Report of a Rapid Biodiversity Assessment at Jiaxi Nature Reserve, Western Hainan, China, June 1999

Kadoorie Farm and Botanic Garden
in collaboration with
Hainan Provincial Forestry Department
South China Institute of Botany
Institute of Botany, CAS
Hainan Normal University
South China Normal University
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Background

The present report details the findings of a visit to western 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 phase is on gathering up-to-date information on the distribution and status of fauna and flora.

Citation

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Contents

Translation of some common Chinese geographical terms

Romanized Chinese (pinyin)	English meaning
Bei	north
Dao	island
Dong	east
Feng shui	the Chinese system of geomancy
Feng, Ding	peak
Gang	harbour
Hai	sea
He, Chuan, Jiang	river
Hu, Chi	lake
Keng, Gu	valley
Kou	outlet
Ling	range
Nan	south
Shan	mountain
Shi	city
Tun	hamlet
Wan	bay
Xi	west
Xi, Yong	stream
Xian	county
Xiang, Cun	village

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Objectives

- The aims of the surveys were to collect up-to-date information on the fauna and flora of Jiaxi Nature Reserve, and to use this to help determine conservation priorities within South China.

Methods

- On 12 June 1999, a team from Kadoorie Farm and Botanic Garden in Hong Kong (GS, JRF, ML, LKS, GTR), Hainan Forestry Department in Hainan (FJP, YZD), South China Institute of Botany in Guangdong (XFW, WRJ and the driver Mr. Huang Guoxiong), Institute of Botany in Beijing (TZH), Hainan Normal University in Haikou (WJY), South China Normal University in Guangdong (LZC, XZ) and Xinyang Teachers' College in Henan (LHJ) drove to Ledong County, having conducted a rapid biodiversity assessment of Wuzhishan Nature Reserve (Kadoorie Farm and Botanic Garden, 2003). They surveyed the Jiaxi Nature Reserve on 13 and 14 June.
- During fieldwork visual searching for plants, mammals, birds, reptiles, amphibians, fish, ants, butterflies and dragonflies was conducted. Frogs and birds were also identified by their calls. Plant records were made by field observation, with some specimens collected.
- Status of large and medium-sized mammals at Jiaxi was inferred largely based on interviews with local people, with reference to colour pictures. For purposes of these interviews a list of South China mammals was compiled from various sources including Guangdong Forestry Department and South China Institute of Endangered Animals (1987), Corbet & Hill (1992) and Zhang *et al.* (1997).
- Vascular plant records (excluding orchids) were made or verified by XFW and WRJ, and edited by NSC. Orchid records were made or verified by GS or TZH. Mammal records were made by LKS, GTR, ML or JRF. Records of birds were made or verified by LKS, reptiles and amphibians by ML or LZC, fish by BC and CXL, ants by JRF, butterflies by GTR, dragonflies by GTR and KW of Hong Kong and molluscs by CDN.
- Nomenclature in the report is standardised based, unless otherwise stated, on the following references:
  - Flora (Pteridophyta, Gymnospermae and Angiospermae excluding Orchidaceae): Anon. (1959-2001); Anon. (1996-2001); Anon. (2002a, 2002b); The Plant Names Project (2002);
  - Orchids (Angiospermae: Orchidaceae): Chen (1999); Lang (1999); Tsi (1999);
  - Mammals (Mammalia): D.E. Wilson & Cole (2000);
  - Birds (Aves): Inskipp *et al*. (1996);
  - Reptiles and Amphibians (Reptilia and Amphibia): Zhao E.-M. & Adler (1993); Zhao E. *et al.* (2000);
  - 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): Schorr *et al.* (2001a, 2001b);
  - Butterflies (Insecta: Lepidoptera): Bascombe (1995).
- Information on the global status of species is from IUCN publications, notably IUCN (2002). Certain taxa, including orchids, reptiles, amphibians, fish and invertebrates, have yet to be properly assessed for global status. 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 State Forestry Administration & Ministry of Agriculture (1999) for plants.

Location and management

- Jiaxi Nature Reserve is in western Hainan, at 18°50'-18°56'N, 109°05'-109°14'E at the northern margin of Ledong Yao Autonomous County where it adjoins Changjiang Li Autonomous County.
- The reserve is 83 km^2 in size.
- The reserve has a moderately hilly landscape with an altitude range from 400 to 1,654 m (MacKinnon *et al.*, 1996). The present survey was limited to the area near Fuguangxin Cun and Hongshui He, between 150 m and 980 m.
- The region has a tropical monsoon climate. Climate data for the reserve were not available. Mean monthly temperature for the central mountainous region ranges from 17-19°C in January to 28°C in July (Hainan Bureau of Surveying and Mapping, 1996). Annual precipitation is about 2,200 mm (mainly between May and October), but is lower towards the west of the island. The streams at Jiaxi drain to the southwest towards Hongshui He, a tributary of the Changhua Jiang which flows to the west coast.
- The area was designated as a Provincial Nature Reserve in 1981 to protect *Pinus fenzeliana*. It is managed by the Hainan Provincial Forestry Department.

Results

Vegetation

- The original vegetation of the region should be tropical seasonal evergreen rainforest. The surveyed area, however, had been heavily deforested. The dominant vegetation of the lower altitude area (below 725 m) near the villages was secondary grassland and shrubland. Small patches of secondary forest up to 10 m tall could be seen in ravines. Relatively mature and well-structured forest about 25-30 m tall and up to 80 cm dbh could be seen in more inaccessible ravines above 800 m, with conifers (apparently *Pinus fenzeliana*) more plentiful above 1,100 m. Due to the limited survey time, the flora team was unable to access the condition of the vegetation over the whole region.

Flora

- The present survey recorded 358 vascular plant species, including six gymnosperms in four families and 352 flowering plant species in 89 families (Tables 1 and 2). This is a moderately high number given the limited survey time. Fifty-one orchid species were recorded. No previous floral data are available.
- Among the flora recorded in this survey, there are some species of conservation interest, especially in the remnant and secondary forest patches:
  - *Paphiopedilum appletonianum* is Critically Endangered nationally and listed in CITES Appendix I.
  - *Calocedrus macrolepis*, *Amoora dasyclada*, *Madhuca hainanensis*, *Alseodaphne hainanensis* and *Aquilaria sinensis* are considered globally Vulnerable and are under Class II National Protection in China. *Madhuca hainanensis* is also an endemic to Hainan and is one of the local dominant of seasonal hillside evergreen rainforest in Hainan, whereas *Alseodaphne hainanensis* is endemic to Hainan and North Vietnam. *Aquilaria sinensis* has a long history of cultivation in South China, especially in Guangdong.
  - *Saccopetalum prolificum* is globally Vulnerable.
  - *Pinus kwangtungensis* and *Toona ciliata* are under Class II National Protection. The former is restricted to montane forest in South China, whereas the latter is widespread in South China and found mainly in relatively good forest.

– Twenty-nine species that are endemic to Hainan were also found: *Peristrophe strigosa*, *Artabotrys pilosus*, *Bauhinia hainanensis*, *Ellipanthus glabrifolius*, *Croton chunianus*, *Macaranga bracteata*, *Trigonostemon chinensis* fo. *fungii*, *T. heterophyllus*, *T. xyphophyllorides*, *Lithocarpus fenzelianus*, *Beilschmiedia longipetiolata*, *Amoora tsangii*, *Ardisia crassinervosa*, *A. densilepidotula*, *Syzygium stenocladum*, *S. tephrodes*, *Dalbergia peishaensis*, *Hedyotis cryptantha*, *H. terminaliflora*, *Mussaenda hainanensis*, *Allophylus trichophyllus*, *Nephelium topengii*, *Wikstroemia hainanensis*, *Microcos chungii*, *Plectocomia microstachys*, *Amomum chinense*, *Dendrobium changjiangense*, *Dendrobium sinense* and *Ceratostylis hainanensis*.
– Several other regionally restricted were found: *Polyalthia lauii* (Hainan and Vietnam), *Homalium hainanense* (Hainan and Vietnam), *Hypolytrum hainanense* (Hainan and Hong Kong), *Eria rosea* (Hainan and Hong Kong), *Eria thao* (Hainan, Shiwandashan in Guangxi and Vietnam). Within China *Liparis barbata* is confined to Hainan; the present record is the first from Ledong County.
– Besides *P. appletonianum* all orchids found are listed in CITES Appendix II.

• While parts of the forest were highly disturbed others were in good condition; 43% of the orchid species recorded were epiphytic.

