Report of Rapid Biodiversity Assessments at Tongtieling Forest Area and Xinglong Tropical Botanic Garden, Southeast Hainan, China, 22-23 May 1999

Kadoorie Farm and Botanic Garden
in collaboration with
Hainan Provincial Forestry Department
South China Institute of Botany
Hainan Normal University
South China Normal University
Liuzhou Technical College
Xinyang Teachers' College

November 2002

South China Forest Biodiversity Survey Report Series: No. 22
(Online Simplified Version)

Report of Rapid Biodiversity Assessments at Tongtieling Forest Area and Xinglong Tropical Botanic Garden, Southeast Hainan, China, 22-23 May 1999

Editors

John R. Fellowes, Bosco P.L. Chan, Ng Sai-Chit, Michael W.N. Lau and Gloria L.P. Siu

Contributors

Kadoorie Farm and Botanic Garden:	Gloria L.P. Siu	(GS)
	John R. Fellowes	(JRF)
	Michael W.N. Lau	(ML)
	Lee Kwok Shing	(LKS)
	Graham T. Reels	(GTR)
	Bosco P.L. Chan	(BC)
	Ng Sai-Chit	(NSC)
Hainan Provincial Forestry Department:	Fu Jiping	(FJP)
	Yun Zhongda	(YZD)
South China Institute of Botany:	Xing Fuwu	(XFW)
	Wang Ruijiang	(WRJ)
Hainan Normal University:	Xiong Yan	(XY)
South China Normal University:	Xiao Zhi	(XZ)
Institute of Zoology (Beijing):	Chen Deniu	(CDN)
Liuzhou Technical College:	Chen Min	(CM)
Xinyang Teachers' College:	Li Hongjing	(LHJ)
Voluntary specialists:	Keith D.P. Wilson	(KW)

Background

The present report details the findings of a visit to southeastern 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

Kadoorie Farm and Botanic Garden, 2002. *Report of Rapid Biodiversity Assessments at Tongtieling Forest Area and Xinglong Tropical Botanic Garden, Southeast Hainan, China, 22-23 May 1999*. South China Forest Biodiversity Survey Report Series (Online Simplified Version): No. 22. KFBG, Hong Kong SAR, ii + 18 pp.

November 2002

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

Report of Rapid Biodiversity Assessments at Tongtieling Forest Area and Xinglong Tropical Botanic Garden, Southeast Hainan, China, 22-23 May 1999

Objectives

- The aims of the survey were to collect up-to-date information on the fauna and flora of Tongtieling Forest Area and Xinglong Tropical Botanic Garden, and to use this to help determine conservation priorities within South China. Emphasis was on groups that have not been extensively studied, including birds, amphibians, reptiles, fish, ants, dragonflies and butterflies. Only one day was spent at Tongtieling and less than one day at Xinglong Tropical Botanic Garden; results of the two surveys are combined here due to their close proximity.

Methods

- In the evening of 21 May 1999 a team from Hong Kong (GS, JRF, ML, GTR, LKS, KW), Haikou (FJP, YZD, XY), Guangzhou (XFW, WRJ, XZ), Xinyang (LHJ) and Liuzhou (CM) arrived in Xinglong Tourism City, following rapid biodiversity assessments in Jianling and Shangxi Nature Reserves (Kadoorie Farm and Botanic Garden, 2002a) and Liji Qingpilin Nature Reserve (Fellowes *et al*., in press) in Wanning City.
- On 22 May, they surveyed the Tongtieling Forest Area and surveyed the Xinglong Tropical Botanic Garden on 23 May.
- 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 (excluding Insectivora, Chiroptera and Muridae) at Tongtieling 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 by XFW or WRJ, and edited by NSC. Records of orchids were made or verified by GS. Records of birds were made or verified by LKS, reptiles and amphibians by ML, fish by BC, ants by JRF, dragonflies by KW and GTR, butterflies by GTR and molluscs by CDN or XY.
- 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 Species Survival Commission (2002). Certain taxa, including orchids, reptiles, amphibians, fish and invertebrates, have yet to be properly assessed for global status.
- 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

- Tongtieling Forest Area is situated in Wanning City, in the Eighth Management District of Xinglong Farm. The area was formerly adjacent to a People's Liberation Army camp and radar station, and consequently the vegetation has been less disturbed than in other areas.
- The region has a tropical monsoon climate. Climatic data for Tongtieling were not available, but at Wanning City, 22.5 km to the northeast, mean monthly temperature ranges from 18°C in January to 28°C in July; annual precipitation is around 2,240 mm (Hainan Bureau of Surveying and Mapping, 1996).
- Tongtieling has a moderately gentle topography, the highest peak being 642 m (Hainan Bureau of Surveying and Mapping, 1996). The present survey covered only lower altitudes between 70 and 130 m.
- Tongtieling is currently not legally protected, but the forest has been preserved largely through the goodwill of the owner of Xinglong Tropical Botanic Garden. The Botanic Garden covers 3.5 km^2, and was established in 1992.

Results

Vegetation

- The original vegetation of Tongtieling would have been tropical seasonal evergreen rainforest. The original forest had been largely destroyed in the past, but in 1999 the area was covered in extensive and natural secondary forest about 10-20 m in height. Patches of remnant mature forest could be seen at higher altitude but they could not be visited in the time available.
- Dominant families in the forest vegetation included Lauraceae, Euphorbiaceae, Moraceae, Sterculiaceae, Annonacaeae and Areaceae. At the edge and at lower elevations the forest was more disturbed; here it had been largely transformed to shrubland, about 1-2 m height, and to plantations of rubber tree (*Hevea brasiliensis*). The Xinglong Tropical Botanic Garden had been established on degraded land including former rubber plantation, but had been extensively planted with a range of species.

Flora

- The present survey recorded 243 vascular plant species including 22 fern species in 14 families, two gymnosperms in one family, and 219 angiosperms in 65 families at Tongtieling Forest Area. This is a very high figure for a one-day survey. Six orchid species were found (Table 2); all other vascular plants are shown in Table 1.
- Among the flora recorded, several species are of conservation interest:
  - *Vatica mangachapoi* is globally Endangered and under Class II National Protection in China.
  - *Heritiera parvifolia* is globally Vulnerable, Class II Nationally Protected and endemic to Hainan.
  - *Ixonanthes chinensis* is globally Vulnerable.
  - *Cibotium barometz* is under Class II National Protection in China and is listed in CITES Appendix II.

– The tree *Chieniodendron hainanense* is endemic to Hainan and southern Guangxi, and is rare and restricted to natural forest.
– Fifteen other species recorded (*Kopsia hainanensis*, *Aristolochia fulvicoma*, *Vernonia chunii*, *Diospyros howii*, *Croton howii*, *Drypetes hainanensis* var. *longistipitata*, *Castanopsis hainanensis*, *Stauntonia oligophylla*, *Ardisia densilepidotula*, *Decaspermum albociliatum*, *Dalbergia hainanensis*, *Reevesia longipetiolata*, *Camellia amplexifolia*, *Gordonia hainanensis*, and *Calamus egregius*) are Hainan endemics, while another three (*Chieniodendron hainanense, Polyalthia lauii* and *Actephila merrilliana*) have very restricted global ranges.

