johnsi* has a restricted distribution and is also known from Guangxi and Vietnam. *Rana hainanensis, Rana tiannanensis, Calotes microlepis, Tropidophorus hainanensis, Achalinus rufescens* and *Elaphe prasina* are apparently new for the reserve. Six of the species, *Tylototriton hainanensis, Leptobrachium hainanensis, Amolops torrentis, Rana fragilis, Rana hainanensis* and *Rhabdophis adleri*, are endemic to Hainan.

Specimens of *T. hainanensis* (after Fei, 1999) also occurred in the specimen room of the reserve. The following species, which were not recorded during these surveys, were also present in the specimen room: *Varanus salvator, Python molurus, Typhlops diardii, Pareas hamptoni, Psammodynastes pulverulentus, Naja atra, Ophiophagus hannah* and *Pseudoxenodon bambusicolor*. During the brief survey in August 2001, reserve staff reported seeing four hatchlings of *Varanus salvator* (Water Monitor) the previous year.

Additional species reported from the Jianfengling area include *Echinotriton andersoni, Pelophryne sculpta* (as *Nectophryne sculptus*), *Hyla simplex, Occidozyga martensii* (as *O. laevis*), *Rana adenopleura, Rana cancrivora, Rana macrodactyla, Rana taipehensis, Amolops hainanensis, Rana andersonii, Rana rugulosa* (as *R. tigrina rugulosa*), *Rana sanguinea* (as *R. varians*), *Occidozyga lima, Buergeria oxycephala, Chirixalus vittatus, Chirixalus doriae, Rhacophorus rhodopus, Microhyla ornata, Microhyla pulchra, Kalophrynus interlineatus* (as *K. pleurostigma interlineatus*), *Kaloula pulchra, Cistoclemmys galbinifrons* (as *Cuora hainanensis*), *Platysternon megacephalum, Pelodiscus sinensis* (as *Trionyx sinensis*), *Acanthosaura armata, Leiolepis reevesii* (as *L. belliana*), *Goniurosaurus lichtenfelderi* (as *Eublepharis lichtenfelderi*), *Gehyra mutilata, Hemidactylus bowringii, Hemidactylus garnotii, Takydromus sexlineatus, Ateuchosaurus chinensis, Ramphotyphlops braminus, Ahaetulla prasina* (as *Dryophis prasinus*), *Boiga multomaculata, Dinodon rosozonatum, Dendrelaphis pictus* (as *Ahaetulla ahaetulla)*, *Elaphe schrenckii, Enhydris bennetti, Amphiesma craspedogaster* (as *Natrix craspedogaster*), *Amphiesma miyajimae* (as *Natrix miyajimae*), *Amphiesma stolatum* (as *Natrix stolata*), *Rhabdophis tigrinus* (as *Natrix tigrina*), *Oligodon chinensis, Oligodon formosanus, Oligodon cinereus* (as *O. swinhonis*), *Plagiopholis blakewayi, Ptyas korros, Ptyas mucosus, Sibynophis chinensis, Xenochrophis piscator* (as *Natrix piscator*), *Bungarus multicinctus, Calliophis kelloggi, Calliophis macclellandi, Hydrophis cyanoccinctus* and *Trimeresurus stejnegeri* (Liu *et al.*, 1973; Zeng *et al.*, 1995). There are some discrepancies between the scientific names and the Chinese names given by Zeng *et al.* (1995) and the above list is based only on the Chinese names. Also, the known ranges of some of the species reported by Zeng *et al.* (1995), e.g. *Echinotriton andersoni, Amphiesma miyajimae, Rhabdophis tigrinus, Elaphe schrenckii*, and *Plagiopholis blakewayi*, are far from Hainan and these records should be treated with caution since the study methods are not explained in the book.

Tylototriton hainanensis and *Rana rugulosa* are Class II protected species in China. The presence of many stream species (e.g. *Leptobrachium hainanensis, Amolops torrentis* and *Rana tiannanensis*) and forest specialists (e.g. *T. hainanensis, Acanthosaura lepidogaster, Dibamus* sp. and *Elaphe prasina*) indicates that the main core area of Jianfengling Nature Reserve has high ecosystem integrity.

