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Preliminary Gibbon Status Review for Lao PDR 2008

J.W. Duckworth

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This review is a work in progress for the conservation of gibbons in Lao PDR. It is intended to be updated periodically. Any comment on this document, including further records, would be gratefully received by the author and by Fauna & Flora International, at the addresses below.

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Author: J. W. Duckworth, PO Box 5773, Vientiane, Lao PDR
Email: willduckworthdprk@yahoo.com

Date: December 2008

For more information or to send further comments contact:

Paul Insua-Cao
Fauna & Flora Asia-Pacific Programme,
340 Nghi Tam, Hanoi, Vietnam
Tel: +84-(0)43-719 4117
Fax: +84-(0)43-719 4119
Email: paul.insua.cao@ffi.org.vn

Front cover photo of a captive young yellow-cheeked crested gibbon by Monty Sly.

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EXECUTIVE SUMMARY

INTRODUCTION

- Lao PDR supports six species of gibbon; Indonesia is the only country with more. Asia east of the Mekong supports only crested gibbons of the genus *Nomascus*, of which there are four species in Lao PDR. Crested gibbons are severely threatened in Vietnam and China, and otherwise inhabit only a rather small area of Cambodia. Lao PDR can play an outstanding role in global gibbon conservation. Hence the present status review of gibbons in Lao PDR. Most of this document is a site directory, preceded by sections of how information was collected, the care taken to ensure its reliability, and the site results pooled together to determine national conservation status for each species, national-level patterns of threats and conservation, and recommendations for urgent gibbon conservation interventions.

INTRODUCING GIBBONS

- Gibbons are small apes and the closest biological relatives of humankind which survive in mainland South-east Asia. They are restricted to biogeographic South-east Asia, an area with generally high threats to wildlife through hunting and habitat conversion. Their family, Hylobatidae, is thus one of very few families (with many species) where all species are IUCN Red Listed as globally threatened.
- For various biological reasons (e.g. low reproductive output and late maturity) gibbon populations are more heavily reduced by even quite modest levels of hunting than are many other mammals of South-east Asian forests. They are also slow to recover from population reductions.
- Gibbons are arboreal so require forest, but are not as tied to old-growth stands as has sometimes been assumed. Viable populations may require areas of forest exceeding 100–200 km². It is unclear whether populations can persist in wholly deciduous forests, but they certainly occupy them near evergreen and semi-evergreen stands. There are no known Lao populations of gibbons in deciduous dipterocarp forests. Gibbon diet is mostly fruit, and in the dispersal of seeds they are important to healthy forest dynamics.

STATUS OF GIBBONS IN LAO PDR

- Six species of gibbons inhabit Lao PDR: Western Black Crested Gibbon *Nomascus concolor*; Northern White-cheeked Gibbon *N. leucogenys*; Southern White-cheeked Gibbon *N. siki*; a form of uncertain identity but morphologically close to Yellow-cheeked Gibbon *N. gabriellae*; White-handed Gibbon *Hylobates lar* and Pileated Gibbon *H. pileatus*. The first two are globally Red Listed as Critically Endangered, the highest category of threat, and the other four are Endangered. Alternative taxonomic treatments exist; for example, siki is often considered a subspecies of *N. leucogenys*. This lack of consistent taxonomic treatment – unavoidable pending further research – hinders the use of the multiple sources, even recent ones, by non-specialists. No sites are known in Lao PDR where gibbon species overlap in distribution.
- All six species were confirmed to persist in Lao PDR during the 1990s. Five are confirmed in the 2000s, but no survey activity from this decade within Pileated Gibbon's Lao range was traced.

- Lao range limits are unclear for all Nomascus taxa. Over much of the northern highlands no gibbons have been identified to species and so *N. concolor* could have, or at least have had, a significantly larger Lao range than records prove. The division between *N. leucogenys* (recorded in various northern highland sites from Phongsali south to Vientiane province) and *N. siki* (of the northern Annamites and adjacent plains) remains unknown in terms of location and what happens there. Somewhere in Savannakhet and/or Salavan provinces *N. siki* is replaced by gibbons which look like N. gabriellae (of Cambodia and far southern Vietnam) but which sing more like *N. siki*, here called *Nomascus sp. incertae sedis*.
- Lao PDR evidently supports most of the world's *N. leucogenys* and *N. siki*; it may even also do so for *N. concolor* and *Nomascus sp. incertae sedis*. White-handed and Pileated Gibbons both have only small Lao ranges, west of the Mekong, respectively in the North and South. Far larger populations occur in other countries.
- Populations of Nomascus gibbons are larger in Lao PDR than in China or Vietnam. This reflects the higher proportion of Lao PDR which remains forested and the retention of multiple large blocks with little easy human access, rather than any hands-on conservation activity.

THREATS TO GIBBONS IN LAO PDR

- All gibbons receive full national legal protection in Lao PDR. An extensive national protected area (NPA) system is more than adequate to conserve Lao gibbon taxa except Pileated Gibbon (within the range of which is no NPA). That excepted, the legal base is thus in place: threats to Lao gibbons come from the reality of widespread illegal hunting and habitat loss.
- Being arboreal, gibbons are insulated from many general hunting threats to forest mammals, including dogs and ground-level traps such as snares. Few, if any, gibbons are by-catch of quarry species; most are killed deliberately and knowingly with projectiles.
- The only suggestion of targeted gibbon hunting anywhere in Lao PDR is in some areas to supply the Vietnamese demand for primate bones. Most hunted animals are in the general take of wild meat and since gibbon reproductive output is so low, they cannot provide a significant part of rural dietary needs.
- As with many other mammals and large birds, trends differ between northern and southern Lao PDR. In and south of the Nam Theun catchment reasonable gibbon populations persist in most remaining large blocks of evergreen and semi-evergreen forest, albeit reduced from the 1990s. In the northern highlands (where live *N. concolor* and *N. leucogenys*) gibbons are largely eradicated and even large blocks of forest (over 1000 km²) support only highly fragmented populations.
- Lao gibbon's national conservation outlook is thus fragile, particularly given ongoing heavy forest conversion and fragmentation in Lao PDR. A strategy for pro-active field-based gibbon conservation programmes is urgently needed.

OPPORTUNITIES FOR PROTECTING GIBBONS

- Gibbons are not crop pests or otherwise in conflict with people and seem generally to enjoy a neutral or positive image among rural people of Lao PDR. Almost a dozen villages are known where customary protection from hunting has retained gibbon populations otherwise doomed.

- Gibbons are also consistently identified as holding high potential to contribute directly to the Lao economy, at all levels, through tourism – a possibility that will disappear if their populations do.
- Their susceptibility to hunting means that in every Lao conservation area which holds them, gibbons require priority conservation attention. Conservation measures can proceed outside the knotty issue of tackling all hunting at once, giving gibbons great potential as flagship species whereby their conservation can lead the way to protect all biological and ecological values within their landscapes.