Table 1. Vascular plants of Jiaxi Nature Reserve recorded in the present survey. Species which are Nationally Protected (Class I or II) (State Forestry Administration & Ministry of Agriculture, 1999), globally Threatened or Lower Risk (Near-threatened) (IUCN, 2002) or globally restricted are indicated.

Family	**Scientific name**	**Remarks**
GYMNOSPERMAE		
Cupressaceae	*Calocedrus macrolepis* Kurz	Protected II, Vulnerable
Gnetaceae	*Gnetum montanum* Markgr.	
Pinaceae	*Pinus kwangtungensis* Chun & Tsiang	Protected II
Podocarpaceae	*Dacrycarpus imbricatus* (Blume) de Laub.	
	Dacrydium pectinatum de Laub.	
	Podocarpus neriifolius D. Don	
ANGIOSPERMAE		
Dicotyledonae		
Acanthaceae	*Championella tetrasperma* (Champ. ex Benth.) Brem.	
	Peristrophe strigosa C.Y. Wu & H.S. Lo	endemic to Hainan
	Thunbergia hainanensis C.Y. Wu & H.S. Lo	
Alangiaceae	*Alangium chinense* (Lour.) Harms.	
	Alangium salviifolium (L. f.) Wangerin	
Anacardiaceae	*Buchanania latifolia* Roxb.	
	Buchanania microphylla Engl.	
	Lannea coromandelica (Houtt.) Merr.	
	Toxicodendron succedaneum (L.) Kuntze.	
Ancistrocladaceae	*Ancistrocladus tectorius* (Lour.) Merr.	
Annonaceae	*Artabotrys pilosus* Merr. & Chun	endemic to Hainan
	Dasymaschalon rostratum Merr. & Chun	
	Dasymaschalon trichophorum Merr.	
	Desmos chinensis Lour.	
	Fissistigma glaucescens (Hance) Merr.	
	Polyalthia cerasoides (Roxb.) Benth. & Hook. f. ex Bedd.	
	Polyalthia lauii Merr.	restricted to Hainan & Vietnam
	Polyalthia obliqua J. D. Hooker & Thomson	
	Polyalthia plagioneura Diels	
	Polyalthia suberosa (Roxb.) Thwaites	
	Saccopetalum prolificum (Chun & F.C. How) Tsiang	Vulnerable
	Uvaria boniana Finet & Gagnep.	
	Uvaria grandiflora Roxb.	
	Uvaria microcarpa Champ. ex Benth.	

Family	Scientific name	Remarks
Apocynaceae	*Melodinus suaveolens* Champ. ex Benth.	
	Tabernaemontana bovina Lour.	
	Tabernaemontana bufalina Lour.	
	Urceola huaitingii (Chun & Tsiang) D.J. Middleton	
	Wrightia pubescens R. Br.	
Araliaceae	*Schefflera arboricola* Hayata	
	Schefflera octophylla (Lour.) Harms	
Asclepiadaceae	*Dischidia nummularia* R. Br.	
	Hoya carnosa (L.f.) R.Br.	
Begoniaceae	*Begonia fimbristipula* Hance	
Bignoniaceae	*Oroxylum indicum* (L.) Kurz	
	Radermachera hainanensis Merr.	
Boraginaceae	*Ehretia longiflora* Champ. ex Benth.	
	Heliotropium indicum L.	
	Tournefortia montana Lour.	
Caesalpiniaceae	*Bauhinia championii* (Benth.) Benth.	
	Bauhinia hainanensis Merr. & Chun	endemic to Hainan
	Caesalpinia crista L.	
Capparaceae	*Stixis suaveolens* (Roxb.) Pierre	
Chloranthaceae	*Sarcandra glabra* (Thunb.) Nakai subsp. *brachystachys* (Blume) Verdc.	
Clusiaceae	*Cratoxylum cochinchinense* (Lour.) Blume	
	Cratoxylum formosum (Jack) Dyer	
	Garcinia oblongifolia Champ. ex Benth.	
Combertaceae	*Combretum punctatum* Blume subsp. *squamosum* (Roxb. ex G. Don) Exell	
	Terminalia nigrovenulosa Pierre ex Laness.	
Connaraceae	*Ellipanthus glabrifolius* Merr.	endemic to Hainan
Convolvulaceae	*Argyreia capitiformis* (Poir.) Ooststr.	
	Merremia umbellata (L.) Hallier. f.	
Daphniphyllaceae	*Daphniphyllum calycinum* Benth	
Dichapetalaceae	*Dichapetalum gelonioides* (Roxb.) Engl.	
Dilleniaceae	*Dillenia pentagyna* Roxb.	
	Dillenia turbinata Finet & Gagnep.	
	Tetracera asiatica (Lour.) Hoog.	
Ebenaceae	*Diospyros diversilimba* Merr. & Chun	
	Diospyros strigosa Hemsl.	
Elaeagnaceae	*Elaeagnus gonyanthes* Benth.	
Elaeocarpaceae	*Elaeocarpus dubius* A. DC.	
	Elaeocarpus petiolatus (Jack) Wall. ex Kurz	
Escalloniaceae	*Polyosma cambodiana* Gagnep.	
Euphorbiaceae	*Alchornea rugosa* (Lour.) Müll. Arg.	
	Aporosa villosa (Lindl.) Baill.	
	Aporusa yunnanensis (Pax & K. Hoffm.) F.P. Metcalf	
	Baccaurea ramiflora Lour.	
	Bischofia javanica Blume	
	Breynia fruticosa (L.) Hook. f.	
	Bridelia stipularis (L.) Blume	
	Croton chunianus Croizat	endemic to Hainan
	Drypetes hainanensis Merr.	
	Endospermum chinense Benth.	
	Flueggea virosa (Roxb. ex Willd.) Voigt.	
	Glochidion lanceolarium (Roxb.) Voigt	
	Macaranga bracteata Merr.	endemic to Hainan
	Macaranga denticulata (Blume) Müll. Arg.	
	Mallotus hookerianus (Seem.) Müll. Arg.	
	Mallotus oblongifolius (Miq.) Müll. Arg.	
	Mallotus paniculatus (Lam.) Müll. Arg.	
	Mallotus philippinensis (Lam.) Müll. Arg.	
	Microdesmis casearifolia Planch.	
	Phyllanthus cochinchinensis (Lour.) Spreng.	

Family	Scientific name	Remarks
	Phyllanthus emblica L.	
	Phyllanthus reticulatus Poir.	
	Suregada glomerulata (Blume) Baill.	
	Trigonostemon chinensis Merr. fo. *fungii* (Merr.) Y.T. Chang	endemic to Hainan
	Trigonostemon heterophyllus Merr.	endemic to Hainan
	Trigonostemon xyphophyllorides (Croizat) L.K. Dai & T.L. Wu	endemic to Hainan
Fagaceae	*Castanopsis fissa* (Champ. ex Benth.) Rehder & E. H. Wilson	
	Castanopsis indica (Roxb. ex Lindl.) A. DC.	
	Cyclobalanopsis neglecta Schottky	
	Lithocarpus caudatilimbus (Merr.) A. Camus	
	Lithocarpus corneus (Lour.) Rehder	
	Lithocarpus fenzelianus A. Camus	endemic to Hainan
Flacourtiaceae	*Homalium cochinchinense* (Lour.) Druce	
	Homalium hainanense Gagnep.	restricted to Hainan & Vietnam
	Scolopia saeva (Hance) Hance	
Gesnariaceae	*Lysionotus pauciflorus* Maxim.	
Hamamelidaceae	*Liquidambar formosana* Hance	
Hydrangeaceae	*Dichroa febrifuga* Lour.	
Icacinaceae	*Apodytes dimidiata* E. Mey. ex Arn.	
	Gonocaryum lobbianum (Miers) Kurz	
Juglandaceae	*Engelhardtia roxburghiana* Wall.	
	Engelhardtia spicata Lesch. ex Blume var. *colebrookeana* (Lindl. ex Wall.) Koord. & Valeton	
Lamiaceae	*Gomphostemma lucidum* Wall. ex Benth.	
	Leucas aspera (Willd.) Link	
Lauraceae	*Actinodaphne pilosa* (Lour.) Merr.	
	Alseodaphne hainanensis Merr.	Protected II; Vulnerable; restricted to Hainan & N. Vietnam
	Beilschmiedia longipetiolata C.K. Allen	endemic to Hainan
	Cinnamomum burmanni (Nees & T. Nees) Blume	
	Lindera nacusua (D. Don) Merr.	
	Litsea elongata (Nees) Benth. & Hook. f.	
	Litsea variabilis Hemsl.	
	Litsea verticillata Hance	
	Machilus chinensis (Champ. ex Benth.) Hemsl.	
	Neolitsea pulchella (Meissn) Merr	
	Phoebe tavoyana (Meisn.) Hook. f.	
Melastomataceae	*Blastus cochinchinensis* Lour.	
	Melastoma candidum D. Don	
	Melastoma sanguineum Sims	
	Memecylon ligustrifolium Champ. ex Benth.	
Meliaceae	*Amoora dasyclada* (F.C. How & T. Chen) C.Y. Wu	Protected II, Vulnerable
	Amoora tsangii (Merr.) X.M. Chen	endemic to Hainan
	Dysoxylum lukii Merr.	
	Toona ciliata M. Roem.	Protected II
Menispermaceae	*Albertisia laurifolia* Yamamoto	
	Diploclisia glaucescens (Blume) Diels	
Mimosaceae	*Acacia pennata* (L.) Willd.	
	Adenanthera pavonina L.var.*microsperma* (Teijsm.& Binnend.) I. C. Nielsen	
	Albizia chinensis (Osbeck) Merr.	
	Albizia corniculata (Lour.) Druce	
	Albizia procera (Roxb.) Benth.	
	Pithecellobium clypearia (Jack) Benth.	
Moraceae	*Antiaris toxicaria* Lesch.	
	Cudrania cochinchinensis (Lour.) Kudo & Masam.	