Fish

Fourteen species of freshwater fish were recorded from Jianfengling (Table 8). Some of the specimens await specialist verification. The most frequently encountered species were *Capoeta semifasciolata* and *Nicholsicypris normalis*. The high abundance of *P. semifasciolatus* and, in particular, the occurrence of (predominantly lowland) *Pseudorasbora parva*, may be attributable to artificial stocking of aquaculture species in Tianchi Lake.

Table 8. Freshwater fish species recorded at Jianfengling and neighbouring sites. Sequence of families follows Nelson (1994).

Species
Nicholsicypris normalis
Capoeta semifasciolata
Spinibarbus hollandi
Onychostoma lepturus
Pseudorasbora parva
Misgurnus anguillicaudatus
Balitoridae sp. 1
Pterocryptis sp. 1
Pterocryptis gilberti
Gambusia affinis
Monopterus albus
Rhinogobius giurinus
Macropodus opercularis
Channa gachua

The geographically widespread *Spinibarbus hollandi* is becoming rare due to overfishing. The presence of stream specialist species such as *Spinibarbus hollandi* and *Onychostoma lepturus* indicated that the streams at Jianfengling were in good ecological condition. However, no fish were seen in the August 2001 survey, although fish were abundant in 1998. Reserve staff reported one of the streams had been poisoned in 2000. In view of the remoteness of that stream, it is probable that other stream systems closer to human habitation in the Jianfengling area have been affected by the same destructive fishing methods.

Ants

At least 61 ant species were recorded from Jianfengling in the present survey (Table 9). The most frequently encountered of these were *Pachycondyla* (cf. *luteipes*) sp. 2, *Prenolepis* (cf. *emmae*) sp. 1, *Odontomachus monticola, Polyrhachis halidayi*, *Polyrhachis tyrannica* and *Leptogenys kitteli*.

Table 9. Ants of Jianfengling.

Species	**Habitat**
Acanthomyrmex (cf. *crassispinus*) sp. 1	forest
Acropyga jiangxiensis	forest
Aenictus (*laeviceps* group) sp. 2	forest
Anoplolepis gracilipes	roadside
Aphaenogaster (cf. *hunanensis*) sp. 3	forest
Camponotus nicobarensis	garden
Camponotus sp.	forest
Camponotus (*variegatus* group) sp. 4	shrubland
Cardiocondyla sp. 2	forest
Cataulacus granulatus	forest, shrubland
Crematogaster (cf. *travancorensis*) sp. 2	shrubland
Crematogaster (cf. *dohrni*) sp. 8	forest
Dolichoderus sp. 12	forest
Gnamptogenys bicolor	shrubland
Hypoponera sp.	forest
Iridomyrmex (*anceps* group) sp. 1	shrubland
Kartidris (cf. *galos*) sp. 1	forest
Lepisiota rothneyi	forest
Leptogenys kitteli	forest
Leptogenys peuqueti	forest
Leptogenys sp.	forest
Monomorium floricola	garden
Monomorium pharaonis	shrubland
Myrmoteras (cf. *cuneinodum*) sp. 1	forest
Odontomachus monticola	forest
Odontoponera (cf. *denticulata*) sp. 1	shrubland
Oecophylla smaragdina	urban
Pachycondyla (*javana* group) sp. 1	forest
Pachycondyla (cf. *luteipes*) sp. 2	forest