RECOMMENDATIONS

- Coupling the Lao PDR situation with each species's global conservation status indicates that the absolute global gibbon conservation priorities in Lao PDR are to secure populations of *N. concolor* and *N. leucogenys*.
- The conservation outlook for *N. concolor* and *N. leucogenys* is so grim, globally and nationally, that their effective conservation at representative Lao sites is of far higher priority than would be any extensive surveys. Conservation sites should be selected more through likelihood of success and potential post-project gibbon population size, than through current gibbon numbers. Erratic success, to date, of site-based conservation in Lao PDR demands much higher consideration, than hitherto, of project feasibility; and this depends much more upon a mix of human factors than upon actual wildlife populations. Priority sites may be Nam Kan NPA (*N. concolor*), Nam Et–Phou Louey NPA (*N. leucogenys*) and, if it supports *N. leucogenys*, Nam Kading NPA.
- Hands-on conservation for the other two Nomascus taxa in Lao PDR can still select from many sites. To retain Lao PDR's full complement of gibbons, action is as urgent for White-handed and Pileated Gibbon as it is for *N. concolor* and *N. leucogenys*.
- Surveys of gibbons warranting consideration are (1) searches for additional populations of *N. concolor*; and (2) assessment of taxonomic identity of gibbons almost anywhere, particularly in the large area between Paklay, Xaisomboun, the upper Nam Theun and Pakkading. These should involve awareness-raising about gibbon conservation to all local-level stakeholders.
- Awareness programmes are needed to build appreciation among decision-makers (from government bodies to individual hunters about to pull the trigger) that hunted gibbons make only a negligible contribution to rural economies, but wild populations have significant ecotourism potential, building on their charismatic interest for local communities, tourists and general public.

ສັງລວມໂດຍຫຍໍ້

ສະພາບລວມ

- ຢູ່ ສປປ ລາວ ມີທະນີ 6 ຊະນິດ; ມີພຽງປະເທດ ອິນໂດເນເຊຍ ມີ ທະນີໜາຍກ່ວາ. ອາຊີ ຕາເວັນອອກຕາມລຸ່ມແມ່ນ້ຳຂອງ ມີພຽງທະນີ ຢູ່ໃນ ສາຍພັນ ໂນມາກຸດ *Nomascus,* ຊຶ່ງມີ 4 ຊະນິດ ຢູ່ໃນ ສປປ ລາວ. ສ່ວນ ທະນີຕະກຸນດັ່ງກ່າວ ແມ່ນຢູ່ບາງຂອບເຂດພື້ນທີ່ ຂອງ ສສ ຫວຽດນາມ ແລະ ສປ ຈີນ ແລະ ອີກຢ່າງໜຶ່ງ ຍັງມີຈຳນວນໜ້ອຍ ບາງ ຂອບ ເຂດ ພື້ນທີ່ຂອງ ປະເທດ ກຳປູເຈຍ. ເປົ້າໝາຍໃນການອະນຸລັກທະນີ ຢູ່ ສປປ ລາວ ແມ່ນ ເປັນປະເດັ່ນທີ່ສຳຄັນທີ່ສຸດ. ສະນັ້ນ, ຈຶ່ງເປັນການທົບທວນຄືນເຖິງ ການກະຈາຍ ຂອງ ທະນີ ຢູ່ ສປປ ລາວ. ຜ່ານມາກໍໄດ້ມີການບັນທຶກໄວ້ສຳລັບຂໍ້ມູນ ຢູ່ໃນບັນດາ ເອກະ ສານ ທັງຫລາຍ, ຊຶ່ງສາມາດເຊື້ອຖືໄດ້ວ່າ, ເປັນເງື່ອນໄຂອັນດີໃນການກຳນົດການຄຸ້ມຄອງ ປົກປັກຮັກສາ ຂອງແຕ່ລະຊະນິດ ແມ່ນເປັນ ການກະຈາຍຂອງທະນີ, ໄພຂົ່ມຂູ່ ແລະ ເພື່ອການອະນຸລັກ. ສະນັ້ນ, ຈຳເປັນຕ້ອງການມີການອະນຸລັກທະນີ ໃນເວລາອັນຄວນ.

ການແນະນຳສຳລັບ ທະນີ

- ທະນີ ແມ່ນ ຊະນິດສັດຄ້າຍຄືລີງຂະໜາດໃຫຍ່ແຕ່ບໍ່ມີຫາງ ແລະ ທາງຊີວະວິທະຍາ ຢາກ ຄ້າຍຄືກັນກັບຄົນ, ຊຶ່ງມີອາຍຸຍືນ ອາໃສຢູ່ໃນພື້ນທີ່ຂອບເຂດ ອາຊີຕາເວັນອອກສຽງໃຕ້. ພວກມັນມັກຢູ່ເຂດພູສັນຖານເຂດອາຊີຕາເວັນອອກສຽງໃຕ້, ຊຶ່ງເປັນເຂດທີ່ໄພຂົ່ມຂູ່ສູງ ເປັນຕົ້ນການລ້າ ແລະ ຖິ່ນທີ່ຢູ່ອາໃສຂອງມັນມີການປ່ຽນແປງ. ຕະກຸນຂອງພວກມັນ, ຫາຍ ໂລບາຕິດີແອ Hylobatidae, ໃນປັດຈຸບັນແມ່ນມີໜ້ອຍທີ່ສຸດຕະກຸນດັ່ງກ່າວ (ຄືກັບຫລາຍ ຊະນິດ) ທັງຫມົດແມ່ນໄດ້ຈັດເຂົ້າຢູ່ໃນບັນຊີປຶ້ມແດງຂອງອົງການອະນຸລັກທຳມະຊາດ IUCN ກໍຄືໄພຂົ່ມຂູ່ທົ່ວໂລກ.
- ສຳລັບເຫດຜົນທາງຊີວະວິທະຍາ ເຫັນວ່າປະຊາກອນ ທະນີ ນັບມື້ຫຼຸດລົງຢ່າງໜ້າວິຕົກ ຈາກການລ້າ ກໍຄືກັບປະເພດສັດປ່າລ້ຽງລູກດ້ວຍນົມອື່ນໆ ຢູ່ໃນຂອບເຂດພື້ນທີ່ປ່າ ອາຊີຕາ ເວັນອອກສຽງໃຕ້. ເຫັນໄດ້ວ່າການຫລຸດລົງຂອງປະຊາກອນໄດ້ມີການຄ່ອຍຟື້ນຟູ.
- ທະນີ ແມ່ນ ສັດທີ່ມັກອາໃສຕາມຕົ້ນໄມ້, ແຕ່ວ່າມັນບໍ່ມັກລົງມາຕາມດິນປານໃດ. ຄວາມ ຕ້ອງການຂອບເຂດພື້ນທີ່ສຳລັບປະຊາກອນທະນີ ໃນເນື້ອທີ່ປ່າໄມ້ 100 ຫາ 200 ຕະລາງ ກິໂລແມັດ. ແຕ່ວ່າຍັງບໍ່ທັນຮັບຮູ້ໄດ້ວ່າປະຊາກອນທະນີເໝາະສົມກັບພື້ນທີ່ປ່າໄມ້ ພັດ ປ່ຽນໃບ ຫຼື ບໍ່, ແຕ່ຫາກວ່າມັນຫາກເປັນໄປໄດ້ຖ້າປ່າດັ່ງກ່າວໃກ້ກັບປ່າດິງຕົກໜາ ແລະ ປ່າປະສົມ. ແຕ່ຍັງບໍ່ຄິດວ່າມັນຈະອາໃສຢູ່ປ່າໂຄກ. ອາຫານຂອງທະນີ ໝາກໄມ້ຊະນິດ

ຕ່າງໆ ແລະ ແກ່ນ. ການປ່ຽນແປງຂອງປ່າໄມ້ ແມ່ນສິ່ງຜົນສະທ້ອນທີ່ສຳຄັນຕໍ່ສຸຂະພາບ ຂອງມັນ.