Family	Scientific name	Remarks
	Ficus altissima Blume	
	Ficus auriculata Lour.	
	Ficus esquiroliana H. Lév.	
	Ficus hispida L. f.	
	Ficus nervosa B. Heyne ex Roth.	
	Ficus tuphapensis Drake	
	Streblus taxoides (B. Heyne) Kurz	
Myrsinaceae	*Ardisia crassinervosa* E. Walker	endemic to Hainan
	Ardisia crenata Sims	
	Ardisia densilepidotula Merr.	endemic to Hainan
	Ardisia hanceana Mez	
	Maesa perlarius (Lour.) Merr.	
	Mysine seguinii H. Lév	
Myrtaceae	*Baeckea frutescens* L.	
	Syzygium chunianum Merr. & L.M. Perry	
	Syzygium fluviatile (Hemsl.) Merr. & L.M. Perry	
	Syzygium hancei Merr. & L. M. Perry	
	Syzygium stenocladum Merr. & L.M. Perry	endemic to Hainan
	Syzygium tephrodes (Hance) Merr. & L.M. Perry	endemic to Hainan
Ochnaceae	*Ochna integerrima* (Lour.) Merr.	
Oleaceae	*Chionanthus ramiflorus* Roxb.	
	*Olea tsoongii (*Merr.) P.S. Green	
	Osmanthus matsumuranus Hayata	
Onagraceae	*Ludwigia adscendens* (L.) H. Hara	
Papilionaceae	*Crotalaria pallida* Ait.	
	Dalbergia benthami Prain	
	Dalbergia hancei Benth.	
	Dalbergia peishaensis Chun & T.C. Chen	endemic to Hainan
	Dendrolobium lanceolatum (Dunn) Schindl.	
	Derris alborubra Hemsl.	
	Millettia dielsiana Harms	
	Millettia pachyloba Drake	
	Ormosia balansae Drake	
	Tadehagi triquetrum (L.) H. Ohashi	
Passifloraceae	*Passiflora foetida* L.	
Pentaphylacaceae	*Pentaphylax euryoides* Gardner & Champ.	
Piperaceae	*Peperomia blanda* (Jacq.) Kunth	
	Piper hancei Maxim.	
	Piper laetispicum C. DC.	
Polygalaceae	*Xanthophyllum hainanense* Hu	
Proteaceae	*Helicia hainanensis* Hayata	
Rhamnaceae	*Ventilago inaequilateralis* Merr. & Chun	
	Ziziphus rugosa Lam.	
Rhizophoraceae	*Carallia brachiata* (Lour.) Merr.	
Rosaceae	*Rubus cochinchinensis* Tratt.	
	Rubus pirifolius Sm.	
Rubiaceae	*Adina pilulifera* (Lam.) Franch. ex Drake	
	Catunaregam spinosa (Thunb.) Tirveng.	
	Diplospora dubia (Lindl.) Masam.	
	Duperrea pavettifolia (Kurz) Pit.	
	Fagerlindia scandens (Thunb.) Tirveng.	
	Geophila herbacea (Jacq.) K. Schum.	
	Hedyotis cryptantha Dunn	endemic to Hainan
	Hedyotis hedyotidea (DC.) Merr.	
	Hedyotis terminaliflora Merr. & Chun	endemic to Hainan
	Ixora hainanensis Merr.	
	Lasianthus chinensis (Champ. ex Benth.) Benth.	
	Lasianthus koi Merr. & Chun	
	Mussaenda hainanensis Merr.	endemic to Hainan
	Mussaenda hirsutula Miq.	
	Nauclea officinalis (Pierre ex Pit.) Merr. & Chun	

Family	Scientific name	Remarks
	Pavetta hongkongensis Brem.	
	Prismatomeris tetrandra (Roxb.) K. Schum.	
	Psychotria straminea Hutch.	
	Wendlandia uvariifolia Hance	
Rutaceae	*Acronychia pedunculata* (L.) Miq.	
	Clausena excavata Burm. f.	
	Evodia glabrifolia (Champ. ex Benth.) C.C. Huang	
	Evodia lepta (Spreng.) Merr.	
	Toddalia asiatica (L.) Lam.	
	Zanthoxylum avicennae (Lam.) DC.	
	Zanthoxylum nitidum (Roxb.) DC.	
Sabiaceae	*Meliosma angustifolia* Merr.	
	Meliosma squamulata Hance	
Santalaceae	*Dendrotrophe frutescens* (Champ. ex Benth.) Danser	
Sapindaceae	*Allophylus trichophyllus* Merr. & Chun	endemic to Hainan
	Amesiodendron chinense (Merr.) Hu	
	Erioglossum rubiginosum (Roxb.) Blume	
	Mischocarpus sundaicus Blume	
	Nephelium topengii (Merr.) H.S. Lo	endemic to Hainan
Sapotaceae	*Madhuca hainanensis* Chun & F.C. How	Protected II, Vulnerable, endemic to Hainan
Scrophulariaceae	*Lindernia antipoda* (L.) Alston	
Simarubaceae	*Brucea javanica* (L.) Merr.	
	Harrisonia perforata (Blanco) Merr.	
Solanaceae	*Lycianthes biflora* (Lour.) Bitter	
Sterculiaceae	*Byttneria aspera* Colebr. ex Wall.	
	Helicteres angustifolia L.	
	Helicteres isora L.	
	Kleinhovia hospita L.	
	Pterospermum lanceifolium Roxb.	
	Pterygota alata (Roxb.) R. Br.	
	Sterculia hainanensis Merr. & Chun	
	Sterculia lanceolata Cav.	
Styracaceae	*Alniphyllum fortunei* (Hemsl.) Makino	
Symplocaceae	*Symplocos cochinchinensis* (Lour.) S. Moore	
Symplocaceae	*Symplocos poilanei* Guill.	
Theaceae	*Adinandra hainanensis* Hayata	
	Eurya macartneyi Champ.	
	Ternstroemia gymnanthera (Wight & Arn.) Bedd.	
Thymelaeaceae	*Aquilaria sinensis* (Lour.) Spreng.	Protected II, Vulnerable
	Wikstroemia hainanensis Merr.	endemic to Hainan
Tiliaceae	*Grewia eriocarpa* Juss.	
	Microcos chungii (Merr.) Chun	endemic to Hainan
	Microcos paniculata L.	
	Triumfetta cana Blume	
	Triumfetta rhomboidea Jacq.	
Ulmaceae	*Celtis timorensis* Span.	
	Gironniera subaequalis Planch.	
	Trema angustifolia (Planch.) Blume	
Urticaceae	*Boehmeria nivea* (L.) Gaudich.	
	Oreocnide frutescens (Thunb.) Miq.	
	Pellionia repens (Lour.) Merr.	
Verbenaceae	*Callicarpa brevipes* (Benth.) Hance	
	Callicarpa formosana Rolfe (C*. pedunculata* R. Br.)	
	Callicarpa rubella Lindl.	
	Clerodendrum cyrtophyllum Turcz.	
	Clerodendrum hainanensis Hand.-Mazz.	
	Vitex pierreana Dop	
	Vitex quinata (Lour.) F.N. Williams	
Viscaceae	*Viscum ovalifolium* DC.	
Vitaceae	*Cissus pteroclada* Hayata	