Species	Habitat
Pachycondyla (cf. *nigrita*) sp. 17	forest
Paratrechina (cf. *bourbonica*) sp. 4	forest
Paratrechina (nr. *indica*) sp. 9	forest
Paratrechina sp.	forest
Pheidole capellini	forest
Pheidole gatesi	forest
Pheidole tjibodana	forest
Pheidole sp. 11	forest
Pheidole sp. 13	forest
Pheidole (cf. *yeensis*) sp. 40	forest
Pheidole sp.	forest
Pheidologeton diversus	forest
Pheidologeton (cf. *melasolenus*) sp. 8	forest
Polyrhachis dives	shrubland
Polyrhachis halidayi	shrubland
Polyrhachis tyrannica	forest, shrubland
Polyrhachis (*mucronata* group) sp. 13	forest
Polyrhachis (cf. *phalerata*) sp. 2	forest
Prenolepis (cf. *emmae*) sp. 1	forest
Prenolepis magnocula	forest
Pristomyrmex pungens	forest
Rhoptromyrmex wroughtonii	shrubland
Solenopsis geminata	urban
Tapinoma sp. 1	forest
Technomyrmex albipes	shrubland, forest
Tetramorium shensiense	forest
Tetramorium (cf. *eleates*) sp. 16	forest
Tetramorium sp. 17	forest
Tetramorium sp. 28	forest
Tetraponera attenuata	forest

Several species are possibly new to science, and await further investigation. Apparently new records for Hainan are the genera *Acanthomyrmex*, *Acropyga* and *Iridomyrmex*. The genera *Gnamptogenys*, *Myrmoteras* and *Prenolepis*, and the species *Polyrhachis tyrannica*, were first recorded from Hainan in the Bawangling area earlier in the same trip (Kadoorie Farm and Botanic Garden, 2001). In addition to these the following are new records for Jianfengling: *Gnamptogenys bicolor, Lepisiota rothneyi, Leptogenys kitteli, Monomorium pharaonis* and *Technomyrmex albipes*.

In addition to species in the above list, Zeng *et al.* (1995) list *Aenictus javanus, Camponotus dolendus, Camponotus exiguoguttatus, Camponotus irritans, Camponotus japonicus, Camponotus mitis, Camponotus parius, Camponotus quadrinotatus, Cardiocondyla nuda, Crematogaster rogenhoferi, Diacamma rugosum, Dilobocondyla fouqueti, Dolichoderus taprobanae, Dorylus orientalis, Leptogenys diminuta, Meranoplus bicolor, Monomorium destructor, Paratrechina longicornis, Paratrechina vividula, Polyrhachis debilis, Polyrhachis illaudata* (as *P. mayryi* [sic]), *Polyrhachis punctillata, Tapinoma melanocephalum, Technomyrmex horni, Tetramorium kraepelini, Tetramorium smithi, Tetraponera allaborans* and *Tetraponera rufonigra* from Jianfengling (all names corrected by referring to Bolton, 1995). Some of these species identifications may require verification, as they are based on outdated literature.

Certain of the ant species appear to be highly restricted or rare within South China; these include *Dolichoderus* sp. 12, *Tetramorium* sp. 17 and *Tetramorium* sp. 28 (each known only from Jianfengling), *Acanthomyrmex* sp. 1, *Acropyga jiangxiensis*, *Myrmoteras* sp. 1, *Pheidole capellini* and *Pheidole tjibodana*. Some or all of these are likely to be forest specialists. The fauna also includes some species known to be exotics, such as *Anoplolepis gracilipes, Monomorium destructor, Monomorium pharaonis, Paratrechina longicornis* and *Solenopsis geminata*, and others which are possibly exotic, e.g. *Lepisiota rothneyi, Monomorium floricola, Paratrechina* (cf. *bourbonica*) sp. 4 and *Technomyrmex albipes*.

Dragonflies

Thirty-four species of odonates were encountered in Jianfengling during the period 9 to 11 April 1998, of which two are awaiting identification, and a further nine could not be collected or identified in the field (Table 10). The most frequently encountered species were *Mnais mneme*, *Pseudolestes mirabilis* and *Matrona basilaris*. The common and widespread libellulids *Pantala flavescens*, *Trithemis aurora* and *Orthetrum pruinosum* were frequently recorded at ponds, marshes and disturbed areas. One forest species – *Drepanosticta zhoui* – is new to science (Wilson & Reels, 2001), and was first recorded from Bawangling earlier on the same survey trip (Kadoorie Farm and Botanic Garden, 2001). *Orolestes selysi*, *Prodasineura croconota* and *Zygonyx takasago* are new provincial records. A total of 13 new records for the reserve were made.