ສະຖານະພາບຂອງທະນີ ໃນ ສປປ ລາວ.

- ທະນີ 6 ຊະນິດ ທີ່ມີຢູ່ໃນ ສປປ ລາວ: ທິດຕາເວັນຕົກ ທະນີ ດຳ Black Crested Gibbon *Nomascus concolor*, ພາກເໜືອ ທະນີແກ້ມຂາວ Northern White-cheeked Gibbon *N. leucogenys* ພາກໃຕ້ ທະນີແກ້ມຂາວ Southern White-cheeked Gibbon *N. siki*, ຈາກການໄຈ້ແຍກແລ້ວເຫັນວ່າຍັງມີການສົງໃສ ກັບ ທະນີແກ້ມເຫລືອງ Yellowcheeked Gibbon *N. gabriellae,* ທະນີ ມືຂາວ White-handed Gibbon *Hylobates lar,* ທະນີ ມົງກຸດ Pileated Gibbon *H. pileatus*, ຊະນິດ ທັງຫມົດກໍແມ່ນນອນຢູ່ໃນ ບັນຊີ ແດງ ຊຶ່ງເປັນຊະນິດທີ່ມີຄວາມສ່ຽງຈາກໄພຂົ່ມຂູ່ ສູງໃກ້ຈະສູນພັນ. ທາງເລືອກທັງ ສອງຢ່າງ ເຖິງວິທີການຈຳແນກອອກ ສຳລັບ ທະນີແກ້ມຂາວ *siki* ແມ່ນຊະນິດໃກ້ຄຽງກັບ ທະນີແກ້ມຂາວ *Nomascus leucogenys*. ວິທີການຈຳແນກນີ້ບໍ່ມີການປ່ຽນແປງ ແຕ່ຫຼີກລ້ຽງ ຈາກ ການຄົ້ນຄ້ວາໃນຕໍ່ຫນ້າ- ເປັນອຸປະສັກກີດກັ້ນໃຫ້ນັກວິຊາການ ຄົ້ນຫາ ແຫລ່ງຂໍ້ມູນ ເດີມ. ບໍ່ຮູ້ວ່າໃນ ສປປ ລາວ ຊ້ອນກັນໃນການກະຈາຍຂອງຊະນິດພັນທະນີ.
- ທັງໝົດ ທະນີ 6 ຊະນິດ ແມ່ນໄດ້ຖືກຮອງຮັບວ່າມີ ຢູ່ໃນ ສປປ ລາວ ໃນຊ່ວງປີ 1990. 6 ຊະນິດພັນ ໃນ ປີ 2000, ແຕ່ວ່າບໍ່ໄດ້ມີການສຳຫລວດສຶບຄົ້ນຫາຢູ່ໃນ ລາວ ກ່ຽວກັບ ທະນີ ມົງກຸດ Pileated Gibbon *Hylobates pileatus* ໃນໄລຍະ 10 ປີ.
- ຢູ່ຂອບເຂດພື້ນທີ່ສູງທາງພາກເໜືອຂອງລາວ ຍັງບໍ່ທັນຮູ້ໄດ້ຢ່າງລະອຽດວ່າ ທັງຫມົດທະນີ *Nomascus* ແລະ *N. concolor* ຂໍ້ມູນແມ່ນມີຫນ້ອຍ. ການຈັດແບ່ງລະຫວ່າງ ທະນີແກ້ມ ຂາວ *N. leucogenys* (ໄດ້ບັນທຶກໃນຂໍ້ມູນ ມີຢູ່ໃນເຂດພື້ນທີ່ສູງ ຂອບເຂດ ທາງໃຕ້ແຂວງ ຜົ້ງສາລີ ແລະ ແຂວງ ວຽງຈັນ) ແລະ ທະນີແກ້ມຂາວ *N. siki* (ຢູ່ຂອບເຂດສາຍພູຫລວງຕອນເໜືອ ແລະ ທົ່ວໆໄປ) ບໍ່ຮູ້ແນ່ນອນວ່າມັນຢູ່ ຂອບເຂດ ແຂວງໃດແດ່ ບາງເທື່ອອາດຈະຢູ່ແຂວງ ສະຫວັນນະເຂດ ແລະ ສາລະວັນ. ເນື່ອງຈາກວ່າ ທະນີແກ້ມຂາວ *N. siki* ຄ້າຍຄືກັບ ທະນີແກ້ມເຫລືອງ *N. gabriellae* (ຢູ່ປະເທດ ກຳປູເຈຍ ແລະ ທາງໃຕ້ຫວຽດນາມ) ອາດຈະເອີ້ນໄດ້ວ່າ *N. siki* ຄືກັນກັບ *Nomascus* sp. *incertae sedis.*
- ເຫັນໄດ້ຢ່າງຈະແຈ້ງແລ້ວ ທະນີແກ້ມຂາວ *N. leucogenys* ແລະ ທະນີແກ້ມຂາວ *N. siki* , *N. concolor* ແລະ *Nomascus* sp. *incertae sedis* ແມ່ນມີຢູ່ໃນ ສປປ ລາວ ກໍຄື ໃນໂລກ. ທະນີທັງ 2 ຊະນິດ: ທະນີມືຂາວ ແລະ ທະນີ ມົງກຸດ ມີຢູ່ໃນ ລາວ

ທາງທິດຕາເວນອອກລຸ່ມແມ່ນ້ຳຂອງ, ໂດຍສະເພາະທາງພາກເໜືອ ແລະ ທາງພາກໃຕ້. ເຫັນວ່າປະຊາກອນ ທະນີ ຍັງຫລາຍ ຢູ່ ສປປ ລາວ.

- ປະຊາກອນ ທະນີຊະນິດ *Nomascus* ຍັງມີຢູ່ ໃນ ສປປ ລາວ ຊຶ່ງຫລາຍກວ່າ ຢູ່ ສປ ຈີນ ແລະ ຫວຽດນາມ. ເນື່ອງຈາກວ່າເນື້ອທີ່ປ່າໄມ້ຢູ່ໃນ ສປປ ລາວ ຍັງມີຫລາຍ ແລະ ມີການອານຸລັກຮັກສາເພື່ອສະຫງວນໄວ້.