Family	Scientific name	Remarks
	Leea indica (Burm. f.) Merr.	
	Tetrastigma planicaule (Hook. f.) Gagnep.	
Monocotyledonae		
Amaryllidaceae	*Curculigo capitulata* (Lour.) Kuntze	
	Curculigo glabrescens (Ridl.) Merr.	
Araceae	*Acorus gramineus* Sol.	
	Alocasia macrorrhiza (L.) Schott	
	Arisaema pattaniense Gagnep.	
	Pothos repens (Lour.) Druce	
	Rhaphidophora hongkongensis Schott	
Areaceae	*Calamus rhabdocladus* Burret	
	Calamus tetradactylus Hance	
	Caryota ochlandra Hance	
	Daemonorops margaritae (Hance) Becc.	
	Licuala fordiana Becc.	
	Licuala spinosa Thunb.	
	Livistona saribus (Lour.) Merr. ex A. Chev.	
	Plectocomia microstachys Burret	endemic to Hainan
Commelinaceae	*Amischotolype hispida* (Less. & A. Rich.) D.Y. Hong	
	Commelina diffusa Burm. f.	
	Commelina paludosa Blume	
	Murdannia edulis (Stokes) Faden	
Cyperaceae	*Carex cryptostachys* Brongn.	
	Hypolytrum hainanense (Merr.) Ts. Tang & F. T. Wang	restricted to Hainan & Hong Kong
Dioscoreaceae	*Dioscorea cirrhosa* Lour.	
	Dioscorea hispida Dennst.	
Eriocaulaceae	*Eriocaulon sexangulare* L.	
Liliaceae	*Aspidistra elatior* Blume	
	Dianella ensifolia (L.) DC.	
	Dracaena angustifolia Roxb.	
	Ophiopogon platyphyllus Merr. & Chun	
	Smilax ocreata A. DC.	
	Smilax perfoliata Lour.	
Marantaceae	*Phrynium oliganthum* Merr.	
	Phrynium placentarium (Lour.) Merr.	
Musaceae	*Musa balbisiana* Colla	
Orchidaceae	(see Table 2)	
	Luisia morsei Rolfe	
Pandanaceae	*Pandanus forceps* Martelli	
Taccaceae	*Tacca chantrieri* André	
Zingiberaceae	*Alpinia maclurei* Merr.	
	Alpinia oxyphylla Miq.	
	Amomum chinense Chun	endemic to Hainan
	Amomum muricarpum Elmer	
	Costus speciosus (J. Koenig) Smith	
	Zingiber corallinum Hance	
	Zingiber zerumbet (L.) Roscoe ex Sm.	

Table 2. Orchids recorded in Jiaxi Nature Reserve and neighbouring areas (150-950 m) from 13 to 14 June 1999. (Abundance: "+" = 1 individual/clump, "++" = 2-5, "+++" = 6-10, "++++" = 11-15, "+++++" ≥16).

Scientific name	Habitat	Remarks
Ania (cf. *hookeriana*) sp.	on floor of sparse woodland and bamboo, beside path (280-660m)	terrestrial
Arachnis labrosa (Lindl. & Paxt.) Rchb. f.	on tree trunk in forest beside path (470-700m)	epiphytic; new record for Ledong County
Bulbophyllum (cf. *affine*) sp.	on tree trunk in forest (520-810m)	epiphytic
Bulbophyllum (cf. *insulsum* (Gagnep.) Seidenf.) sp.	on tree trunk in forest (840m)	epiphytic; new record for Ledong County

Scientific name	Habitat	Remarks
Bulbophyllum (cf. *obtusangulum* Z.H. Tsi) sp.	on tree trunk in forest (500-550m)	epiphytic; endemic to Hainan; new record for Ledong County
Calanthe sp.	on forest floor with rich humus (840m)	terrestrial
Ceratostylis hainanensis Z.H. Tsi	on tree trunk in forest (810 -900m)	epiphytic; endemic to Hainan; new record for Ledong County
Cleisostoma filiforme (Lindl.) Garay	on tree trunk (280m)	epiphytic
Cleisostoma paniculatum (Kar Gawl.) Garay	on tree trunk in forest (550m)	epiphytic
Cleisostoma parishii (Hook. f.) Garay	on tree trunk beside a stream	
Cleisostoma simondii (Gagnep.) Seidenf.	on tree trunk (450m)	epiphytic
Cymbidium bicolor Lindl. subsp. o*btusum* Du Puy & Cribb	on tree trunk in forest (400-800m)	epiphytic
Cymbidium dayanum Rchb. f.	on rotten wood on forest floor (660m)	epiphytic
Dendrobium acinaciforme Roxb.	on tree trunk (430-840m)	epiphytic
Dendrobium aduncum Lindl.	on tree trunk in forest beside a stream (500-550m & 800m)	epiphytic
Dendrobium changjiangense S.J. Cheng & C.Z. Tang	on tree trunk in forest (840m)	epiphytic; endemic to Hainan
Dendrobium densiflorum Lindl.	on tree trunk in forest (460- 700m)	epiphytic
Dendrobium sinense T. Tang & F.T. Wang	on tree trunk in forest (830-910m)	epiphytic; endemic to Hainan
Dendrobium (cf. *williamsonii* Day & Rchb. f.) sp.	on tree trunk in forest (910m)	epiphytic; new record for Ledong County
Eria pannea Lindl.	on tree trunk in forest (840m)	epiphytic
Eria rosea Lindl.	on tree trunk in forest beside stream (500-550m)	epiphytic; restricted to Hainan & Hong Kong
Eria thao Gagnep.	on tree trunk in forest and edge of forest (900m)	epiphytic; restricted to Hainan, Shiwandashan in Guangxi & Vietnam
Gastrochilus (cf. *acinacifolius*) sp.	on tree trunk in forest (810m)	epiphytic
Gastrochilus sp.	on tree trunk in forest (435m)	epiphytic
Geodorum sp.	on forest floor with rich humus (450m)	terrestrial
Goodyera procera (Ker Gawl.) Hook.	in gaps among rocks with soil beside stream (660m)	terrestrial
Goodyera viridiflora (Blume) Blume	on forest floor with rich humus (625m)	terrestrial
Goodyera sp.1	on rock with rich humus beside stream (480m)	terrestrial
Goodyera sp.2	on forest floor with rich humus (800-880m)	terrestrial
Habenaria rhodocheila Hance	on bamboo floor with rich humus beside stream (470m & 660m)	terrestrial
Habenaria sp.1	on forest floor with rich humus (450-660m)	terrestrial
Habenaria sp.2	on grassy slope close to good forest (790m)	terrestrial
Liparis barbata Lindl.	on forest floor with rich humus (390m)	terrestrial; new record for Ledong County; restricted to Hainan within China
Liparis odorata (Willd.) Lindl.	on grassy slope close to good forest (680-720m)	terrestrial
Liparis viridiflora (Blume) Lindl.	on tree trunk beside stream (700m)	epiphytic
Liparis (cf. *odorata*) sp.	on forest floor with rich humus beside stream (480m)	terrestrial
Luisia sp.	on rock and tree trunk (280-340m)	epiphytic
Malaxis calophyllum (Rchb. f.) Kuntze	on forest floor with rich humus beside stream (500-550m)	terrestrial

Scientific name	Habitat	Remarks
Malaxis latifolia Sm.	on bamboo floor with rich humus beside stream (430-480m)	terrestrial
Nephalaphyllum cristatum Rolfe	on tree trunk and forest floor with rich humus (950m)	terrestrial
Nervilia sp.1	on grassy slope close to good forest (780m)	terrestrial
Nervilia sp.2	on grassy slope close to good forest (780m)	terrestrial
Paphiopedilum appletonianum (Gower) Rolfe	on forest floor with rich humus (950m)	terrestrial; Endangered
Pholidota chinensis Lindl.	on rock and tree trunk beside stream (470-700m)	epiphytic
Platanthera minor (Miq.) Rchb. f.	on bamboo floor with rich humus beside a stream (475m)	terrestrial
Rhynchostylis gigantea (Lindl.) Ridl.	on tree trunk beside path (180-480m)	epiphytic; new record for Ledong County
Robiquetia spathulata (Blume) J.J. Sm.	on tree trunk and branches beside stream (460m & 700m)	epiphytic; new record for Ledong County
Robiquetia succisa (Lindl.) Seidenf. & Garay	on tree branches beside stream (470-485m)	epiphytic; new record for Ledong County
Tainia sp.	on forest floor with rich humus (450m)	terrestrial
Vanda sp.	on tree trunk	epiphytic
Zeuxine sp.	on bamboo floor with rich humus beside stream (480m)	terrestrial

Mammals

- Several Maritime Striped Squirrels (*Tamiops maritimus*) and one Pallas's Squirrel (*Callosciurus erythraeus*) were seen at Jiaxi.
- Partially-eaten fruits, and scats believed to be of *Petaurista philippensis* were found near Jiaxi.
- Burrows believed by the guides to be of Hainan Gymnure occurred on the forest floor. The guides reported that loose soil appears above the tunnels after rain.
- The status of mammals was inferred (Table 3) based on an interview with an official of Jiaxi Nature Reserve, and on recorded distributions, including past records from Ledong and Changjiang Counties (Guangdong Institute of Entomology and Zhongshan University, 1983; Zhang *et al*., 1997). Reports of species not previously recorded from Hainan are here considered doubtful.