Table 10. Dragonflies at Jianfengling: species encountered. Sequence follows Wilson & Reels (2001).

Species	**Habitat**	**Notes**
Philoganga robusta	forest	
Matrona basilaris basilaris	forest stream	
Mnais mneme	forest stream, shrub	new reserve record
Rhinocypha fenestrella	forest stream	
Euphaea ornata	forest stream	endemic to Hainan; new reserve record
Orolestes selysi	forest (close to stream)	new record for Hainan
Pseudolestes mirabilis	forest stream	endemic to Hainan
Agriomorpha fusca	forest	
Coeliccia scutellum hainanense	forest	
Coeliccia cyanomelas	forest	
Copera marginipes	tall shrub	new reserve record
Drepanosticta zhoui	forest	new species (endemic to Hainan)
Prodasineura croconota	forest stream	new record for Hainan; endemic to South China
Anax sp.	pond adjacent to forest	not collected
Asiagomphus hainanensis	forest stream	new reserve record; endemic to South China
Stylogomphus chunliuae	forest stream	new reserve record; endemic to South China
Macromia moorei malayana	forest stream	new reserve record
Diplacodes trivialis	tall shrub	
Orthetrum glaucum	pond, shrub	
Orthetrum luzonicum	marshy stream	new reserve record
Orthetrum pruinosum	pond, marsh	
Orthetrum triangulare	forest stream	new reserve record
Pantala flavescens	ubiquitous	
Trithemis aurora	pond, marsh	
Trithemis festiva	marsh	
Zygonyx iris insignis		
Zygonyx takasago	forest stream	new record for Hainan; endemic to South China

Zeng *et al.* (1995) list 64 species for Jianfengling, of which 13 were recorded in the present survey. It has not been possible to verify the other records in this report.

Euphaea ornata and *Pseudolestes mirabilis* are both endemic to Hainan, while *Prodasineura croconota*, *Asiagomphus hainanensis*, *Stylogomphus chunliuae* and *Zygonyx takasago* are endemic to South China. *Agriomorpha fusca* is a monotypic genus considered of high conservation priority (Moore, 1997). The presence of the damsels *Philoganga vetusta*, *Euphaea ornata*, *Orolestes selysi*, *Pseudolestes mirabilis*, *Agriomorpha fusca*, *Drepanosticta zhoui* and *Prodasineura croconota*, together with the dragonflies *Asiagomphus hainanensis*, *Macromia moorei* and *Macromia* sp., indicates that a certain area is healthy and relatively undisturbed.

Butterflies

Thirty-four species of butterfly were encountered at Jianfengling during the period 9 to 11 April (Table 11). Of these, 12 species were not collected or identified in the field.

Table 11. Butterflies: species encountered. Sequence of families follows Bascombe (1995).

Species	Habitat	Notes
Capila pauripunctata	forest	endemic to Hainan
Celaenorrhinus aspersa	forest	
Gerosis phisara	forest around stream	
Papilio helenus	forest around stream	
Papilio memnon	forest around stream	
Papilio protenor	forest around stream	
Appias sp.	forest around stream	
Eurema hecabe	forest	
Eurema sp.	forest around stream	
Abisara echerius	tall shrub/stream	
Acytolepis puspa	forest around stream	
Arhopala sp.	tall shrub/stream	not collected
Eulaceura osteria	forest around stream	
Euthalia niepelti	forest	
Faunis eumeus	forest around stream	
Hypolimnas bolina	forest around stream	
Lethe confusa	forest	
Lethe (Nosea) hainanensis hainanensis	forest	endemic to Hainan
Lethe sp.	forest around stream	
Melanitis leda	tall shrub	
Mycalesis sp.	forest	
Neorina (Ethope) henrici	forest around stream	endemic to Hainan
Neptis sp.	forest around stream	
Parantica sp.	forest around stream	probably *melaneus*
Polygonia (Kaniska) canace	forest	
Polyura sp.	forest	
Precis (Junonia) almana	tall shrub/stream	
Tanaecia julii	forest around stream	
Thaumantis diores	forest	
Ragadia crisilda	forest	
Ypthima motschulskyi	forest	