ໄພຂົ່ມຂູ່ ຕໍ່ທະນີ ຢູ່ ສປປ ລາວ

- ທັງຫມົດ ທະນີ ແມ່ນປະເພດຫວງຫ້າມ ຫລື ຂີ້ນບັນຊີ ຢູ່ໃນ ສປປ ລາວ. ລະບົບການຄຸ້ມຄອງ ປ່າສະຫງວນແຫ່ງຊາດ ກໍມີການຄຸ້ມຄອງປົກປັກຮັກສາ

ທະນີ ມີແຕ່ທະນີ ມົງກຸດ Pileated Gibbon ແມ່ນຢູ່ນອກປ່າສະຫງວນແຫ່ງຊາດ) . ເຖິງແມ່ນວ່າຈະມີການຫວງຫ້າມ ແຕ່ກໍຍັງ ມີການລ້າ ແລະ ສູນເສຍຖິ່ນທີ່ຢູ່ອາໃສຂອງມັນ.

- ທະນີ ມັກອາໃສຢູ່ຕາມຕົ້ນໄມ້ ຖືກໄພຂົ່ມຂູ່ ດ້ວຍການລ້າຍິງ ສັດປ່າ ເປັນຕົ້ນ ແມ່ນ ໝາ ແລະ ການໃສ່ແຮວ ຕະຫລອດຮອດໃຊ້ອາວຸດ ປືນຍິງເອົາມັນ.
- ການລັກລອບຍິງ ຫລື ລ້າທະນີ ແມ່ນມີທົ່ວໄປ ຢູ່ ສປປ ລາວ, ພ້ອມນັ້ນຍັງມີຊາວ ຫວຽດ ນາມຈຳນວນຫນຶ່ງຕ້ອງການກະດູກຂອງທະນີ. ການລັກລອບລ້າເພື່ອກິນເປັນອາຫານ ແລະ ເຮັດໃຫ້ການສືບພັນ ຂອງທະນີແມ່ນ ຢູ່ໃນລະດັບຕ່ຳ, ອາຫານທີ່ມັນຕ້ອງການແມ່ນບໍ່ພຽງພໍ.
- ຄືກັນກັບສັດລ້ຽງລູກດ້ວຍນົມ ແລະ ຈຳພວກນົກ ແນວໂນມ ແມ່ນມີຄວາມແຕກຕ່າງກັນ ລະຫວ່າງພາກເໜືອ ແລະ ພາກໃຕ້ ຂອງ ສປປ ລາວ. ຈາກຂໍ້ມູນໃນ ປີ 1990 ເຫັນວ່າ ທາງພາກໃຕ້ ໂດຍສະເພາະ ເຂດນາກາຍນ້ຳເທີນ ຍັງມີປະຊາກອນທະນີຍັງຫລາຍ ຢູ່ຕາມ ປ່າດົງດິບ. ສະເພາະທາງພາກເໜືອ ເຂດພື້ນທີ່ສູງ ຍັງມີປະຊາກອນ ທະນີດຳ Black Crested Gibbon *N. concolor*, ທະນີແກ້ມຂາວ White-cheeked Gibbon *N. leucogenys* ຢູ່ຕາມ ປ່າດົງດິບເຂດສູງ (ຫລາຍກວ່າ 1000 ຕະລາງກິໂລແມັດ).
- ການອະນຸລັກທະນີຢູ່ລາວຍັງບໍ່ທັນເຂັ້ມແຂງເທົ່າທີ່ຄວນ, ຊຶ່ງປ່າໄມ້ຍັງດົກໜາ, ພ້ອມທັງມີ ລະບຽບກົດໝາຍ, ຍຸດທະສາດທີ່ຕິດພັນ ຢູ່ໃນ ສປປ ລາວ. ການອະນຸລັກ ທະນີ ແມ່ນມີ ຄວາມຈຳເປັນຕ້ອງໄດ້ມີການຄຸ້ມຄອງປົກປັກ ອັນຮີບດ່ວນ.

ການປ້ອງກັນ ທະນີ

- ທະນີ ບໍ່ແມ່ນສັດທີ່ທຳລາຍຜົນລະປູກ ແລະ ບໍ່ເປັນອັນຕະລາຍຕໍ່ຄົນ ແລະ ເປັນສັດທີ່ ໜ້າຮັກ ມັກສະນຸກສະໜານ ສິ່ງສຽງອັນອ່ອນຊອນ ຕາມທຳມະຊາດ ຫຼື ເປັນພື້ນຖານ

ຂອງຊາວບ້ານແຕ່ໃດໆມາ. ຄວາມເຊື້ອຖືຂອງປະຊາຊົນທ້ອງຖິ່ນ ຖ້າຍິງ ຫລື ຂ້າ ທະນີ ຈະມີກຳມີເວນໃນຕໍ່ນ້າ.

- ທະນີ ເປັນສັດທີ່ສາມາດສ້າງລາຍຮັບໃຫ້ແກ່ເສດຖະກິດຂອງຊາດໄດ້ ຈາກການທ່ອງທ່ຽວ ເບິ່ງທະນີຕາມທຳມະຊາດໄດ້ ຖ້າຫາກປະຊາກອນທະນີ ເພີ້ມຂຶ້ນ.
- ຕ້ອງໄດ້ມີການສະກັດກັ້ນການລັກລອບລ້າ ທະນີ ຢູ່ ສປປ ລາວ. ຖືເອົາການອະນຸລັກ ທະນີ ຢູ່ ສປປ ລາວ ເປັນບຸລິມະສິດໜຶ່ງ. ການອະນຸລັກແມ່ນຕ້ອງໄດ້ເຍີ່ງຫລາຍບັນຫາ ເປັນຕົ້ນ ແມ່ນການກວດກາ, ເກັບອຸປະກອນສຳລັບລ້າຍິງ ແລະ ມີການຄຸ້ມຄອງ ພື້ນທີ່ທາງ ລະບົບ ນິເວດ ແລະ ພູມສັນຖານສຳລັບທະນີ.