• Among the orchids, the record of *Cryptostylis arachnites* was the first from Hainan. Three of the six orchids are primitive species. All are listed in CITES Appendix II.

Table 1. Vascular plants of Tongtieling Forest Area recorded in the present survey. Not including orchids (see Table 2). Species which are Nationally Protected (Class I or II) (State Forestry Administration & Ministry of Agriculture, 1999), globally Threatened or Lower Risk (Near-threatened) (IUCN Species Survival Commission, 2002) or narrowly distributed are indicated.

Family	Species	Remarks
PTERIDOPHYTA		
Aspleniaceae	*Asplenium prolongatum* Hook.	
Athyriaceae	*Callipteris esculenta* (Retz.) J.Sm.	
Blechnaceae	*Blechnum orientale* L.	
Bolbitidaceae	*Bolbitis subcordata* (Copel.) Ching	
	Egenolfia appendiculata (Willd.) J.Sm.	
Dicksoniaceae	*Cibotium barometz* (L.) J. Sm.	Protected II
Gleicheniaceae	*Dicranopteris linearis* (Burm. f.) Underw.	
Lindsaeaceae	*Lindsaea orbiculata* (Lam.) Mett. ex Kuhn	
Lygodiaceae	*Lygodium flexuosum* (L.) Sw.	
	Lygodium japonicum (Thunb.) Sw.	
	Lygodium scandens (L.) Sw.	
Osmundaceae	*Osmunda vachellii* Hook.	
Polypodiaceae	*Lemmaphyllum microphyllum* C. Presl	
Pteridaceae	*Pteris dispar* Kunze	
	Pteris ensiformis Burm. f.	
	Pteris semipinnata L.	
Selaginellaceae	*Selaginella doederleinii* Hieron	
	Selaginella uncinata (Desv.) Spring	
Stenochlaenaceae	*Stenochlaena palustris* (Burm.f.) Bedd.	
Thelypteridaceae	*Cyclosorus aridus* (D.Don) Ching	
	Pronephrium simplex (Hook.) Holttum	
	Pronephrium triphyllum (Sw.) Holttum	
GYMNOSPERMAE		
Gnetaceae	*Gnetum montanum* Markgr.	
	Gnetum parvifolium (Warb.) Chun	
ANGIOSPERMAE		
Dicotyledonae		
Actinidiaceae	*Saurauia tristyla* DC.	
Amaranthaceae	*Achyranthes aspera* L.	
	Amaranthus spinosus L.	
	Amaranthus viridis L.	
	Celosia argentea L.	
	Cyathula prostrata (L.) Blume	
	Gomphrena celosioides Mart.	
Annonaceae	*Alphonsea monogyna* Merr. & Chun	
	Artabotrys hongkongensis Hance	
	Dasymaschalon rostratum Merr. & Chun	
	Dasymaschalon trichophorum Merr.	
	Desmos chinensis Lour.	

Family	Species	Remarks
	Goniothalamus chinensis Merr. & Chun	
	Goniothalamus howii Merr. & Chun	
	Mezzettiopsis creaghii Ridl.	
	Miliusa chunii W. T. Wang	
	Chieniodendron hainanense (Merr.) Tsiang & P. T. Li	endemic to Hainan & S. Guangxi
	Polyalthia cerasoides (Roxb.) Benth. & Hook. f. ex Bedd.	
	Polyalthia obliqua J. D. Hooker & Thomson	
	Polyalthia lauii Merr.	endemic to Hainan & Vietnam
	Polyalthia plagioneura Diels	
	Uvaria boniana Finet & Gagnep.	
	Uvaria calamistrata Hance	
	Uvaria grandiflora Roxb.	
	Uvaria microcarpa Champ. ex Benth.	
Apocynaceae	*Alyxia odorata* Wall.ex G. Don	
	Kopsia hainanensis Tsiang	endemic to Hainan
	Melodinus suaveolens Champ. ex Benth.	
Araliaceae	*Aralia decaisneana* Hance	
Aristolochiaceae	*Aristolochia fulvicoma* Merr. & Chun	endemic to Hainan
Asteraceae	*Siegesbeckia orientalis* L.	
	Vernonia chunii C. C. Chang	endemic to Hainan
	Vernonia cinerea (L.) Less.	pantropical weed
	Vernonia cumingiana Benth.	
	Vernonia patula (Dryand.) Merr.	
	Xanthium sibiricum Patrin ex Widder	
	Youngia japonica (L.) DC.	
Bignoniaceae	*Radermachera frondosa* Chun & F.C. How	
	Radermachera hainanensis Merr.	
Caesalpiniaceae	*Caesalpinia crista* L.	
Capparaceae	*Capparis cantoniensis* Lour.	
	Stixis suaveolens (Roxb.) Pierre	
Celastraceae	*Euonymus laxiflorus* Champ. ex Benth.	
	Euonymus nitidus Benth.	
Clusiaceae	*Hypericum japonicum* Thunb. ex Murray	
Combertaceae	*Combretum oliviforme* A.C. Chao	
	Combretum punctatum Blume subsp. *squamosum* (Roxb. ex G. Don) Exell	
	Quisqualis indica L.	
Dipterocarpaceae	*Vatica mangachapoi* Blanco.	Protected II, Endangered
Droseraceae	*Drosera burmannii* Vahl	
Ebenaceae	*Diospyros diversilimba* Merr. & Chun	
	Diospyros eriantha Champ. ex Benth.	
	Diospyros howii Merr & Chun	endemic to Hainan
Elaeocarpaceae	*Elaeocarpus sylvestris* (Lour.) Poir.	
Erythroxylaceae	*Erythroxylum sinense* Y. C. Wu	
Escalloniaceae	*Itea macrophylla* Wall. ex Roxb.	
	Polyosma cambodiana Gagnep.	
Euphorbiaceae	*Actephila merrilliana* Chun	endemic to Hainan & S. Guangxi
	Alchornea rugosa (Lour.) Müll. Arg.	
	*Alchornea trewioide*s (Benth.) Müll. Arg.	
	Antidesma montanum Blume	
	Aporosa dioica (Roxb.) Müll. Arg.	
	Baccaurea ramiflora Lour.	
	Bischofia javanica Blume	
	Blachia pentzii (Müll. Arg.) Benth.	
	Breynia fruticosa (L.) Hook. f.	
	Bridelia insulana Hance	
	Bridelia stipularis (L.) Blume	
	Bridelia tomentosa Blume	