Table 3. The inferred status of mammals at Jiaxi Nature Reserve, Hainan, based on interviewing Mr. Lin, an official of the Jiaxi Nature Reserve (June 1999) and on past distribution records. "+" = rare, "++" = quite common, "+++" = abundant; "C" = Changjiang County, "L" = Ledong County. Sequence follows D.E. Wilson & Cole (2000).

Scientific name	English name	Historic records	Mr. Lin	Probable status
Hylomys hainanensis	Hainan Gymnure		++	present
Tupaia belangeri	Northern Tree Shrew	C, L	+++	present
Rousettus leschenaulti	Leschenault's Rousette	C	(not asked)	present
Rhinolophus affinis	Intermediate Horseshoe Bat	C	(not asked)	present
Rhinolophus cornutus	Little Japanese Horseshoe Bat	C	(not asked)	present
Hipposideros armiger	Great Roundleaf Bat	C	(not asked)	present
Myotis chinensis (recorded as *M. myotis*)	Large Myotis	C	(not asked)	present
Miniopterus australis	Little Long-fingered Bat	C	(not asked)	present
Macaca mulatta	Rhesus Monkey	C, L	+++	present
Nomascus (cf. *nasutus*) sp. (recorded as *Hylobates concolor*)	Eastern Crested Gibbon	C	-	extirpated
Prionailurus bengalensis	Leopard Cat	L	++	insecure
Panthera pardus	Leopard		++	doubtful

Scientific name	English name	Historic records	Mr. Lin	Probable status
Herpestes javanicus	Javan Mongoose	L	-	insecure
Amblonyx cinereus	Oriental Small-clawed Otter	C	++	insecure
Melogale moschata	Chinese Ferret-badger	C	+++	present
Martes flavigula	Yellow-throated Marten		++	insecure
Mustela kathiah	Yellow-bellied Weasel		+++	present
Ursus thibetanus	Asiatic Black Bear	C	+	insecure or extirpated
Paguma larvata	Masked Palm Civet		++	insecure
Paradoxurus hermaphroditus	Asian Palm Civet		++	insecure
Prionodon pardicolor	Spotted Linsang		++	doubtful
Viverricula indica	Small Indian Civet	C, L	++	insecure
Sus scrofa	Wild Boar	C	-	insecure or extirpated
Cervus unicolor	Sambar	L	++	insecure
Muntiacus muntjak	Indian Muntjac	C	+++	present
Manis pentadactyla	Chinese Pangolin		++	insecure
Callosciurus erythraeus	Pallas's Squirrel	C, L	+++	present
Dremomys pyrrhomerus	Red-hipped Squirrel	L	+++	present
Ratufa bicolor	Black Giant Squirrel	C, L	++	insecure
Tamiops maritimus (recorded as *T. swinhoei*)	Maritime Striped Squirrel	L	+++	present
Belomys pearsonii	Hairy-footed Flying Squirrel		+++	present
Petaurista philippensis (recorded as *P. hainana*)	Indian Giant Flying Squirrel	L	+++	present
Hylopetes alboniger	Particolored Flying Squirrel		+++	present
Rattus tanezumi (recorded as *R. flavipectus*)	Tanezumi Rat	L	(not asked)	present
Rattus nitidus	Himalayan Field Rat	L	(not asked)	present
Rattus turkestanicus (recorded as *R. rattoides*)	Turkestan Rat	C	(not asked)	present
Niviventer confucianus (recorded as *Rattus niviventer*)	Chinese White-bellied Rat	C, L	(not asked)	present
Niviventer fulvescens (recorded as *Rattus fulvescens*)	Chestnut White-bellied Rat	L	(not asked)	present
Atherurus macrourus	Asiatic Brush-tailed Porcupine		++	insecure
Hystrix brachyura	Malayan Porcupine		++	insecure
Lepus hainanus	Hainan Hare	C, L	-	insecure or extirpated

- Some of the species suspected to occur are of particular conservation concern:
  - Hainan Gymnure *Hylomys hainanensis* is globally Endangered, and Class II Protected in China.
  - Particolored Flying Squirrel *Hylopetes alboniger* is globally Endangered.
  - Asiatic Black Bear *Ursus thibetanus* and Hainan Hare *Lepus hainanus* are globally Vulnerable, and Class II Protected in China.
  - Malayan Porcupine *Hystrix brachyura* is globally Vulnerable.
  - Chinese Pangolin *Manis pentadactyla*, Rhesus Monkey *Macaca mulatta* and Oriental Small-clawed Otter *Amblonyx cinereus* are at Lower Risk (Near-threatened) globally and Class II Protected in China.
  - Hairy-footed Flying Squirrel *Belomys pearsonii* is at Lower Risk (Near-threatened) globally.
  - Yellow-throated Marten *Martes flavigula*, Small Indian Civet *Viverricula indica*, Sambar *Cervus unicolor* and Indian Giant Flying Squirrel *Petaurista philippensis* are Class II Protected in China.

- A large number of forest squirrels were reported; the forest at Jiaxi may be of special importance to the conservation of this group.

Birds

- Fifty-four species of birds were recorded in Jiaxi Nature Reserve during this survey (Table 4).
- The most frequently encountered species were Grey-cheeked Fulvetta *Alcippe morrisonia*, Black-browed Barbet *Megalaima oorti*, Mountain Imperial Pigeon *Ducula badia*, Chestnut Bulbul *Hemixos castanonotus* and Puff-throated Bulbul *Alophoixus pallidus*.

Table 4. Birds recorded at Jiaxi Nature Reserve, June 1999. Sequence follows Clements (2000).

Scientific name	**English name**
Milvus migrans	Black Kite
Accipiter trivirgatus	Crested Goshawk
Francolinus pintadeanus	Chinese Francolin
Lophura nycthemera	Silver Pheasant
Chalcophaps indica	Emerald Dove
Ducula badia	Mountain Imperial Pigeon
Hierococcyx sparverioides	Large Hawk Cuckoo
Hierococcyx fugax	Hodgson's Hawk Cuckoo
Centropus bengalensis	Lesser Coucal
Glaucidium cuculoides	Asian Barred Owlet
Otus bakkamoena	Collared Scops Owl
Caprimulgus indicus	Grey Nightjar
Hirundapus cochinchinensis	Silver-backed Needletail
Cypsiurus balasiensis	Asian Palm Swift
Apus affinis	House Swift
Nyctyornis athertoni	Blue-bearded Bee-eater
Megalaima oorti	Black-browed Barbet
Dendrocopos canicapillus	Grey-capped Pygmy Woodpecker
Blythipicus pyrrhotis	Bay Woodpecker
Hirundo rustica	Barn Swallow
Pericrocotus solaris	Grey-chinned Minivet
Pycnonotus sinensis	Light-vented Bulbul
Alophoixus pallidus	Puff-throated Bulbul
Hemixos castanonotus	Chestnut Bulbul
Hypsipetes mcclellandii	Mountain Bulbul
Hypsipetes leucocephalus	Black Bulbul
Chloropsis hardwickii	Orange-bellied Leafbird
Prinia flaviventris	Yellow-bellied Prinia
Phylloscopus hainanus	Hainan Leaf Warbler
Abroscopus albogularis	Rufous-faced Warbler
Cyornis hainanus	Hainan Blue Flycatcher
Enicurus leschenaulti	White-crowned Forktail
Rhipidura albicollis	White-throated Fantail
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
Stachyris ruficeps	Rufous-capped Babbler
Pteruthius flaviscapis	White-browed Shrike Babbler
Minla cyanouroptera	Blue-winged Minla
Alcippe morrisonia	Grey-cheeked Fulvetta
Yuhina zantholeuca	White-bellied Yuhina
Sitta solangiae	Yellow-billed Nuthatch
Aethopyga christinae	Fork-tailed Sunbird
Dicaeum concolor	Plain Flowerpecker

Scientific name	English name
Dicaeum ignipectus	Fire-breasted Flowerpecker
Dicaeum cruentatum	Scarlet-backed Flowerpecker
Zosterops japonica	Japanese White-eye
Lanius schach	Long-tailed Shrike
Dicrurus aeneus	Bronzed Drongo
Cissa hypoleuca	Indochinese Green Magpie
Dendrocitta formosae	Grey Treepie
Lonchura striata	White-rumped Munia

- Some of the species recorded are of particular conservation significance:
  – Hainan Leaf Warbler *Phylloscopus hainanus* is considered Vulnerable globally.
  – Yellow-billed Nuthatch *Sitta solangiae* is at Lower Risk (Near-threatened) globally.
  – Black Kite *Milvus migrans*, Crested Goshawk *Accipiter trivirgatus*, Silver Pheasant *Lophura nycthemera*, Mountain Imperial Pigeon, Lesser Coucal *Centropus bengalensis*, Asian Barred Owlet *Glaucidium cuculoides*, Collared Scops Owl *Otus bakkamoena* and Silver-backed Needletail *Hirundapus cochinchinensis* are Class II Protected species in China.
- The presence of many forest-dependent species, including bulbuls, babblers, pigeons and woodpeckers, indicated that the forests at Jiaxi have quite high integrity.