ການສະເໜີໃນການປົກປັກຮັກສາ

- ສະພາບເງື່ອນໄຂການອະນຸລັກທະນີ ທຸກໆຊະນິດ ສຳລັບ ຢູ່ ສປປ ລາວ ກໍຄືຢູ່ໃນທົ່ວໂລກ ແມ່ນເປັນບຸລິມາສິດໜຶ່ງຕ້ອງໄດ້ປົກປັກຮັກສາຢ່າງເຂັ້ມງວດ ໂດຍສະເພາະປະຊາກອນ ທະນີດຳ Black Crested Gibbon *N. concolor* ແລະ ທະນີແກ້ມຂາວ Northern White-cheeked Gibbon *N. leucogenys.*
- ຄວນໃຫ້ເບິ່ງກວ້າງເບິ່ງໄກຂອງວຽກງານອະນຸລັກທະນີ ດຳ Black Crested Gibbon *N. concolor* ແລະ ທະນີແກ້ມຂາວ Northern White-cheeked Gibbon *N. leucogenys.* ເນື່ອງຈາກວ່ານັບມື້ໜຸດໜ້ອຍລົງ ຢູ່ໃນທົ່ວໂລກ. ສຳລັບ ສປປ ລາວ ກໍແມ່ນ ບຸລິມະສິດໜຶ່ງໃນການອະນຸລັກ ທະນີຊະນິດດັ່ງກ່າວ. ຄວາມເປັນໄປໄດ້ໃນການອະນຸລັກ ຕີລາຄາ ແລະ ຈັດຕັ້ງປະຕິບັດ ໂຄງການອະນຸລັກ ເພື່ອປົກປັກຮັກສາທະນີ, ຊຶ່ງຄັດເລືອກ ເອົາສະຖານທີ່ເປັນບຸລິມະສິດທະນີຊະນິດນີ້ອາໄສຢູ່ ເຊັ່ນ: ປ່າສະຫງວນນ້ຳກ່ານ (ທະນີ ດຳ Black Crested Gibbon *N. concolor*), ນ້ຳແອດພູເລີຍ ແລະ ນ້ຳກະດິງ (ທະນີ ແກ້ມຂາວ Northern White-cheeked Gibbon *N. leucogenys*).
- ຄວນມີການອະນຸລັກປົກປັກຮັກສາ ທະນີ ທັງ 2 ຊະນິດ *Nomascus* ຢູ່ ສປປ ລາວ ສາມາດເລືອກຫາຫລາຍພື້ນທີ່ໄດ້.ພ້ອມທັງ ມີກິດຈະກຳເຄື່ອນໄຫວຢ່າງເປັນປົກກະຕິ ໃນ ການປົກປັກຮັກສາທະນີ ມືຂາວ White-handed Gibbon ແລະ ທະນີມົງກຸດ Pileated Gibbon.
- ສຳຫລວດເກັບກຳຂໍ້ມູນຢ່າງລະອຽດເພື່ອຮັບຮູ້ໄດ້ວ່າ: (1) ສຳຫລວດຄົ້ນຫາປະຊາກອນ ທີ່ເພີ້ມຂຶ້ນຂອງທະນີຂົນຫົວຈຸກ *N. concolor* .(2) ຕິດຕາມປະເມີນຜົນໄຈ້ແຍກ ເບິ່ງວ່າຢູ່ໃນຂອບເຂດພື້ນທີ່ ໂດຍສະເພາະ ລະຫວ່າງ ປາກລາຍ, ໄຊສົມບູນ, ທາງຕອນ ເທິງນ້ຳເທີນ ແລະ ນ້ຳກະດິງ. ຄວນຈະມີການອະນຸລັກສຶກສາໂຄສະນາເຜີຍແຜ່ ກ່ຽວກັບ ການອະນຸລັກທະນີ ຢູ່ຂັ້ນພື້ນຖານ.

- ແຜນການອະນຸລັກສຶກສາໂຄສະນາເຜີຍແຜ່ຄວາມຫມາຍສຳຄັນໃນການອະນຸລັກທະນີ ໃຫ້ແກ່ນາຍພານ ທີ່ມັກລ້າສັດ ໃຫ້ມີຄວາມເຂົ້າໃຈຕໍ່ວຽກງານດັ່ງກ່າວປັດສະຈາກການລ້າທະນີຢ່າງສິ້ນເຊີງ. ໃນການລ້າທະນີບໍ່ມີດີຕໍ່ເສດຖະກິດຂອງຊາດ, ຄວນຕ້ອງໄດ້ມີການຮັກສາໄວ້ເປັນຕົ້ນແມ່ນເພື່ອການທ່ອງທ່ຽວ ຊຶ່ງຈະສ້າງລາຍຮັບໃຫ້ແກ່ຊຸມຊົນ ກໍ່ຄືປະຊາຊົນ ຂັ້ນທ້ອງຖິ່ນ

Hylobatidae: Gibbon (5-6 ຊະນິດຢູ່ໃນ ສປປ ລາວ; 13 ຊະນິດ ໃນໂລກ)

ທະນີ ມືຂາວ : *Hylobates lar* White-handed Gibbon

ທະນີ ມົງກຸດ : *Hylobates pileatus* Pileated Gibbon

ທະນີ ດຳ : *Nomascus* (= *Hylobates*) *concolor* Black Crested Gibbon

ທະນີ ແກ້ມຂາວ: *Nomascus leucogenys* (= *Hylobates l. leucogenys*) Northern White-cheeked Gibbon & *Nomascus siki* (= *Hylobates l. siki*) Southern White-cheeked Gibbon
ທະນີ ແກ້ມເຫລືອງ: *Hylobates gabriellae* Yellow-cheeked Gibbon

1 BACKGROUND

1.1 INTRODUCTION

Gibbons constitute the smaller apes among the order Primates of the class of mammals. They are highly sensitive to human activities. Various life-history traits, notably their late age at first breeding, small litter size, and long inter-birth interval, mean that they may have only slow rates of potential population increase even under optimal conditions. Their frequent loud, lengthy, calling and their propensity to feed at fruit trees allow hunters to find them easily. Their diurnal behaviour exposes them to much higher levels of opportunistic direct killing than are suffered by nocturnal mammals, which are active at times overlapping with many fewer people. Hunting can therefore drive rapid declines. About the only two inherent attributes not exposing them to elevated threat are that they are not crop pests or otherwise actively problematic for people, and that they are arboreal and so are buffered from the effects of non-selective trapping and dogs (accompanied and unaccompanied) which are currently devastating the ground-dwelling mammal fauna in much of their geographic range. But strict arboreality brings its own problems: forest cover is essential for gibbons, meaning that the widespread conversion, degradation and fragmentation of forest over the last few centuries, and particularly the last few decades, has eradicated them from most of their pre-exploitation range.

Gibbons occur only in biogeographical 'South-east Asia': the countries (except the Philippines and, at least today, Singapore) conventionally considered to comprise 'South-east Asia' (Myanmar, Thailand, Lao PDR, Vietnam, Cambodia, Malaysia, Indonesia and Brunei) and southern China (including Tibet), Bangladesh and north-east India (e.g. Geissmann 1995, 2007a, Groves 2001). This area has an overall much higher human population density than most other tropical and subtropical areas. In recent decades, rampant habitat change and commercially-driven hunting of wild mammals in the area reflects the rising affluence of China and neighbouring countries, coupled with a widely-held view in the region that wild meat is a luxury, health-giving, dietary item (e.g. Corlett 2007). In an overview of global primate conservation status, Mittermeier *et al.* (2007: 4) stated that "it is significant that 11 of the 25 Most Endangered Primates are from Asia. A list of the most threatened primates in Asia could easily reach 50, all as threatened as any on this list of the World's 25 Most Endangered". Gibbons are among the most threatened of the world's primates and all species are in general decline, mostly steeply, notwithstanding the healthy, stable (and even in some areas, increasing) populations at a few sites. The plight of gibbons is much overlooked by the wider world, eclipsed by media attention to the larger apes (Geissmann 2003).