Family	Species	Remarks
	Claoxylon hainanense Pax & K. Hoffm.	
	Claoxylon indicum (Reinw. ex Bl.) Hassk.	
	Cleistanthus sumatranus (Miq.) Müll. Arg.	
	Croton cascarilloides Raeusch.	
	Croton howii Merr. & Chun ex Y.T. Chang	endemic to Hainan
	Croton laevigatus Vahl	
	Dimorphocalyx poilanei Gagnep.	
	Drypetes hainanensis Merr.	
	Drypetes hainanensis Merr. var. *longistipitata* P.T. Li	endemic to Hainan
	Endospermum chinense Benth.	
	Glochidion coccineum (Buch.-Ham.) Müll. Arg.	
	Glochidion hirsutum (Roxb.) Voigt	
	Glochidion lanceolarium (Roxb.) Voigt	
	Glochidion philippicum (Cav.) C.B. Rob.	
	Mallotus anomalus Merr. et Chun	
	Mallotus apelta (Lour.) Müll. Arg.	
	Sapium discolor (Champ. ex Benth.) Müll. Arg.	
Fagaceae	*Castanopsis fissa* (Champ. ex Benth.) Rehder et E. H. Wilson	
	Castanopsis hainanensis Merr.	endemic to Hainan
	Castanopsis jucunda Hance	
Flacourtiaceae	*Casearia aequilateralis* Merr.	
	Scolopia buxifolia Gagnep.	
	Scolopia chinensis (Lour.) Clos	
	Scolopia saeva (Hance) Hance	
Hamamelidaceae	*Liquidambar formosana* Hance	
Ixonanthaceae	*Ixonanthes chinensis* Champ.	Vulnerable
Lardizabalaceae	*Stauntonia chinensis* DC.	
	Stauntonia oligophylla Merr. & Chun	endemic to Hainan
Lauraceae	*Cassytha filiformis* L.	
	Cryptocarya concinna Hance	
	Cryptocarya densiflora Blume	
	Litsea monopetala (Roxb. ex Baker) Pers.	
	Phoebe tavoyana (Meisn.) Hook. f.	
Lecythidaceae	*Barringtonia racemosa* (DC.) Spreng.	
Loganiaceae	*Strychnos angustiflora* Benth.	
Loranthaceae	*Helixanthera parasitica* Lour.	
Lythraceae	*Rotala densiflora* (Roth) Koehne	
Malpighiaceae	*Hiptage benghalensis* (L.) Kurz	
Malvaceae	*Malvastrum coromandeliaum* (L.) Garcke	pantropical weed
	Sida acuta Burm. f.	pantropical weed
	Sida chinensis Retz.	
	Sida cordata (Burm. f.) Borss. Waalk.	
	Sida cordifolia L.	pantropical weed
	Sida rhombifolia L.	pantropical weed
	Urena lobata L.	pantropical weed
	Urena procumbens L.	
Melastomataceae	*Melastoma candidum* D. Don	
	Melastoma sanguineum Sims	
	Memecylon ligustrifolium Champ. ex Benth.	
	Memecylon nigrescens Hook. & Arn.	
Menispermaceae	*Hypserpa nitida* Miers	
Molluginaceae	*Glinus oppositifolius* (L.) Aug. DC.	
	Mollugo pentaphylla L.	
Moraceae	*Ficus altissima* Blume	
	Ficus auriculata Lour.	
	Ficus fistulosa Reinw. ex Blume	
	Ficus hirta Vahl	
	Ficus hispida L. f.	
	Ficus microcarpa L. f.	
	Ficus nervosa B. Heyne ex Roth.	

Family	Species	Remarks
	Ficus oligodon Miq.	
	Ficus pandurata Hance	
	Ficus pumila L.	
Myrsinaceae	*Ardisia densilepidotula* Merr.	endemic to Hainan
	Ardisia faberi Hemsl.	
	Ardisia humilis Vahl	
	Ardisia obtusa Mez	
	Ardisia quinquegona Blume	
Myrtaceae	*Baeckea frutescens* L.	
	Decaspermum albociliatum Merr. & L. M. Perry	endemic to Hainan
	Decaspermum gracilentum (Hance) Merr. & L.M. Perry	
	Rhodomyrtus tomentosa (Aiton) Hassk.	
	Syzygium hancei Merr. & L. M. Perry	
	Syzygium odoratum (Lour.) DC.	
Oxalidaceae	*Oxalis corniulata* L.	
	Oxalis corymbosa DC.	
Papilionaceae	*Abrus mollis* Hance	
	Abrus precatorius L.	
	Dalbergia benthami Prain	
	Dalbergia hainanensis Merr. & Chun	endemic to Hainan
	Dalbergia hancei Benth.	
Pentaphylacaceae	*Pentaphylax euryoides* Gardner & Champ.	
Piperaceae	*Peperomia blanda* (Jacq.) Kunth	
	Piper hancei Maxim.	
	Piper sarmentosum Roxb.	
Polygalaceae	*Xanthophyllum hainanense* Hu	
Polygonaceae	*Polygonum barbatum* L.	
	Polygonum chinense L.	
	Polygonum perfoliatum L.	
	Polygonum plebeium R. Br.	
Portulacaceae	*Portulaca oleracea* L.	
Proteaceae	*Helicia cochinchinensis* Lour.	
Rosaceae	*Photinia benthamiana* Hance	
	Pygeum topengii Merr.	
	Rhaphiolepis indica (L.) Lindl.	
Rubiaceae	*Antirhea chinensis* (Champ. ex Benth.) F.B. Forbes & Hemsl.	
	Morinda cochinchinensis DC.	
	Pavetta hongkongensis Brem.	
Rutaceae	*Acronychia oligophlebia* Merr.	
Sabiaceae	*Sabia limoniacea* Wall. ex Hook. f. & Thomson	
Scrophulariaceae	*Scoparia dulcis* L.	weed from tropical America
Solanaceae	*Datura metel* L.	introduced
	Solanum lasiocarpum Dunal	
	Solanum macaonensis Dunal	
	Solanum undatum Lam.	
Sterculiaceae	*Byttneria aspera* Colebr. ex Wall.	
	Helicteres angustifolia L.	
	Heritiera parvifolia Merr.	Protected II, Vulnerable, endemic to Hainan
	Kleinhovia hospita L.	
	Pterospermum heterophyllum Hance	
	Reevesia longipetiolata Merr. et Chun	endemic to Hainan
	Reevesia thyrsoidea Lindl	
	Sterculia hainanensis Merr. et Chun	
	Sterculia lanceolata Cav.	
	Waltheria indica L.	
Theaceae	*Adinandra hainanensis* Hayata	
	Camellia amplexifolia Merr. & Chun	endemic to Hainan
	Gordonia hainanensis H.T. Chang	endemic to Hainan
Tiliaceae	*Corchorus aestuans* L.	

Family	Species	Remarks
	Microcos paniculata L.	
	Triumfetta cana Blume	
	Triumfetta rhomboidea Jacq.	
Ulmaceae	*Trema cannabina* Lour.	
Verbenaceae	*Callicarpa candicans* (Burm. f.) Hochr.	
	Callicarpa longifolia Lam.	
	Callicarpa nudiflora Hook. & Arn.	
	Clerodendrum hainanensis Hand.-Mazz.	
Violaceae	*Viola diffusa* Ging.	
Vitaceae	*Cayratia corniculata* (Benth.) Gagnep.	
Monocotyledonae		
Araceae	*Acorus gramineus* Sol.	
Areaceae	*Calamus egregius* Burret	endemic to Hainan
	Calamus faberi Becc.	
	Calamus rhabdocladus Burret	
	Calamus tetradactylus Hance	
Cyperaceae	*Carex cryptostachys* Brongn.	
Liliaceae	*Smilax corbularia* Kunth	
	Smilax glabra Roxb.	
	Smilax macrocarpa Blume	
Poaceae	*Arundinella anomala Steud.*	
	Axonopus compressus (Sw.) P. Beauv.	
	Panicum brevifolium L.	
	Panicum incomtum Trin.	
	Panicum notatum Retz	
	Panicum repens L.	