Reptiles and Amphibians

- Sixteen species of amphibian, one species of terrapin, seven species of lizard and five species of snakes were recorded at Jiaxi during this survey (Table 5).
- The most frequently encountered species in the forest was *Philautus odontotarsus*, while that near streams and seeps was a *Philautus* frog that resembles *P. ocellatus* but is probably a new species. The most common species in the village was *Hemidactylus frenatus* and that in the nearby river was *Rana limnocharis*.

Table 5. Amphibians and reptiles of Jiaxi Nature Reserve and neighbouring areas recorded in the present survey. Sequence follows Zhao E.-M. & Adler (1993).

Species	Habitat
AMPHIBIA	
Leptobrachium hainanensis	forest stream
	shrubland
	stream in shrubland
Bufo melanostictus	village
	forest
Amolops hainanensis	forest stream
Amolops torrentis	forest stream
	stream
Occidozyga martensii	paddy field
Rana fragilis	seep in forest/abandoned field
	forest stream
	stream in shrubland
Rana limnocharis	paddy field
	stream
	river
Rana spinulosa	forest stream
Rana taipehensis	rubber plantation
	paddy field
Buergeria oxycephala	stream
Philautus (nr. *ocellatus*) sp.	seasonal stream in forest
	seep in shrubland
	stream in shrubland
	seep in plantation
Philautus odontotarsus	forest
Polypedates mutus	stream in shrubland
Rhacophorus rhodopus	forest

Species	Habitat
Microhyla heymonsi	forest seep
	forest stream
	seep in shrubland
	stream in shrubland
	forest
Microhyla pulchra	pool in shrubland/grassland
REPTILIA	
Sacalia quadriocellata	stream
Hemidactylus frenatus	village
Acanthosaura lepidogaster	forest
Calotes versicolor	rubber plantation
Draco maculatus	forest
	rubber plantation
Eumeces quadrilineatus	forest
Mabuya multifasciata	rubber plantation
Sphenomorphus indicus	forest
Oligodon cinereus	shrubland
Oligodon formosanus	rubber plantation
	shrubland
	forest
Rhynchophis boulengeri	forest
Xenochrophis piscator	river
Trimeresurus albolabris	rubber plantation

- Many Hainan endemics occurred at Jiaxi: *Leptobrachium hainanensis*, *Amolops hainanensis*, *Amolops torrentis*, *Rana fragilis*, *Buergeria oxycephala* and *Philautus* (nr. *ocellatus*) sp.
- The occurrence of many forest species and forest stream specialists at Jiaxi such as *Leptobrachium hainanensis*, *Amolops hainanensis*, *Rhacophorus rhodopus*, *Acanthosaura lepidogaster*, *Draco maculatus* and *Rhynchophis boulengeri* indicated that the forest had high integrity.

Fish

- Three freshwater fish species were recorded from Jiaxi; an additional five species were reported to be present but specimens have not been examined by specialists (Table 6).
- The most widespread species recorded were *Gambusia affinis* and *Carassius auratus*.

Table 6. Freshwater fish recorded from Jiaxi Nature Reserve and neighbouring areas, 13-14 June 1999 ("✓" = present, "#" = unconfirmed report, "*" = nomenclature follows Pan, 1991). Sequence of families follows Nelson (1994).

Species	
Opsariichthys bidens	✓
Capoeta semifasciolata	✓
*Cyprinus carpio**	#
Carassius auratus	✓
*Gambusia affinis**	#
*Oreochromis niloticus**	#
Rhinogobius giurirus	#
Channa gachua	#

- No fish species of particular conservation concern were recorded.

Ants

- Seventy-four ant species were recorded from the Jiaxi area (Table 7). Many of these could not be reliably named, and some may be new to science.

- The most frequently recorded included *Odontoponera* sp. 1, *Anoplolepis gracilipes*, *Crematogaster* sp. 8, *Technomyrmex* sp. 2, *Diacamma* sp. 1 and *Lepisiota rothneyi*.

Table 7. Ant species recorded in and around Jiaxi Nature Reserve, June 1999. * Species with a strong forest association.

Species	**Habitat**
Aenictus (*ceylonicus* group) sp. 1	closed forest, shrubland
Aenictus (*dentatus* group) sp. 4	open shrubland
Aenictus (*laeviceps* group) sp. 2	closed 10m broadleaf
Anoplolepis gracilipes	open vegetation
Aphaenogaster (cf. *beccarii*) sp. 1 *	closed logged 25m broadleaf forest
Calyptomyrmex (cf. *wittmeri*) sp. 1 *	closed broadleaf forest
Camponotus (cf. *aethiops vitiosus*) sp. 21	stream
Camponotus (nr. *aethiops vitiosus*) sp. 27	open 25m broadleaf
Camponotus (cf. *mitis*) sp. 11	stream
Camponotus nicobarensis	open 10m rubber
Camponotus rufoglaucus	open vegetation
Camponotus (*variegatus* group) sp. 4	forest, shrubland
Camponotus (nr. *vitreus praerufus*) sp. 32	closed 15m rubber
Camponotus sp. 43	open 10m broadleaf, stream
Cataulacus granulatus	broadleaf forest
Cerapachys sp. 2	closed 30m broadleaf & conifer
Crematogaster (cf. *dohrni*) sp. 8	forest, shrubland
Crematogaster (cf. *ebenina*) sp. 19	shrubland
Crematogaster (cf. *laboriosa*) sp. 3	closed 15m broadleaf
Crematogaster sp. 23	closed 15m rubber
Diacamma (nr. *rugosum*) sp. 1	forest, shrubland
Dolichoderus (cf. *flatidorsus*) sp. 6	open 2m shrubland
Dolichoderus sp. 7 *	broadleaf forest
Gnamptogenys binghami *	closed broadleaf forest
Hypoponera (cf. *excoecata*) sp. 2 *	closed 20m broadleaf
Hypoponera sp. 3 *	broadleaf forest
Hypoponera sp. 5 *	closed broadleaf forest
Kartidris (cf. *galos*) sp. 1 *	closed broadleaf forest
Lepisiota rothneyi	open vegetation
Leptogenys kitteli *	broadleaf forest
Leptogenys (cf. *diminuta*) sp. 20	closed broadleaf forest
Monomorium (cf. *impexum*) sp. 2 *	open 2m shrubland
Monomorium (cf. *latinodoides*) sp. 10	open shrubland
Monomorium sp. 13	closed 25m broadleaf
Myrmoteras (cf. *cuneinodum*) sp. 1 *	closed broadleaf forest
Mystrium (nr. *camillae*) sp. 1	closed logged 25m broadleaf
Odontomachus monticola *	open 10m broadleaf/shrubland
Odontoponera (cf. *denticulata*) sp. 1	forest, shrubland
Oecophylla smaragdina	forest, rubber plantation
Oligomyrmex (cf. *wheeleri*) sp. 1 *	closed broadleaf forest
Pachycondyla (*javana* group) sp. 1 *	broadleaf forest
Pachycondyla leeuwenhoeki *	open shrubland
Pachycondyla (cf.*luteipes*) sp. 2 *	closed broadleaf forest
Paratrechina (cf. *bourbonica*) sp. 4	shrubland
Paratrechina longicornis	closed 15m rubber plantation
Paratrechina (nr. *indica*) sp. 9 *	closed broadleaf forest
Pheidole nodifera	shrubland
Pheidole rinae incensa	broadleaf forest, shrubland
Pheidole sp. 7 *	broadleaf forest
Pheidole sp. 11	closed broadleaf forest
Pheidole sp. 13 *	closed 25m broadleaf
Pheidole sp. 34	open vegetation
Pheidologeton affinis	open vegetation
Philidris sp. 1 *	open 10m broadleaf forest