Three endemic butterfly taxa – *Lethe hainanensis hainanensis*, *Neorina henrici* and *Capila pauripunctata* – were recorded. The latter was described as recently as 1994 (Chou, 1994). *Eulaceura osteria* has not been recorded from mainland China (Chou, 1994; Bascombe, 1995).

Zeng *et al.* (1995) list 449 species for Jianfengling, including all of the species found during the present survey. This figure is rather optimistic and may in fact be a species list for all of Hainan.

Neorina henrici, *Eulaceura osteria*, *Faunis eumeus*, *Lethe hainanensis*, *Thaumantis diores*, *Ragadia crisilda*, *Capila pauripunctata* and *Celaenorrhinus aspersa* are all indicators of good forest.

Rove Beetles

Six staphylinid beetles were recorded from Jianfengling (Table 12). Of these, two - *Stenus* sp. and *Zyras* sp. - are new to science, while the remaining four, *Falagria semilucens*, *Homaeotarsus sanguinolentus*, *Pinophilus* sp. and *Zyras yangi*, are new to Hainan.

Table 12. Rove beetles (Staphylinidae) identified from Jianfengling.

Species	Notes
Falagria semilucens	new to Hainan

Species	Notes
Homaeotarsus sanguinolentus	new to Hainan
Pinophilus sp.	new to Hainan
Stenus sp. nov.	new to science; very distinctive micropterous species
Zyras yangi	new to Hainan; described from China
Zyras sp. nov.	new to science

Summary of flora and fauna

Although some parts of Jianfengling are now degraded, one area with its primary forest cover is of immense value as a refuge for flora and fauna. These surveys recorded 276 species of plants including 21 species of orchids. Some plants, such as *Dacrydium pectinatum*, *Dacrycarpus imbricatus* var. *patulus*, *Alstonia rostrata*, *Madhuca hainanensis*, *Alseodaphne hainanensis*, and *Nephelium topengii*, are now largely confined to such undisturbed forests. A number of highly threatened species (e.g. *Hopea hainanensis*, *Alseodaphne rugosa*, *Cymbidium eburneum*, *Cymbidium sinense*, *Vanda subconcolor*), and many species endemic to Hainan (e.g. *Angiopteris oblanceolata*, *Ardisia densilepidotula*, *Ceratostylis hainanensis*), occur. Many of these species are under national protection. Of the protected and endemic species recorded previously, only a small proportion was found in this survey. However, the finding of certain terrestrial orchids (*Cymbidium sinense* and *Anoectochilus roxburghii*) suggests the forest is still in good condition in places.

The fauna, and especially the amphibians, reptiles and dragonflies, of Jianfengling were found to be highly diverse. They include many species of conservation concern, such as Hainan Partridge, Hainan Leaf Warbler, the newt *Tylototriton hainanensis* and the frogs *Bufo galeatus*, *Rana fragilis* and *Rana johnsi*, and many insect species indicative of high ecological integrity. Undescribed species of reptiles, dragonflies, ants and beetles were also found in these surveys, and the primary forest and streams doubtless hold many more undiscovered species. The reserve may also still harbour highly threatened species whose survival could not be confirmed in this survey, such as Particolored Flying Squirrel, Clouded Leopard, and many forest birds such as White-eared Night Heron and Fairy Pitta. If some of these regionally threatened bird species survive here, Jianfengling must be one of the most important areas for bird conservation in South China. Indeed, the present findings support the view that the biodiversity of Jianfengling is of national importance (MacKinnon *et al*., 1996) despite the reduced extent of the remaining natural forest.