Table 2. Orchids recorded in Yabatian and Tongtieling Forest area, Wanning, Hainan on 22 May 1999.

Species	Habitat	Remarks
Apostasia odorata Bl.	on forest floor with rich humus (130–160 m)	terrestrial, primitive orchid
Cryptostylis arachnites (Blume) Hassk.	on forest floor (150 m)	terrestrial, new genus record for Hainan
Gastrochilus sp.	on tree trunk near base (150 m)	epiphytic
Neuwiedia singapureana (Baker) Rolfe	on forest floor with rich humus (130-160 m)	terrestrial, primitive orchid
Pholidota chinensis Lindl.	on tree trunk (550 m)	epiphytic
Tropidia curculigoides Lindl.	on bamboo floor with rich humus (400–410 m)	terrestrial, primitive orchid

Mammals

- A Red-hipped Squirrel, *Dremomys pyrrhomerus*, was seen by the guides in the forest at Tongtieling at dusk.
- A Maritime Striped Squirrel, *Tamiops maritimus*, was seen by the botanists in the forest at Tongtieling.
- A number of species were reported to occur at Tongtieling by Mr He, a former hunter. Status of mammals is inferred (Table 3) based on the observations of Mr He and on past distribution records (Liu & Liu, 1976; Hsu & Wu, 1981; Xu *et al*., 1983; Zhang *et al.*, 1997).
- Hoof prints of a large deer were seen on the forest floor by XFW and WRJ at Tongtieling. They might have belonged to either Sambar *Cervus unicolor* or Eld's Deer *Cervus eldii*. Mr He reported the presence of Eld's Deer (with tracks about 6 cm in length).
- Mr He had reportedly in the past shot animals that matched the description of Binturong *Arctictis binturong*. Binturong has never been recorded from Hainan, and is here considered doubtful, but occurs in Vietnam and Yunnan.

- There are no firm records of Red Fox *Vulpes vulpes* and Spotted Linsang *Prionodon pardicolor* from Hainan (Zhang *et al*., 1997); reports of these are therefore considered doubtful.

Table 3. The status of mammals (excluding Erinaceidae, Talpidae, Soricidae, Muridae and Chiroptera) at Tongtieling Forest Area, Hainan, based on past records (Zhang *et al*., 1997) and on an interview with a guide of the Forest Area. "X" = Xinglong; "+" = rare, "++" = quite common, "+++" = abundant. Sequence follows D.E. Wilson & Cole (2000).

Scientific name	English name	Past records from Wanning	Mr. He	Probable status
Hylomys hainanensis	Hainan Gymnure	-	+	insecure
Tupaia belangeri	Northern Tree Shrew	-	+++	present
Macaca mulatta	Rhesus Monkey	-	+++	present
Nomascus (cf. *nasutus*) sp. (recorded as *Hylobates concolor*)	Eastern Crested Gibbon	✓("probably extirpated")	-	extirpated
Vulpes vulpes	Red Fox	-	+++	doubtful
Prionailurus bengalensis	Leopard Cat	-	+++	present
Neofelis nebulosa	Clouded Leopard	-	+++	present
Herpestes javanica	Javan Mongoose	✓	-	insecure or extirpated
Lutra lutra	Eurasian Otter	-	+	insecure
Martes flavigula	Yellow-throated Marten	✓ (X)	+	insecure
Melogale moschata	Chinese Ferret-badger	✓	+++	present
Mustela kathiah	Yellow-bellied Weasel	-	++	present
Ursus thibetanus	Asiatic Black Bear	✓	+	insecure
Arctictis binturong	Binturong	-	+	doubtful
Paguma larvata	Masked Palm Civet	-	+++	present
Paradoxurus hermaphroditus	Asian Palm Civet	✓	+++	present
Prionodon pardicolor	Spotted Linsang	-	+++	doubtful
Viverra zibetha	Large Indian Civet	✓	+++	present
Viverricula indica	Small Indian Civet	✓	+++	present
Sus scrofa	Wild Boar	-	+++	present
Cervus eldii	Eld's Deer	✓,X	+	insecure
Cervus unicolor	Sambar	✓	-	insecure
Muntiacus muntjak	Indian Muntjac	✓	+++	present
Manis pentadactyla	Chinese Pangolin	✓	++	insecure
Dremomys pyrrhomerus	Red-hipped Squirrel	-	+++	present
Callosciurus erythraeus	Pallas's Squirrel	✓	+++	present
Ratufa bicolor	Black Giant Squirrel	✓	-	extirpated
Tamiops maritimus	Maritime Striped Squirrel	-	+++	present
Petaurista philippensis	Indian Giant Flying Squirrel	-	+	insecure
Rattus tanezumi (recorded as *R. flavipectus*)	Tanezumi Rat	✓	(not asked)	unknown
Rattus turkestanicus (recorded as *R. rattoides*)	Turkestan Rat	✓	(not asked)	unknown
Rhizomys sinensis	Chinese Bamboo Rat	-	+++	present
Hystrix brachyura	Malayan Porcupine	-	+++	present
Atherurus macrourus	Asiatic Brush-tailed Porcupine	✓	+++	present
Lepus hainanus	Hainan Hare	-	+++	present

- Some of the species suspected to occur are of particular conservation importance:
  - Hainan Gymnure is listed as globally Endangered.
  - Clouded Leopard and Eld's Deer are globally Vulnerable, and Class I Protected in China. Eld's Deer has previously been recorded from Xinglong (Zhang *et al.*, 1997).
  - Asiatic Black Bear *Ursus thibetanus* and Hainan Hare *Lepus hainanus* are globally Vulnerable, and Class II Protected in China.
  - Chinese Pangolin *Manis pentadactyla* is globally Near-threatened, and Class II Protected in China.

– Yellow-throated Marten, Eurasian Otter, Large Indian Civet, Small Indian Civet, Spotted Linsang and Golden Flying Squirrel are also Class II Protected nationally. Xinglong is one of the very few known localities in Hainan for Yellow-throated Marten *Martes flavigula* (Zhang *et al.*, 1997), but it was also reported from Shangxi Nature Reserve (Kadoorie Farm and Botanic Garden, 2002a).

Birds

- Thirty-two species of birds were recorded at Tongtieling, and thirteen at Xinglong Tropical Botanic Garden, during this survey (Table 4).
- The most frequently encountered species at Tongtieling were Hainan Blue Flycatcher *Cyornis hainanus* and Light-vented Bulbul *Pycnonotus sinensis*. The most frequently encountered species at Xinglong Tropical Botanic Garden were Asian Palm Swift *Cypsiurus parvus*, Light-vented Bulbul *Pycnonotus sinensis* and Japanese White-eye *Zosterops japonicus.*
- The guide Mr He reported the presence of Chinese Francolin *Francolinus pintadeanus*, Silver Pheasant *Lophura nycthemera* and Hainan Peacock Pheasant *Polyplectron katsumatae* at Tongtieling, as well as Red Junglefowl *Gallus gallus* which was confirmed during this survey.

Table 4. Birds recorded in Tongtieling Forest Area and Xinglong Tropical Botanic Garden. Sequence follows Clements (2000).