Species	Habitat
Polyrhachis demangei	open 10m broadleaf forest
Polyrhachis halidayi	forest, shrubland
Polyrhachis tyrannica	low broadleaf forest
Prenolepis (cf. *emmae*) sp. 1 *	closed broadleaf forest
Pristomyrmex pungens	closed forest, rubber plantation
Pristomyrmex sp. 4 *	closed broadleaf forest
Pyramica canina *	broadleaf forest
Recurvidris sp. *	low forest, shrubland
Rhoptromyrmex (cf. *wroughtonii*) sp. 1	open 10m broadleaf
Tapinoma sp. 1	open vegetation
Technomyrmex albipes	forest, plantation, shrubland
Technomyrmex sp. 2 *	closed broadleaf forest
Technomyrmex sp. 6	open 25m broadleaf forest
Tetramorium (cf. *kheperra*) sp. 19	closed 6m broadleaf forest
Tetramorium (cf. *kraepelini*) sp. 4 *	forest, shrubland
Tetramorium nipponense *	closed broadleaf forest
Tetramorium (cf. *shensiense*) sp. 6 *	broadleaf forest
Tetramorium (cf. *walshi*) sp. 20 *	closed broadleaf forest
Tetraponera attenuata	forest, shrubland
Vollenhovia (cf. *emeryi*) sp. 1 *	closed 30m broadleaf

- *Cerapachys* sp. 2, *Dolichoderus* sp. 7, *Mystrium* sp. 1 and *Tetramorium* sp. 19 have been found only at Jiaxi.
- *Hypoponera* sp. 5, *Kartidris* sp. 1, *Myrmoteras* sp. 1, *Pristomyrmex* sp. 4, *Tetramorium* sp. 6 and *Tetramorium* sp. 20 are known only from mature natural forests.
- The percentage of forest-dependent species (not including unique species) recorded in the Jiaxi area was 43%, a moderate figure indicating a mixture of habitats. If habitats outside the reserve (below 400 m) are excluded, the percentage is still only 47%. But if only the area above 800 m is considered, the proportion is 64%, a high figure indicating high forest integrity.
- The African exotic ant *Anoplolepis gracilipes* was widespread in open vegetation, while the exotic *Paratrechina longicornis* was found.

Dragonflies

- Twenty-four species were recorded from Jiaxi over the two-day survey (Table 8).
- No species occurred in particularly high numbers.

Table 8. Dragonflies recorded from Jiaxi Nature Reserve and neighbouring areas, 13-14 June 1999. Sequence of families follows Schorr *et al.* (2001a, 2001b).

Species	Notes
Rhinocypha f. fenestrella	
Ceriagrion indochinense	
Euphaea ornata	
Pseudolestes mirabilis	endemic to Hainan
Coeliccia cyanomelas	
Coeliccia scutellum hainanense	subspecies endemic to Hainan
Drepanosticta zhoui	new species (K.D.P. Wilson & Reels, 2001)
Gynacantha saltatrix	
Chlorogomphus usudai	endemic to Hainan
Idionyx victor	
Macromia moorei malayana	
Nychogomphus flavicaudus	endemic to Hainan
Diplacodes trivialis	
Neurothemis fulvia	
Neurothemis tullia	
Onychothemis testaceum tonkinensis	
Orthetrum glaucum	
Orthetrum pruinosum	

Species	Notes
Orthetrum sabina	
Orthetrum triangulare	
Pantala flavescens	
Potamarcha congener	
Trithemis aurora	
Trithemis festiva	

- *Drepanosticta zhoui, Pseudolestes mirabilis, Coeliccia scutellum hainanense, Chlorogomphus usudai* and *Nychogomphus flavicaudus* are endemic to Hainan.
- Many of the dragonflies present are forest-dependent.

Butterflies

- Seventy-four butterfly species were recorded over the two-day period (Table 9).
- The most abundant species were *Cirrochroa tyche* and *Papilio nephelus*.
- *Penthema formosana* is apparently a new record for Hainan, not recorded for the province by Chou (1994) or Bascombe (1995).

Table 9. Butterflies recorded in Jiaxi Nature Reserve and neighbouring areas, 13-14 June 1999. Sequence of families follows Bascombe (1995).

Species	Habitat	Notes
Borbo bevani	rubber plantation	
Hasora taminatus	forest	
Hasora sp.	forest	
Isoteinon lamprospilus	forest	
Notocrypta curvifascia	forest	
Graphium agamemnon	forest	
Graphium chironides	forest	
Lamproptera sp.	forest	
Papilio demoleus	forest	
Papilio memnon	forest	
Papilio nephelus	forest	
Papilio paris	forest	
Papilio polytes	forest	
Papilio protenor	forest	
Appias nero	forest	
Appias sp.	forest	
Catopsilia pomona	forest	
Cepora nerissa	forest	
Dercas verhuelli	forest	
Eurema laeta	forest	
Eurema sp.	forest	
Hebomoia glaucippe	forest	
Ixias pyrene	forest	
Leptosia nina	forest	
Prioneris thestylis	shrub	
Abisara echerius	forest	
Arhopala aida	forest	
Arhopala arvina	forest	
Arhopala eumolphus	forest	
Caleta elna	agric./river	
Hypolycaena erylus	agric./shrub	
Hypolycaena (Zeltus) amasa	rubber plantation forest	
Jamides bochus	forest	
Neopithecops zalmora	forest	
Paralaxita dora	forest	
Prosotas nora	agric./shrub	

Species	Habitat	Notes
Zemeros flegyas	forest	
Athyma nefte	forest	
Athyma selenophora	forest	
Charaxes marmax	forest	
Cethosia biblis	forest	
Cethosia cyane	forest	
Cirrochroa tyche	agric./river forest	
Cupha erymanthis	forest	
Cyrestis cocles	forest	
Cyrestis themire	forest	
Cyrestis thyodamas	forest	
Cyrestis sp.	forest	unidentified
Discophora sondaica	forest	
Euploea midamus	forest	
Euploea sylvester	rubber plantation	
Euthalia phemius	rubber plantation	
Faunis eumeus	forest	
Hypolimnas bolina	forest	
Kaniska canace	rubber plantation	
Lethe verma	forest	
Limenitis (Parathyma) sulpitia	forest	
Melanitis leda	forest	
Mycalesis sp.	forest	
Neorina (Ethope) henrici	forest	
Neptis hylas	forest	
Neptis (Phaedyma) columella	forest	
Orsotriaena medus	forest	
Pantoporia hordonia	forest	
Parantica aglea	forest	
Penthema formosana	forest	new Hainan record
Polyura athamas	forest	
Precis (Junonia) atlites	forest	
Precis (Junonia) iphita	forest	
Precis (Junonia) lemonias	rubber plantation	
Precis (Junonia) orithya	agric./river	
Stichophthalma sp.	forest	
Tirumala limniace	rubber plantation forest	
Ypthima baldus	forest	

- The butterfly fauna included a number of apparently rare and/or restricted species, not previously encountered on KFBG surveys, such as *Cyrestis themire*, *Penthema formosana*, *Arhopala aida*, *Arhopala arvina*, *Arhopala eumolphus*, *Hypolycaena erylus* and *Zeltus amasa*. This may reflect the relatively good condition and large size of the forest at Jiaxi.

Molluscs

- One species of terrestrial snail and four species of freshwater mollusc were recorded at Jiaxi reserve and the nearby Changhua Jiang (Table 10).
- The two bivalves, *Corbicula largillierti* and *C. nitens*, were the most abundant mollusc species in Changhua Jiang.

Table 10. Molluscs recorded at Jiaxi Nature Reserve and the surrounding area (June 1999).

Species	Habitat
Pearsonia gredleri	montane forest
Stermyla riqueti	river (150 m)
Melania tuberculata	river (150 m)
Corbicula largillierti	river (150 m)
Corbicula nitens	river (150 m)

- *Pearsonia gredleri* is endemic to Hainan.