Threats and problems

Forest in the buffer zone had recently been logged and was heavily disturbed. Following the logging ban, a thousand former forestry workers in the area had no other source of income, and some illegal logging and hunting inevitably continued. Attempts have been made to develop tourism in the Jianfengling area, with mixed results. For example, a marsh near the management centre was flooded, apparently in order to create a more picturesque lake (Tianchi Lake), but apparently without assessment or mitigation of the natural habitats lost. This may have contributed to the lack of wetland birds, such as kingfishers and snipe, in the present surveys. In addition, Tianchi Lake has been artificially stocked with 'economic' fishes such as the major carps and, worse still, aliens such as African tilapia (*Oreochromis* spp.) and South American pompano (*Colossoma* sp.). Some of these species are documented invasive species and their introduction is sure to have negative impacts on the natural aquatic ecosystems. Poisoning is another threat; the stream in the main core area, which supported many endemic and rare species, was reportedly poisoned in 2000.

Vendors of wild-caught snakes were also encountered in the tourist area, killing and selling the snakes on demand. Such activities are quite out of place at a nature reserve, and are unlikely to foster an appreciation among the public of their living natural heritage. The demand for wild orchids also threatens the survival of many species in the reserve. Careful

planning is required to attract more tourists without undermining the environment at Jianfengling. The ecological integrity of forest and freshwater habitats are also vulnerable to indirect effects of human disturbance, such as raw sewage from the expanding hotels and the spread of invasive plant and animal species. Several such species were recorded in these surveys.

Opportunities and recommendations

In recent years international attention towards Hainan's biodiversity has increased. MacKinnon *et al*. (1996) recommended forming an extended protected area in southwest Hainan, including Jianfengling and Bawangling, that would be of global conservation importance. A Management and Biological Diversity Protection Plan for Jianfengling was produced in 1998 for the Asian Development Bank (Associates In Rural Development, 1998). There are also current proposals to inject Global Environment Facility funding into Hainan's nature reserves. Such developments provide an excellent opportunity to safeguard the interests of both biodiversity conservation and the local community.

Illegal and inappropriate activities should be immediately stopped at Jianfengling, with increased patrolling and enforcement as necessary. Staff should thoroughly understand the objectives of biodiversity and habitat protection, and motivated to achieve them. It may be necessary to review and refine the previous objectives of the reserve, giving particular attention to conserving endangered and unique elements of the current biota at Jianfengling, including those highlighted in this report.

Any future amendments to the management plans or their implementation should take into account the perspectives of different stakeholders. Plans should incorporate the following elements:

(1) Capacity building needs and schedule. Plans should include specific needs and proposals for personnel recruitment, training and deployment. This will help ensure that funding is directed to achieve the objectives. Increased communication and collaboration between reserve staff and researchers (such as those of the Chinese Academy of Forestry) would enable better understanding of management implications and priorities.

(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. In habitats with high integrity, management should be directed toward maintaining this integrity. In degraded habitats, restoration of ecological diversity and functioning should be among the objectives.

(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.

Ecotourism is an obvious possibility at Jianfengling. The area already has fairly good road access and existing facilities (e.g. hotels, restaurants, an observation tower and a nature trail

just outside the reserve) and the possibility of promoting ecotourism at this reserve should be explored. However, further developments could pose considerable risks to ecosystem integrity; thus all associated developments should be preceded by environmental impact assessments. Education should go hand in hand with this promotion of tourism, and specialised educational staff and materials are suggested. Detailed guidelines for ecotourism are given by Cellabos-Lascuráin (1996) and China Man and Biosphere National Committee (1998).

The restoration of habitats in the buffer zone is an important task that will require the application of scientific expertise in restoration ecology. For example, forest recovery could be enhanced through appropriate planting, while natural freshwater habitats, such as marshes, could be recreated in part of the artificial lake just outside the reserve. Such activities could provide employment for local people, and potential model restoration projects for the Hainan region.