Scientific name	**English name**
Milvus migrans	Black Kite
Accipiter trivirgatus	Crested Goshawk
Gallus gallus	Red Junglefowl
Streptopelia chinensis	Spotted Dove
Hierococcyx sparverioides	Large Hawk Cuckoo
Cuculus micropterus	Indian Cuckoo
Surniculus lugubris	Drongo Cuckoo
Megalaima virens	Great Barbet
Apus affinis	House Swift
Cypsiurus parvus	Asian Palm Swift
Alcedo atthis	Common Kingfisher
Megalaima oorti	Black-browed Barbet
Hirundo rustica	Barn Swallow
Pericrocotus flammeus	Scarlet Minivet
Pericrocotus solaris	Grey-chinned Minivet
Pycnonotus sinensis	Light-vented Bulbul
Hemixos castanonotus	Chestnut Bulbul
Hypsipetes leucocephalus	Black Bulbul
Prinia flaviventris	Yellow-bellied Prinia
Cyornis hainanus	Hainan Blue Flycatcher
Copsychus saularis	Oriental Magpie Robin
Garrulax maesi	Grey Laughingthrush
Garrulax chinensis	Black-throated Laughingthrush
Pomatorhinus hypoleucos	Large Scimitar Babbler
Pomatorhinus ruficollis	Streak-breasted Scimitar Babbler
Stachyris ruficeps	Rufous-capped Babbler
Alcippe morrisonia	Grey-cheeked Fulvetta
Yuhina zantholeuca	White-bellied Yuhina
Nectarinia jugularis	Olive-backed Sunbird
Aethopyga christinae	Fork-tailed Sunbird
Zosterops japonicus	Japanese White-eye
Lanius schach	Long-tailed Shrike
Lonchura striata	White-rumped Munia

- Black Kite *Milvus migrans*, Crested Goshawk *Accipiter trivirgatus* and Red Junglefowl *Gallus gallus* are Class II Protected species of China.

Reptiles and Amphibians

- A total of 11 species of amphibian, seven species of lizard and three species of snakes were recorded (Table 5).
- The most frequently encountered species at Tongtieling were *Occidozyga martensii*, *Rana taipehensis* and *Hemidactylus frenatus*. At Xinglong Tropical Botanic Garden, *Mabuya multifasciata* was most often seen.
- The identity of the small skink that resembles *Scincella rupicola* from Southeast Asia but with a scaly eye-lid is still being studied. This constitutes a new record for Hainan.
- The guides and a local villager also reported the presence of *Python molurus*, *Varanus salvator*, and *Pyxidea mouhotii* at Tongtieling.

Table 5. Amphibians and reptiles of Tongtieling Forest Area and Xinglong Tropical Botanic Garden. Sequence follows Zhao E.-M. & Adler (1993).

Species	**Habitat**
AMPHIBIA	
Bufo melanostictus	plantation
	forest
Amolops torrentis	forest stream
Occidozyga martensii	paddy field
Rana guentheri	paddy field
Rana limnocharis	abandoned field
	forest
Rana taipehensis	paddy field
	stream/paddy field
Philautus ocellatus	forest/bamboo
	forest
Philautus odontotarsus	forest
Polypedates megacephalus	paddy field
Kaloula pulchra hainanensis	parkland/garden
Microhyla butleri	forest
REPTILIA	
Goniurosaurus hainanensis	forest/bamboo
Hemidactylus frenatus	agriculture field/plantation
	village
	parkland/garden
Calotes versicolor	forest edge
	village
	parkland/garden
Ateuchosaurus chinensis	plantation edge
Mabuya multifasciata	parkland/garden
	forest edge
Scincella (cf. *rupicola*) sp.	forest
Tropidophorus hainanus	forest
Dendrelaphis pictus	forest edge
	forest
Enhydris chinensis	stream
Xenochrophis piscator	stream in plantation

- Some species are of particular conservation importance:
  - *Amolops torrentis* and *Goniurosaurus hainanensis* are endemic to Hainan.
  - *Kaloula pulchra hainanensis* is a subspecies restricted to Hainan and coastal southwestern Guangdong.
- The presence of several forest specialists (*Philautus ocellatus*, *Goniurosaurus hainanensis*, *Scincella* sp. and *Tropidophorus hainanus*) at Tongtieling indicated the forest there is still intact.

Fish

- Four species of freshwater fish were recorded from the small streams in the Tongteling area; an additional three species were reported to be present but specimens have not been examined by specialists (Table 6).
- The most frequently encountered species was *Gambusia affinis*, an invasive alien species.

Table 6. Freshwater fish recorded from Tongteling, 22 May 1999. ("✓" = present, "#" = unconfirmed report, "*" = nomenclature follows Pan, 1991)

Species	
Nicholsicypris normalis	#
Capoeta semifasciolata	✓
Cobitis sinensis	✓
Misgurnus anguillicaudatus	✓
Gambusia affinis *	✓
Macropodus opercularis	#
Channa gachua	#

Ants

- Forty-four ant species were recorded at Tongtieling and the Botanic Garden (Table 7).
- The most frequently encountered species at Tongtieling were *Diacamma* sp. 1*, Odontoponera* sp. 1*, Prenolepis* sp. 1*, Anoplolepis gracilipes, Aphaenogaster* sp. 1, *Crematogaster* sp. 8, *Gnamptogenys binghami* and *Pheidole plagiaria*.

Table 7. Ant species recorded at Tongtieling Forest Area and Xinglong Tropical Botanic Garden, May 1999. * Species with a strong forest association.

Species	**Habitat**
Aenictus (*aratus* group) sp. 5	broadleaf & bamboo forest, 490-510m
Anoplolepis gracilipes	low forest, shrubland, grassland, 20-140m
Aphaenogaster (cf. *beccarii*) sp. 1 *	closed broadleaf forest, 90-550m
Aphaenogaster (cf. *exasperata*) sp. 2 *	closed 10m broadleaf, 140m
Camponotus (cf. *aethiops vitiosus*) sp. 21	(missing data)
Camponotus nicobarensis	open shrubland, 120m
Camponotus rufoglaucus	open vegetation, 20-170m
Camponotus (nr. *vitreus praerufus*) sp. 32	open Casuarina plantation, 20m
Cataulacus granulatus	open shrubland, 120m
Crematogaster (cf. *ebenina*) sp. 19	open Casuarina plantation, 20m
Crematogaster (cf. *travancorensis*) sp. 2	shrubland, 110-240m
Crematogaster (cf. *laboriosa*) sp. 3	closed broadleaf/bamboo, 400-560m
Crematogaster (cf. *dohrni*) sp. 8	low forest, 20-140m
Diacamma (nr. *rugosum*) sp. 1	forest, shrubland, 20-500m
Dolichoderus sp. A	open palm/ grassland, 110m
Gnamptogenys binghami *	low broadleaf & bamboo forest, 280-460m
Harpegnathos venator	streamside, 40m
Kartidris (cf. *galos*) sp. 1 *	low forest, 40-420m
Leptogenys (cf. *kraepelini*) sp. 7 *	low closed broadleaf forest, 120m
Leptogenys sp. 17	low closed broadleaf forest, 120m
Leptogenys sp. 23	(missing data)
Monomorium (cf. *latinodoides*) sp. 10	open rubber plantation/ grassland, 190m
Monomorium sp. 13	building, 30m
Myrmecina sp. 1 *	20m closed broadleaf & bamboo, 560m
Odontoponera (cf. *denticulata*) sp. 1	forest, shrubland, 30-270m
Oecophylla smaragdina	closed bamboo shrubland, 60m
Pachycondyla (*javana* group) sp. 1 *	broadleaf & bamboo forest, 300-560m
Pachycondyla (cf. *luteipes*) sp. 2 *	open bamboo & broadleaf shrubland, 140m
Paratrechina longicornis	open plantation, 20m
Paratrechina (nr. *indica*) sp. 9 *	forest, near building, 30-440m