A 2006 IUCN/SSC red listing workshop for Asian primates concluded that all gibbon species warranted listing in one of the IUCN Red List categories of globally threatened, and indeed only one species was in the lowest threat category, that of Vulnerable (Geissmann 2007a). Major threats for gibbons globally were assessed there as, in decreasing significance, (1) habitat loss and fragmentation; (2) habitat degradation; (3) hunting (for food, traditional medicine and sport), and (4) illegal trade (as pets and for traditional medicine). This does not presuppose the same relative ranking of threats in any given country or site; and effective conservation action anywhere requires understanding the specific set of threats there. Of the gibbon species occurring in Lao PDR, the workshop proposed that Western Black Crested Gibbon *Nomascus concolor* and Northern White-cheeked Gibbon *N. leucogenys* be considered Critically Endangered (the gravest threat category for a species still extant in the wild) and that

the other four taxa be considered Endangered (the next most severe category). These listings, which were formally adopted by the IUCN Red List in October 2008 (IUCN 2008), indicate how seriously are gibbons threatened with global extinction.

There are four now generally recognised genera of gibbon. Of these *Nomascus*, the crested gibbons, is one of the more speciose. Yet it occurs almost solely east of the Mekong (and is the only genus to penetrate this area, at least in the last hundred years), although in the upstream reaches of this river, in Yunnan province of China, it also occurs to its west (Geissmann 1995). As a result of various socio-political factors of the 20th century, the four countries within this range (Cambodia, Lao PDR, PR China and Vietnam) are still evolving effective policies and mechanisms for long-term conservation of natural resources, including both forest habitat and the gibbons it contains. Lao PDR and Vietnam contain the majority of current *Nomascus* range: rather little of Cambodia lies east of the Mekong, and while a large expanse of China does so, gibbons have been devastated during the last few centuries from a formerly very large range (Geissmann 1995, Geissmann *et al.* 2000). Vietnam has a much larger human population density than does Lao PDR, and consequently contains much less forest habitat. The Government of the Socialist Republic of Vietnam (2004: 3) wrote that "the free market economy has resulted in feverish periods of trade in wild species nation-wide, with negative impacts on biodiversity", so it is no surprise that the last *Vietnam Primate Conservation Status Review* (Geissmann *et al.* 2000) found gibbons now to be limited to a few large populations, and rather more small ones (each with at most a few dozen groups), and that some species are verging on national-level extinction.

This grim picture for China and Vietnam contrasts with a much healthier situation for gibbons in Cambodia (Traeholt *et al.* 2005) and, at least in the 1990s, Lao PDR (Duckworth *et al.* 1999). These latter two countries have retained typically much larger tracts of forest than the former two. Both Thailand and Vietnam have high species totals of gibbons, 4–5 species (Geissmann *et al.* 2000, Phoonjampa & Brockelman 2008), but, using the same taxonomic framework, Lao PDR has five (in the two genera *Nomascus* and *Hylobates*), and on the taxonomy of Geissmann (2007a), six, species. Under this latter taxonomy so does China (although the survival of one is questionable: Holden 2008); and Indonesia is the only country with more species of gibbons than Lao PDR, with seven. This high species richness for Lao PDR is under-appreciated because the country is often missed in global compilations from the ranges of White-handed Gibbon *H. lar* (e.g. Groves 2001, Mootnick 2006) and, to a lesser extent, of Pileated Gibbon *H. pileatus* (e.g. Groves 2005), reflecting the lack of specimens from undisputed precise Lao localities.

However, simple species richness is a poor guide to biodiversity significance. The two of Lao PDR's gibbon species in the genus *Hylobates* (White-handed Gibbon, Pileated Gibbon) have only small ranges in the country, and the species identity of one in the genus *Nomascus* is controversial (it may or may not represent Yellow-cheeked Gibbon *N. gabriellae*). The irreplaceable global significance of Lao PDR for gibbon conservation includes its relatively huge (albeit much declined) populations of 'pale-cheeked gibbons', as placed by Geissmann (2007a) into Northern White-cheeked Gibbon, Southern White-cheeked Gibbon *N. siki* and Yellow-cheeked Gibbon. In addition, the devastation of Western Black Crested Gibbon in its other range states (China and Vietnam) gives surviving Lao populations major international significance although there are many fewer of them in Lao PDR today than of the other crested gibbons except, perhaps, Northern White-cheeked Gibbon.

The last available national conservation status overview of gibbons in Lao PDR is within Duckworth *et al.* (1999), who reviewed all tetrapod vertebrates, meaning that extensive data and discussion for each species were impossible: all gibbons were

covered in under three pages. White-handed, Pileated and Western Black Crested Gibbons were considered At Risk in Lao PDR (roughly equivalent, at the national level, to globally threatened), White-cheeked Gibbon (there comprising both *N. leucogenys* and *N. siki*) as Potentially At Risk in Lao PDR, whilst Yellow-cheeked Gibbon was listed as Little Known in Lao PDR, reflecting uncertainty as to whether it occurred in the country at all, and if it did so, where, precisely. The *Biodiversity Country Report* (Holmgren *et al.* 2004: 106), prepared to inform the *Lao PDR National Biodiversity Strategy and Action Plan*, listed [Western] Black Crested Gibbon and Pileated Gibbon as in need of specific attention because neither was known to occur in any national protected area (NPA; in the interim, a new NPA, Nam Kan NPA, has been declared within the range of the former, and this species has anyway been found in Nam Ha NPA; Johnson *et al.* 2005) and listed all Lao gibbon species as "expected to fall below viable populations", being threatened by habitat loss (all except combined *N. leucogenys* and *N. siki*) and harvesting. Aside from intrinsic concerns over loss of biodiversity, it highlighted the decline of gibbons as particularly problematic because of their potential to contribute directly to the Lao economy, at all levels, through tourism. International tourism has grown phenomenally in Lao PDR in the last two decades (Manivong & Sipaaseuth 2007), and gibbons indeed feature prominently in material for international tourists, e.g. a series of guide-booklets covering the major tourism provinces prepared by the Lao National Tourism Authority in 2006.

1.2 AIM OF THE REVIEW

Government of Lao PDR has repeatedly affirmed its commitment to biodiversity conservation within the country. The *National Growth and Poverty Eradication Strategy* (Government of Lao PDR 2004), the *Forestry Strategy 2020* (Government of Lao PDR 2005) and the *National Socio-economic Development Plan 2006–2010* (Committee for Planning and Investment 2006) all explicitly recognise that biodiversity is a vital underpinning of economic and social development. Its irreplaceable contributions to the economy at all levels from subsistence to global, particularly through protected areas, their component wildlife, and the wealth of ecological services they supply to the communities and landscapes within and outside them, were discussed in the context of Lao PDR by ICEM (2003). All gibbons are protected in Lao PDR, throughout the year and everywhere they occur (i.e. they fall in the 'Prohibited Species' category) through the Wildlife and Aquatic Law (as revised 24 December 2007), and have been since at least a national decree of 1989 (Duckworth *et al.* 1999: Table 5), although they apparently were not in the 1960s–early 1970s (Domalain 1977: 35). However, illegal hunting still occurs widely and in the last decade, Lao PDR has seen tremendous change in habitat. Growth of the economy has been fuelled by, in large part, and further stimulated, natural resource extraction. The status conclusions in the 1999 report are increasingly losing relevance to current gibbon conservation needs. Hence the current review, which must be seen in the context of the ongoing rapid, largely unstanched, declines in Lao mammals and general biodiversity (e.g. Duckworth *et al.* 1999, Nooren & Claridge 2001, IUCN, WCS and WWF 2007, Krahn & Johnson 2007).