Summary of flora and fauna

- The lower-altitude parts of the reserve had been largely deforested, and the vegetation below 800 m was mainly shrubland and grassland with patches of young secondary forest. Well-structured mature forest could be found above 800 m. The present rapid survey recorded 358 vascular plant species, including the orchid *Paphiopedilum appletonianum* which is Critically Endangered nationally, six species (*Calocedrus macrolepis*, *Amoora dasyclada*, *Madhuca hainanensis*, *Alseodaphne hainanensis*, *Aquilaria sinensis* and *Saccopetalum prolificum*) which are globally Vulnerable, and numerous species which are nationally Protected or highly restricted in global range.
- The mammal fauna is little known, but is believed to include a number of species of conservation concern, including the Endangered Hainan Gymnure and Particolored Flying Squirrel. A large number of forest squirrels were reported; the forest at Jiaxi may be of special importance to species of this group.
- The bird fauna included the Vulnerable Hainan Leaf Warbler and a number of other forest-dependent species including bulbuls, babblers, pigeons, woodpeckers and Yellow-billed Nuthatch.
- Jiaxi had at least six amphibian species which are endemic to Hainan, including the forest-dependent *Leptobrachium hainanensis* and *Amolops hainanensis*.
- Four ant species (*Cerapachys* sp. 2, *Dolichoderus* sp. 7, *Mystrium* sp. 1 and *Tetramorium* sp. 19) have been found only at Jiaxi, while seven butterflies (*Cyrestis themire*, *Penthema formosana*, *Arhopala aida*, *Arhopala arvina*, *Arhopala eumolphus*, *Hypolycaena erylus* and *Zeltus amasa*) have been found at no other site during KFBG surveys. Five dragonflies and one snail are endemic to Hainan. Many of the insect species, particularly above 800 m, were forest-dependent, indicating high habitat integrity. Some tropical insect genera were found even above 900 m, confirming the importance of Hainan's middle-elevation fragments of natural forest for Hainan's biodiversity.
- Jiaxi was predicted to be of local biodiversity significance by MacKinnon *et al.* (1986). Depending on the extent of remaining mature forest the present findings suggest it may even be of national significance, if ongoing degradation has not further depleted the forest integrity.

Threats and problems

- Logging was a severe problem at Jiaxi; most of the low-altitude forests had been cleared and there were only fragments left along the streams. Such activity did not appear to be under control by reserve staff. Logging continued in the remaining mature forest higher up, and trunks

were being cut into planks before being dragged down to the village. Judging from the size of the planks, the trees may have been over one hundred years old. Despite the extensive rubber plantations the local economy apparently relied on timber, at least since the downturn in the rubber market (villagers previously sold rubber sheets for 8-9 yuan per catty, but in 1999 could obtain only 4 yuan per catty).

- Forests were also cleared and/or burnt to create grazing land for livestock. These not only posed a threat to the forest remnants on lower slopes but also prevented forest regeneration.
- Hunting continued deep in the forest, although it was still possible to see large birds at close range at the time of the survey. Local villagers had two young scops owls, and three Black-browed Barbets, captured locally.
- Some orchids with high ornamental value and medicinal properties (e.g. *Dendrobium* spp., *Paphiopedilum appletonianum* and *Rhynchostylis gigantea* etc.) were threatened by over collection. The team was told by local villagers that 500g fresh weight of Dendrobiums would fetch RMB¥3.00 from orchid traders.

Opportunities

- The mature forest received some protection from its remoteness, and the steep slope above the village, but improved protection was clearly needed.
- The local villagers will need an alternative source of income to unsustainable and illegal logging. Suitable agroforestry could be established in the more degraded areas near the village, giving more diverse sources of income and raw materials than the existing rubber monocultures. Some residents might also be employed in forest protection and restoration.
- If grazing, hillfire and other forms of disturbance can be limited to areas outside the nature reserve, then the deforested hillside within the reserve should eventually recover. The present of nearby relatively good forest will act as natural seed sources for vegetation regeneration in the mixed grassland-shrubland. This could be supplemented by the planting of native tree saplings on the most degraded and grassy site. Some planting of species without adequate dispersal could be conducted. Reforestation of these grassy hills would help link up the forest fragments and to reestablish the low-altitude forest ecosystem.
- The enlargement of Jiaxi Nature Reserve to cover unprotected natural forest has been suggested, although there is some uncertainty about the distribution of the most intact forest. MacKinnon *et al*. (1996) suggested extending the reserve to cover the three county portions of “Mihanling”, a name which does not appear on all maps. According to XFW there is still extensive natural forest at the border of the three counties, especially on the Dongfang side (in Houmiling Forest Farm, east of the Daguangba Reservoir). Further surveys are needed in the area, with detailed vegetation mapping.
- Jiaxi is within 15 km of both Jianfengling National Nature Reserve to the west and Bawangling National Nature Reserve to the north. Establishment and augmentation of natural forest corridors between these three forest systems would improve their prospects of retaining integrity in the long term, and the extended protected-area system would be of undoubted global conservation importance. Such a system could have great benefits for both biodiversity conservation and the local community.

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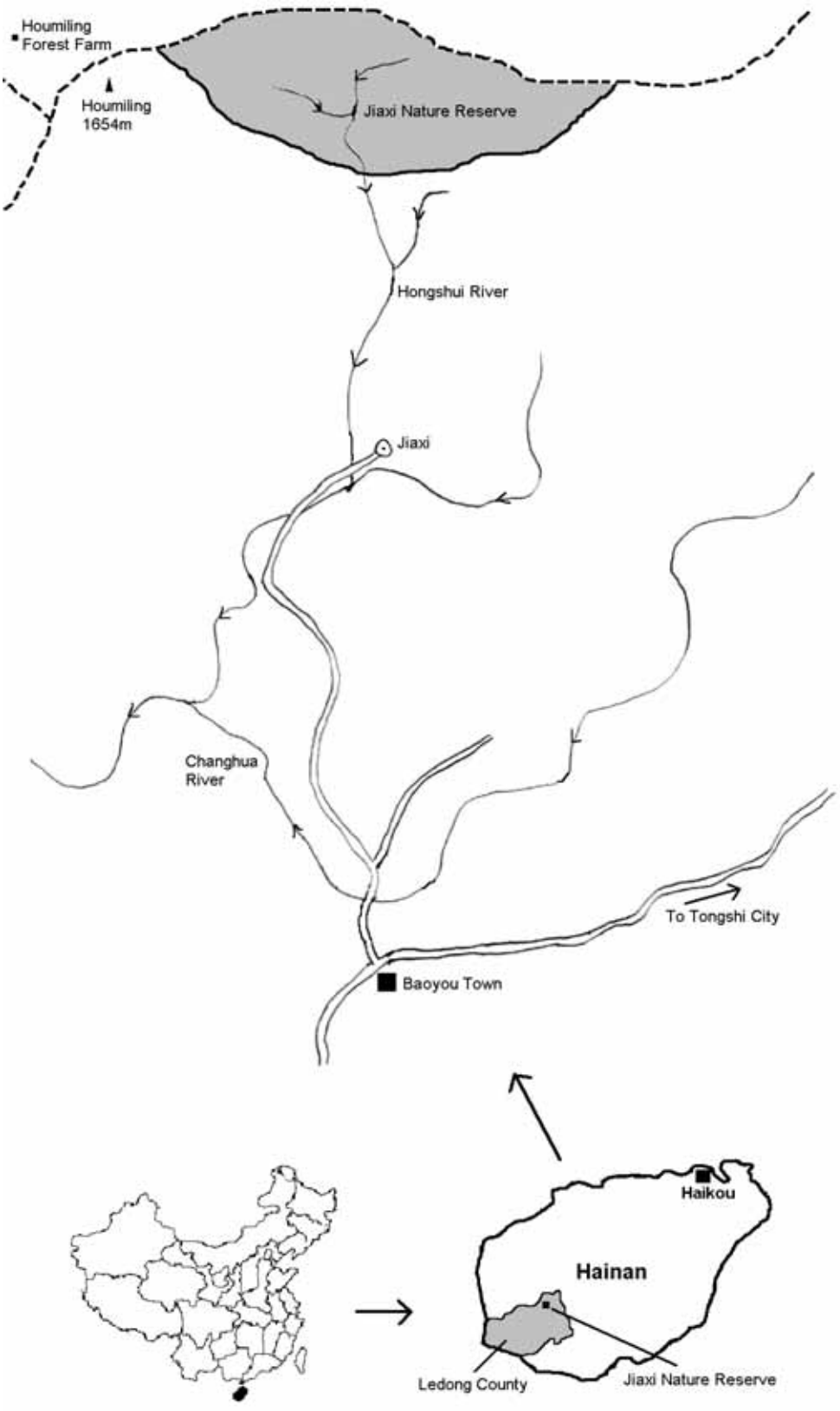

Figure 1. Map showing location of Jiaxi Nature Reserve, Western Hainan, China