Species	Habitat
Pheidole plagiaria	forest, 40-330m
Pheidole (cf. *noda*) sp. 1	open bamboo & broadleaf shrubland, 140m
Pheidole sp. 11	low closed broadleaf forest, 80-110m
Pheidole (cf. *tsailuni*) sp. 7 *	20m closed broadleaf & bamboo, 560m
Pheidole (*rinae* group) sp. 9	forest, shrubland, 110-140m
Polyrhachis tyrannica	forest, shrubland, grassland, 120-130m
Prenolepis (cf. *emmae*) sp. 1 *	forest, 120-560m
Prenolepis magnocula *	forest, 500-560m
Pristomyrmex pungens	low closed broadleaf & banana, 540m
Tapinoma sp. 1	bamboo shrubland, plantation, 20-230m
Technomyrmex albipes	low broadleaf & bamboo forest, 420m
Tetramorium nipponense *	low closed broadleaf & banana, 540m
Tetraponera attenuata	open rubber plantation/ grassland, 200m
Vollenhovia (cf. *emeryi*) sp. 1 *	closed 10m broadleaf, 130m

- *Leptogenys* sp. 23 has been found only from Xinglong.
- The percentage of forest-dependent species was about 34% at Tongtieling, indicating the moderately low integrity of the habitats surveyed. No forest-dependent species were found at the Botanic Garden.
- *Anoplolepis gracilipes*, an invasive species from Africa, was widespread outside the closed-canopy forest. *Paratrechina longicornis*, another African exotic, was found only in plantation.

Dragonflies

- Seventeen species were recorded at Tongtieling, and ten at Xinglong Tropical Botanic Garden (Table 8).
- The most frequently encountered species at Tongtieling was *Drepanosticta zhoui*, which was first recorded from Shangxi on the same survey trip (Kadoorie Farm and Botanic Garden, 2002a).
- *Burmargiolestes xinglongensis* is a species new to science. It has been described from a single specimen by Wilson K.D.P. & Reels (2001), and named after the locality.
- The record of *Pseudoagrion australasiae* is the first from China.
- The records of *Macromia berlandi*, *Macromia katae*, *Macromia moorei malayana* and *Macromia rapida* are the first from Hainan.

Table 8. Dragonflies recorded at Tongtieling (22 May 1999) and Xinglong (23 May 1999). Sequence follows Schorr et al. (2001a, 2001b).

Species	Notes
Rhinocypha b. biforata	
Euphaea ornata	
Burmargiolestes xinglongensis	new species (Wilson & Reels, 2001)
Pseudolestes mirabilis	Hainan endemic
Cercion calamorum dyeri	
Pseudagrion australasiae	first Chinese record
Pseudagrion r. rubriceps	
Coeliccia scutellum hainanense	Hainan endemic subspecies
Coeliccia cyanomelas	
Drepanosticta zhoui	new species (Wilson & Reels, 2001)
Copera marginipes	
Asiagomphus hainanensis	
Ictinogomphus pertinax	
Paragomphus pardalinus	
Epopthalmia elegans	
Macromia berlandi	
Macromia calliope	
Macromia katae	previously considered a Hong Kong endemic
Macromia rapida	

Species	Notes
Nannophyopsis clara	
Orthetrum pruinosum neglectum	
Hydrobasileus croceus	
Urothemis s. signata	
Tramea virginia	
Zygonyx iris insignis	

- Some species at Tongtieling are of particular conservation significance:
  - *Burmargiolestes xinglongensis* is known only from Tongtieling.
  - *Euphaea ornata*, *Pseudolestes mirabilis*, *Coeliccia scutellum hainanense*, *Drepanosticta zhoui* are known only from Hainan.
  - *Macromia katae* and *Zygonyx iris insignis* are known only from Hainan and Hong Kong.
  - *Macromia calliope* is known only from Hainan and Vietnam.
  - *Macromia rapida* is known only from Hainan, Hong Kong and Guangdong
  - *Paragomphus pardalinus* is known only from Hainan, Guangxi and Guangdong.
  - *Macromia berlandi* is known only from Hainan, Guangxi, Hong Kong and Vietnam.
- At Xinglong Botanic Garden the species present were more associated with lentic habitats such as ponds.

Butterflies

- Forty-four species were recorded at Tongtieling, while only 15 were recorded at the Botanic Garden (Table 9).
- Most abundant at Tongtieling was *Zizeeria maha*.

Table 9. Butterflies at Tongtieling Forest Area and Xinglong Tropical Botanic Garden, 22-23 May 1999. Sequence of families follows Bascombe (1995).

Species	Habitat
Borbo cinnara	farmland/stream
Iambrix salsala	farmland/stream
	garden/plantation
Mooreana trichoneura	scrub/forest
Potanthus sp.	farmland/stream
Satarupa (cf. *gopala*) sp.	scrub/forest
Graphium agamemnon	farmland/stream
Graphium sarpedon	garden/plantation
Pachliopta aristolochiae	scrub/forest
Papilio bianor	farmland/stream
Papilio demoleus	farmland/stream
	garden/plantation
Papilio memnon	scrub/forest
	farmland/stream
Papilio nephelus	farmland/stream
	garden/plantation
Papilio paris	farmland/stream
Papilio polytes	farmland/stream
Papilio xuthus	garden/plantation
Papilio (Chilasa) clytia	garden/plantation
Papilio (Chilasa) sp.	farmland/stream
Troides sp.	farmland/stream
Appias lyncida	scrub/forest
Delias acalis	farmland/stream
Eurema sp.	farmland/stream
	garden/plantation
Gandaca harina	farmland/stream
Prioneris sp.	farmland/stream
Jamides alecto	farmland/stream
	scrub/forest

Species	Habitat
Nacaduba kurava	farmland/stream
Zizeeria maha	farmland/stream
Cethosia biblis	farmland/stream
Charaxes bernardus	garden/plantation
Cupha erymanthis	farmland/stream garden/plantation
Discophora sondaica	scrub/forest
Elymnias hypermnestra	farmland/stream
Euthalia phemius	garden/plantation
Faunis eumeus	scrub/forest
Hypolimnas bolina	farmland/stream
Ideopsis similis	farmland/stream garden/plantation
Mycalesis mineus	scrub/forest
Mycalesis zonata	scrub/forest
Neptis hylas	farmland/stream
Parantica aglea	farmland/stream
Phalanta phalanta	farmland/stream
Polyura nepenthes	garden/plantation
Precis (Junonia) almana	farmland/stream
Precis (Junonia) atlites	farmland/stream garden/plantation
Precis (Junonia) lemonias	farmland/stream garden/plantation
Thaumantis diores	scrub/forest
Vagrans egista	farmland/stream garden/plantation
Vindula sp.	farmland/stream
Ypthima baldus	farmland/stream
Ypthima motschulskyi	scrub/forest
Ypthima sp.	farmland/stream

- *Gandaca harina* and *Satarupa* sp. (Tongtieling) have not previously been recorded on KFBG surveys.
- The presence of *Thaumantis diores* and *Mooreana trichoneura* at Tongtieling may be considered as indicative of good forest.