1.3 SCOPE OF THE REVIEW

This review is a synthesis of information available within Vientiane by person-to-person meetings, telephone, email and document review. No visits were undertaken to evaluate field status, or to meet provincial, district or protected-area staff. Much relevant unpublished information would be available in such places. All gibbon taxa in Lao PDR are covered and information from all areas, whether inside or outside the protected area system, was sought.

It is the compiler's expectation that the review be a stage in triggering actual conservation action for Lao gibbons, not simply a doomsday documentation for reference a decade later, to assist in speculating how severe have been declines. It is explicitly not, however, the building of a national action plan, because such documents must be formulated by the parties responsible for their implementation. It could serve as an information base from which the appropriate parties could develop one.

1.4 TAXONOMY, IDENTIFICATION AND GENERAL DISTRIBUTION OF GIBBONS IN LAO PDR

The relatively few objective identifications available indicate that all gibbons west of the Mekong in North Lao PDR (i.e. Xaignabouli province, and a small adjacent sliver of Bokeo province) are White-handed Gibbons *Hylobates lar*, and in South Lao PDR (i.e. several districts of Champasak province) are Pileated Gibbons *H. pileatus*. This is as expected for these species with their species-level taxonomy and global geographic ranges generally well clarified (Geissmann 1995). Delacour's (1933) statement that he had captured crested gibbons well west of the Mekong in Cambodia (around Angkor Wat) was recanted, implicitly, by Delacour (1951).

Gibbon identification east of the Mekong is, by contrast, difficult. Modern trends consider crested gibbons a distinct genus, *Nomascus*, rather than a subgenus, *Hylobates* (*Nomascus*); and although they were for a long time generally considered to be all conspecific (under the name *H.* (*N.*) *concolor*), since the late 1980s there has been a pervasive tendency to divide the crested gibbons into multiple species. Various different taxonomic treatments have recently been presented (e.g. Corbet & Hill 1992, Geissmann 1995, 2002, 2007a, Groves 2001, 2005, Roos & Geissmann 2001, Brandon-Jones *et al.* 2004, Takacs *et al.* 2005, Roos *et al.* 2007), and it is not clear how many taxa *Nomascus* holds, still less how many of them are distinct at species level. Conclusive identification characters cannot be determined for each taxon until its validity is clear; the identification of the pale-cheeked taxa is particularly difficult; and there are few Lao point localities with objective identifications of gibbons. The species-level names potentially applying to Lao *Nomascus* are *N. concolor* s.s. (the only species in Lao PDR where black animals have dark, not pale, cheeks), and, living from north to south, Northern White-cheeked Gibbon *N. leucogenys*, Southern White-cheeked Gibbon *N. siki*, and Yellow-cheeked Gibbon *N. gabriellae*, here together called 'pale-cheeked gibbon' (not capitalised, not being the name of a purported species).

Intergrades between Yellow-cheeked and Southern White-cheeked Gibbons were suspected, based on pelage features, in Savannakhet and Salavan provinces (Delacour 1951, Groves 1972, 2001), but Geissmann *et al.* (2000: 49, 82) proposed alternative explanations that do not invoke hybridisation, and in fact the presence of Yellow-cheeked Gibbon at all in Laos is open to doubt. Gibbons of South Lao PDR (north at least to Xe Bang-Nouan NPA) in pelage resemble *N. gabriellae* s.s. (Geissmann 1995, Timmins & Bleisch 1995), but songs, analysed from Xe Bang-Nouan NPA and Xe Sap NPA south to the Cambodian border, more closely resemble those of Southern White-cheeked Gibbon (T. Geissmann 1995, *in litt.* 2008). The same is true in Rattanakiri province (northern Cambodia) and in Vietnam across a similar latitude range (Geissmann *et al.* 2000). The gibbons in this relatively large area have a consistent song-type, neither of Yellow-cheeked nor of 'typical' Southern White-cheeked Gibbon, nor suggesting a clinal mix from one to the other (Konrad & Geissmann 2006), meaning that true taxonomic variation may not be treatable within existing names. This gibbon is here referred to as *Nomascus* sp. *incertae sedis*, the use of '*incertae sedis*' (= of uncertain taxonomic position) reflecting its assignment to indeterminate *N. siki* or *N. gabriellae* by Geissmann *et al.* (2000). Some other recent

sources have shoe-horned it into an existing name, e.g. Geissmann (2007a) put it in *N. gabriellae*, but this obscures that *N. gabriellae* s.s. and *Nomascus* sp. *incertae sedis* are evidently diagnosably distinct taxa, and thus have their own conservation status and needs. They therefore warrant separate conservation planning. This does not mean that when systematics are settled *N.* sp. *incertae sedis* might not fall within *N. gabriellae* or *N. siki*, or that these three forms are as taxonomically distinct as more obviously unique forms such as Pileated Gibbon. Recent statements that *N. gabriellae* inhabits Lao PDR in terms either general (e.g. Brandon-Jones *et al.* 2004) or specific (e.g. an animal in Budapest zoo; Takacs *et al.* 2005: Table 2) presumably follow taxonomic rationale similar to Geissmann (2007a).

North of *Nomascus* sp. *incertae sedis* lives what is generally called *siki*, variously considered a subspecies of *N. gabriellae* (e.g. Corbet & Hill 1992), of *N. leucogenys* (e.g. Geissmann 1995) or a full species (e.g. Groves 2001). However, the holotype of *H. c. siki* Delacour, 1951 came from Thua Luu (Thua Thien–Hue province, central Vietnam; 16°16′N, 108°00′E), a site very close to Bach Ma National Park (16°05–15′N, 107°43–53′E), which today supports *Nomascus* sp. *incertae sedis* (Geissmann *et al.* 2007, based on song). The song of the *siki* holotype is unknown, as is whether it could have come in trade from a wild origin other than Thua Luu. Were the holotype found to represent *Nomascus* sp. *incertae sedis*, this form would then take the name *siki*, leaving the northern form currently unnamed. Definitive association of the holotype with actual field populations may yet be possible, and pending that, given that all the foregoing is so conditional, the name *siki* is used for this northern taxon in this report, as by Geissmann (2007a).

Groves (2001: 297) courageously highlighted the arbitrary nature of many taxonomic decisions with "there is some difference of opinion as to whether [*siki*] is a subspecies of [*N.*] *leucogenys* or of [*N.*] *gabriellae* ... The chromosomes of this taxon have been reported as different from those of both, and the facial pattern of the male is not precisely like either of them ... Zhang (1997) recommended giving it species rank. To rank it as a full species ... seems the best way of cutting the Gordian knot". Geissmann (2007a) continued the trend to treat *siki* as a distinct species, and so does the present report: it is better to undertake conservation reviews on over-segregated taxa (for which the separate conclusions can be combined, if desirable) than on over-lumped ones (where if they are later shown, unambiguously, to contain two or more species, the process must begin again).