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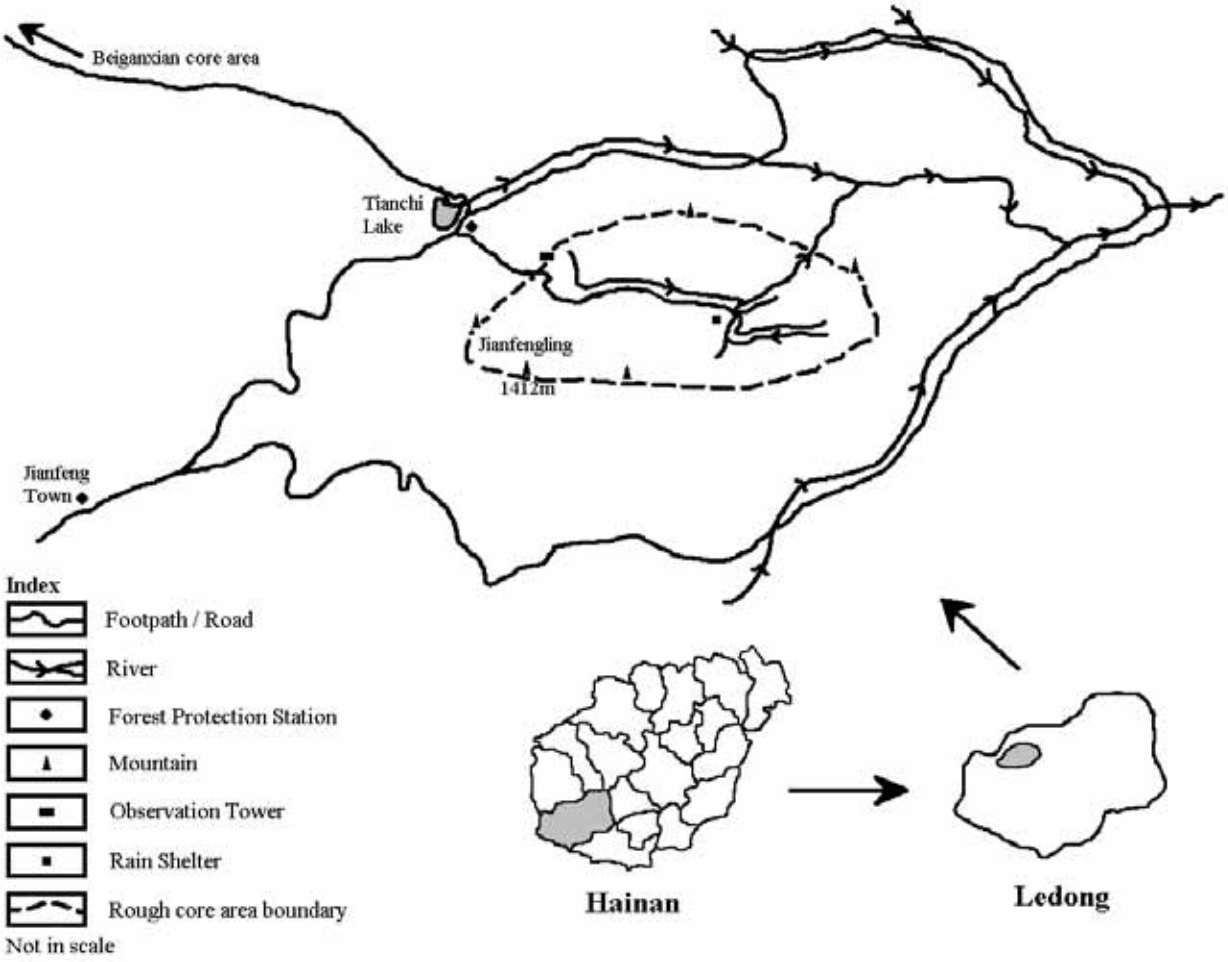

Figure 1 Jianfengling Nature Reserve, Ledong County, Hainan