Molluscs

- Only three species of snail and two species of slug were recorded (Table 10).

Table 10. Molluscs of Tongtieling Forest Area and Xinglong Tropical Botanic Garden.

Species	Habitat
Achatina fulica	plantation
Camaena xanthoderma polyzona	forest
Derocceras agrestis	forest
Kaliella depressa	forest
Macrochlamys cincta	plantation

- *Camaena xanthoderma polyzona*, *Kaliella depressa* and *Derocceras agrestis* are forest species indicating the forest at Tongtieling is quite intact.
- The molluscs at Xinglong Tropical Botanic Garden, like the exotic *Achatina fulica*, are typical of disturbed habitats.

Summary of flora and fauna

- The Tropical Botanic Garden and outer reaches of Tongtieling Forest Area had rather low ecological integrity, due to past deforestation and disturbance. The vegetation on the lower slopes of Tongtieling Forest Area was mainly secondary forest about 10-20 m in height, which had been partly transformed to plantation and shrubland at the edges.
- More mature forest was present higher up at Tongtieling. Altogether 243 vascular plant species were recorded in the present survey, suggesting the flora of Tongtieling is very rich.
- Among the recorded biota were three globally Threatened plant species (*Vatica mangachapoi*, *Heritiera parvifolia* and *Ixonanthes chinensis*), and some insects that have been found nowhere else, including the dragonfly *Burmargiolestes xinglongensis*, one ant (*Leptogenys* sp. 23) and one butterfly (*Satarupa* sp.). Tongtieling also supports a large number of plants and vertebrates with narrow global ranges, including some endemic to Hainan (e.g. *Goniurosaurus hainanensis*).
- Overall Tongtieling Forest Area was of high local biodiversity significance, comparable to other provincial-level nature reserves in the region.

Threats and problems

- Tongtieling is not a protected area and is not managed for conservation. It has been preserved through the goodwill of the conservation-minded owner of Xinglong Tropical Botanic Garden. A belt of land at the perimeter of the forest has been acquired so as to save this patch of forest from being cleared.
- Farming continued at Yabatian, and other forms of disturbance, such as hunting and collecting of terrapins, still occurred at the site. Hunting is particularly severe in winter, when many overseas Chinese from Southeast Asia reportedly visit Xinglong and consume large numbers of wild-caught animals.
- The outer and lower parts of the Forest Area had been mostly transformed to rubber tree plantation and much of the forest was secondary.

Opportunities

- Tongtieling has good lowland secondary forests and is of high local significance to biodiversity conservation. If protected from logging and hunting and managed for conservation, it could form an important part of the protected-areas network.
- Population in the forest area has decreased because of the low living standard in the Forest Area. This means the forest will have good chance to recover from previous disturbance. The Area's rich flora will facilitate regeneration of the forest.
- The Tropical Botanic Garden has made an important contribution to conserving valuable habitat. The Director, Mr. Zhang, reported that they were reforesting old rubber plantation. This restoration site adjacent to forest offers a good opportunity to monitor ecosystem recovery.
- Natural regeneration could be accelerated by planting native trees in old plantations which have lost their productivity. Seeds for reforestation could be collected locally.
- Due to its position behind the Xinglong Tropical Botanic Garden, which has excellent exhibits and facilities for visitors, there is potential to develop an environmental education programmme at Tongtieling.

Acknowledgements

The editors wish to thank the Hainan Forestry Department for their cooperation and assistance, and all participants of the survey team, including field staff at the two sites. We also thank our

colleagues at KFBG, Miss Joanne Loi and Wicky Lee, for data input. This work was funded by KFBG.

References

Anon., 1959-2001. *Flora Reipublicae Popularis Sinicae*. Tomus 2-80. Science Press, Beijing. (in Chinese)

Anon., 1996-2001. *Flora of China* Vol. 4, 15, 16, 17, 18, & 24. Science Press, Beijing, and Missouri Botanic Garden Press, St. Louis.

Anon., 2002a. *Flora of China Checklist.* Published on the Internet: http://mobot.mobot.org/W3T/Search/foc.html [accessed 1 May, 2002]

Anon., 2002b. *Flora of China Manuscript.* Published on the Internet: http://flora.huh.harvard.edu/china/ [accessed 1 May, 2002]

Bascombe, M.J. 1995. Check list of the butterflies of South China. *Memoirs of the Hong Kong Natural History Society* 20: 1-206.

Bolton, B. 1995. *A New General Catalogue of the Ants of the World*. Harvard University Press, Cambridge, Massachussetts, 504 pp.

Chen, S.-C. (ed.), 1999. Angiospermae Monocotyledoneae Orchidaceae (2). *Flora Reipublicae Popularis Sinicae*. Tomus 18. Science Press, Beijing, 463 pp. (In Chinese.)

Clements, J.F., 2000. *Birds of the World: A Checklist, Fifth Edition*. Ibis Publishing Company, California, 867pp.

Corbet, G.B. and Hill, J.E. 1992. *The Mammals of the Indomalayan Region: a Systematic Review*. Oxford University Press, New York, 488 pp.

Fellowes, J.R. *et al*., in press. Observations on the biota of Liji Qingpilin Nature Reserve, Southeast Hainan. *Living Forests* 5. KFBG, Hong Kong SAR.

Guangdong Forestry Department and South China Institute of Endangered Animals, 1987. *Colour Guide of Wildlife in Guangdong Province.* Guangdong Science and Technology Press, Guangzhou, 139 pp. + 300 colour plates. (In Chinese.)

Hainan Bureau of Surveying and Mapping, 1996. *Maps of Hainan Province*. Chengdu Map Publishing House, Sichuan, 82 pp. (In Chinese.)

Hsu, L.H. and Wu J.Y., 1981. A new subspecies of *Martes flavigula* from Hainan Island. *Acta Theriologica Sinica* 1(2): 145-148. [Cited by Zhang, Y. *et al*., 1997.]

Hua, W.L. and Yan, Q.W., 1993. *Protected Animals in China.* Shanghai Scientific and Technological Education Publishing House, Shanghai, 618 pp. (In Chinese with English abstract.)

Inskipp, T., Lindsey, N. and Duckworth, W., 1996. *An Annotated Checklist of the Birds of the Oriental Region*. Oriental Bird Club, Sandy, Bedfordshire, U.K, 294 pp.

IUCN Species Survival Commission, 2002. *2000 IUCN Redlist of Threatened Species.* Published on the Internet: http://www.redlist.org/ [Accessed on 1 May, 2002]

Kadoorie Farm and Botanic Garden, 2002a. *Report of Rapid Biodiversity Assessments at Jianling and Shangxi Nature Reserves, Southeast Hainan, China, May 1999*. South China Forest Biodiversity Survey Report Series No. 21. KFBG, Hong Kong SAR, ii + 21 pp.

Kadoorie Farm and Botanic Garden, 2002b. *Report of a Rapid Biodiversity Assessment at Diaoluoshan National Forest Park, Southeast Hainan, China, 23-28 May 1999.* South China Forest Biodiversity Survey Report Series No. 23. KFBG, Hong Kong SAR, ii + 34 pp.

Lang, K.-Y. (ed.), 1999. Angiospermae Monocotyledoneae Orchidaceae (1). *Flora Reipublicae Popularis Sinicae.* Tomus 18. Science Press, Beijing, 551 pp. (In Chinese.)

Liu, M.Q. and Liu Z.H., 1976. Insectivores and ecological observation of their common species in Guangdong Province. *Chinese Journal of Zoology* (3), 29-30. [Cited by Zhang Y. *et al*., 1997.]

Nelson, J.S., 1994. *Fishes of the World, 3rd edition*. John Wiley & Sons, New York, 600 pp.

Pan, J.-H. (ed.), 1991. *The Freshwater Fishes of Guangdong Province.* Guangdong. Guangdong Science and Technology Press, Guangzhou, 589 pp. (In Chinese.)

Schorr, M., Lindeboom, M. and Paulson, D., 2001a. *List of Odonata of the World (Part 1, Zygoptera and Anisozygoptera).* July 2001 version. Published on the Internet: http://www.ups.edu/biology/museum/worldodonates.html

Schorr, M., Lindeboom, M. and Paulson, D., 2001b. *List of Odonata of the World (Part 2, Anisoptera).* April 2001 version. Published on the Internet: http://www.ups.edu/biology/museum/worldanisops.html

State Forestry Administration and Ministry of Agriculture, 1999. *State Protection List of Wild Plants*. (In Chinese.)

The Plant Names Project, 2002. *International Plant Names Index.* Published on the Internet: http://www.ipni.org/ [accessed 1 May, 2002].

Tsi, Z.-H. (ed.), 1999. Angiospermae Monocotyledoneae Orchidaceae (3). *Flora Reipublicae Popularis Sinicae.* Tomus 19. Science Press, Beijing, 485 pp. (In Chinese.)

Wilson, D.E. and Cole, F.R., 2000. *Common Names of Mammals of the World.* Smithsonian Institution Press, Washington and London, xiv + 204 pp.

Wilson, K.D.P. and Reels, G.T., 2001. Odonata of Hainan, China. *Odonatologica* 30(2): 145-208.

Wu, H.L., Shao, K.T. and Lai, C.F. (eds.), 1999. *Latin-Chinese Dictionary of Fishes' Names*. Sueichan Press, Taiwan, 1,028 pp. (In Chinese and English.)

Xu, L.H., Liu, Z.H. and Yu, S.M., 1983. Mammalia. Pp. 278-398 in *Birds and Beasts of Hainan Island*. Beijing: Science Press. [Cited by Zhang Y. *et al*., 1997.]

Zhang, Y. *et al*. 1997. *Distribution of Mammalian Species in China*. China Forestry Publishing House, Beijing, 280 pp.

Zhao, E., Chang, H.W., Zhao, H. and Adler, K., 2000. Revised Checklist of Chinese Amphibia & Reptilia. *Sichuan Journal of Zoology* 19(3): 196-207. (In Chinese.)

Zhao, E.-M. and K. Adler, 1993. *Herpetology of China.* Society for the Study of Amphibians and Reptiles, Oxford, Ohio, U.S.A., 522 pp.

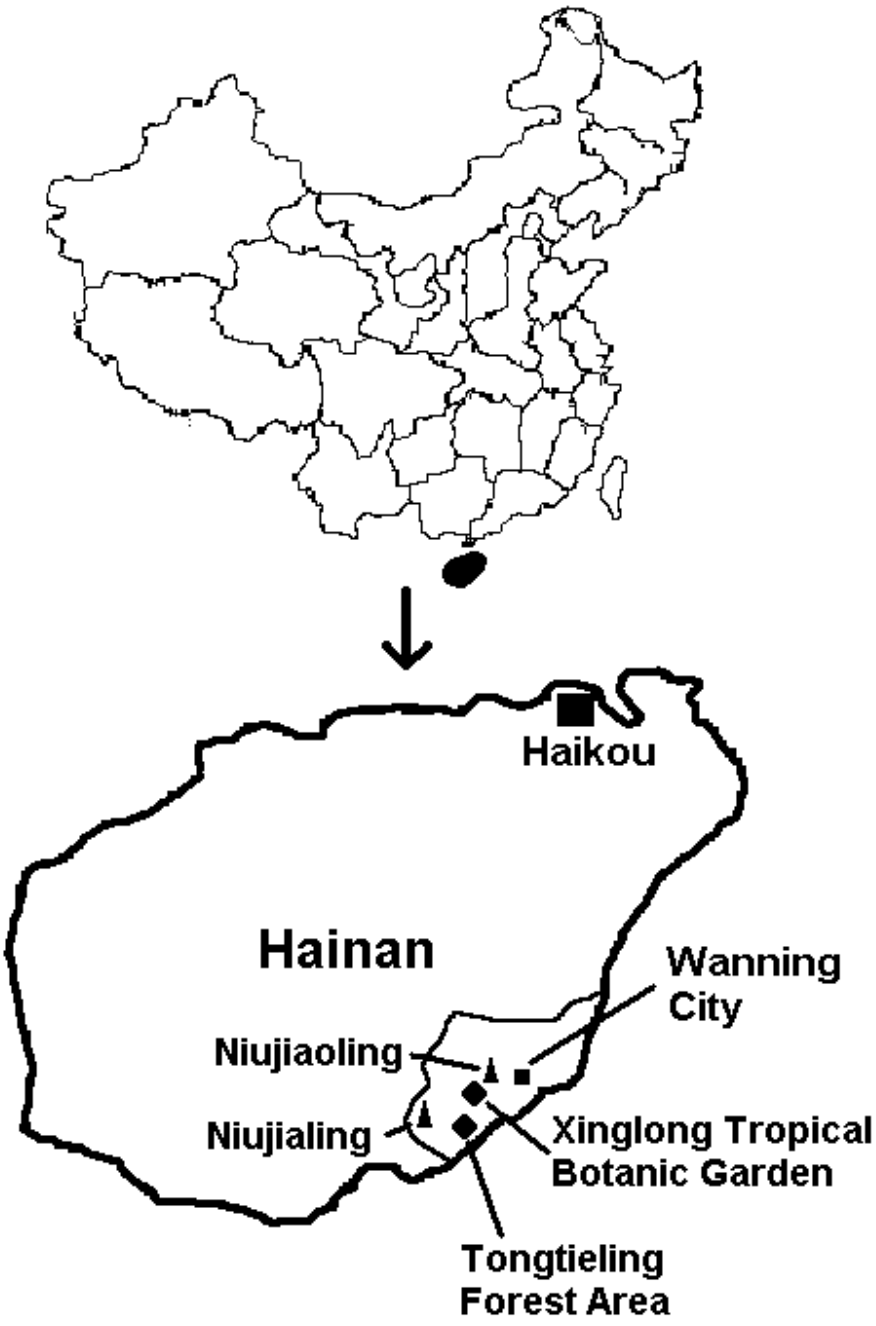

Figure 1. Map showing location of Tongtieling Forest Area and Xinglong Tropical Botanic Garden, Southeast Hainan, China.