The black-cheeked gibbons discovered in Lao PDR in 1939 were described as a new race, *H. c. lu* Delacour, 1951. The taxonomic validity of this presumed Lao endemic is questionable, on morphological and vocal grounds; nor do genetic investigations to date suggest it is distinct (Geissmann 1989, 2007a, 2007b, Geissmann *et al.* 2000, Mootnick 2006, Roos *et al.* 2007). In this report, it is referred to simply as *N. concolor*. It makes no great difference to the global or national conservation priority of Western Black Crested Gibbon in Lao PDR whether *lu* is valid or not, given that the species is so severely threatened globally.

Genetic analysis is a powerful tool in unravelling the 'real' systematics, i.e. how today's animal populations are related to each other, and several DNA studies included some or all Lao gibbon taxa (e.g. Zhang Yaping 1997, Roos & Geissmann 2001, Takacs *et al.* 2005, Roos *et al.* 2007). However, significant uncertainty remains, for several reasons. Across zoology, the enthusiasm to draw conclusions from analyses of mitochondrial DNA sometimes outstrips its responsible use. The phylogenetic and phylogeographic patterns investigated are those of the organelle, and it is an assumption (rarely explicit) that they parallel those of the host. For various reasons they may not do so, and non-conspecific animal populations may share highly similar mitochondrial DNA (which may even be identical at the level of analysis), meaning that

species-level taxonomic conclusions need caution and corroboration (Ballard & Whitlock 2004, Edwards *et al.* 2005). Not heeding the implications of this assumption can lead to extraordinary proposals for taxonomic rearrangement (e.g. the South-east Asian bovid case discussed in Hassanin & Ropiquet 2007, Hedges *et al.* 2007). Analyses which use also nuclear DNA, of both autosomes and the Y-chromosome, allow more powerful taxonomic inference, but, are not, on their own and as currently undertaken, anything like infallible either (Zink & Barrowclough 2008).

Essentially, there is no quick short-cut method to unravelling 'true' phylogeny and therefore the 'correct' taxonomic arrangement. It is possible that when this is eventually done, the resulting taxonomy may still not be unambiguous (e.g. there may be sister taxa on the cusp of speciation); it is possible that the crested gibbons will be diagnosable through characters as yet barely- or non-used; and it is possible that the geographical ranges of each form will be quite different from those used here for the current nominal forms. In the interim, conservation interventions must proceed (time is literally running out for some of the Indochinese gibbons), making the best use of such fragmentary information as has yet been generated. A good general introduction for conservationists to the background of the genetics-driven taxonomic upheavals currently in process, although written for hobby birders, is Maclean *et al.* (2005).

More taxonomic controversies with Lao gibbons may, therefore, yet arise. The locations of contact between Western Black Crested and Northern White-cheeked Gibbons, and of Northern with Southern White-cheeked Gibbons, remain unknown, as, therefore, does their inhabitant gibbons' taxonomic behaviour. There might be clear taxonomic division, possibly even sympatry; limited hybridisation (but no taxonomic blurring); extensive hybridisation (preventing assignment of populations to one or other species); or, even, further populations *incertae sedis*.

Geissmann (1995 *et seq*.) has so far made the most explicit predictions where range limits of the *Nomascus* species might lie in Lao PDR. Geissmann *et al.* (2000: 31) "speculated" that *N. leucogenys* (type locality: on the Lao Mekong's east bank north of Paklay; Fooden 1987) and *N. siki* (type locality: Thua Luu, central Vietnam; Delacour 1951) might be separated in Lao PDR by the Nam Gniap and its tributary the Nam Chian (Bolikhamxai and Xiangkhouang provinces). While plausible for the lowlands, there is a large hill area in which these rivers' headwaters are not wide enough to impede gibbon movement. Geissmann (2007a: 7) proposed "Savannakhet" for the change between *N. siki* and *Nomascus* sp. *incertae sedis*: All three forms are generally presumed to have wide ranges in Lao PDR, although the number of definitive, objective, identifications upon which this is based are few.

Imprecision over distribution is of most conservation significance for Black Crested Gibbon. It is invariably portrayed as very restricted in Lao PDR, for example by the map in Geissmann (1995: Fig. 5; and various derivatives), and as expressed by Duckworth *et al.* (1999: 180): "a tiny part of North Lao PDR"; by Groves (2001: 296): "a tiny area in the bend of the Mekong in Lao PDR at about 20°N"; and by Geissmann *et al.* (2000: 28) "this isolated population is restricted to Bokeo province. The Mekong river represents its western border, and, on the other sides, it is surrounded by populations of Northern White-cheeked Gibbon, but the exact location of the inter-species boundary is unknown". No evidence to prove precise statements of a tiny, or even a disjunct, range has been traced. The population extends from Bokeo north into Louang-Namtha province (Johnson *et al.* 2005), and there are no gibbon records from the Mekong Lao hinterland from there north up to at least the Chinese border. There seems to be no published, explicit, documentation of the identity of the gibbons which lived along the Mekong hinterland of its downstream reaches in China, and superficial investigation (anything more was beyond the scope of the current document) was not able to trace any unpublished information, either. Pending evidence that pale-cheeked

gibbons ever did go right up to the Mekong in China, the possibility remains that the Lao black-cheeked animals were connected with the currently known populations in Yunnan along the Mekong, until the animals in the intervening area were hunted out, presumably some time in the last few centuries. So few gibbons have been identified reliably to species in North Lao PDR that how far to the east and south Black Crested Gibbon extends in Lao PDR is also unclear. Distances from known Black Crested Gibbon localities to known pale-cheeked gibbon localities are typically 200–250 km (Table 1): even the closest is fully 175 km away. Thus, much of the northern highlands support (or, at least until recently, supported) gibbons of uncertain identity.

Table 1. Nearest known populations of pale-cheeked gibbons in Lao PDR to the known Black Crested Gibbons.

Direction	Locality	Reference for identification	Distance
North-east	Ban Muangyo	Osgood 1932	175 km
East-south-east	Nam Et–Phou Louey NPA	T. Geissmann *in litt.* 2008	200 km
South-east	Xiangkhouang	Thomas 1927	250 km
South	Muang Khi	Fooden 1987	250 km

To the west lies the Mekong.

Perceptions that Black Crested Gibbon is very restricted in Lao PDR may go back to Delacour (1940: 22), who stated that "*Hylobates concolor leucogenys*" (= Northern and Southern White-cheeked Gibbons) were "common in all Lao forests" (original in French), excluding only "[le] N.-O. de Laos (Ban Houeisai)" (and, by implication, "Bas Laos", the domain of "*Hylobates concolor gabriellae*", and areas west of the Mekong). He later (Delacour 1951: 121) described the Lao distribution of Black Crested Gibbon as "l'extrême ouest du Laos": but this was an indication of known range, not an assertive circumscription of total range, given the large question mark for the nearby area on his map (Fig. 1), and statement that "il existe encore de nombreuses lacunes dans notre connaissance de la distribution des six sous-espèces" (p. 122). Delacour barely entered Lao PDR's northern highlands west and north of Xiangkhouang (Hennache & Dickinson 2000): in 1925–1926 he went only 70 km to the north-west, as far as Ban Souy (19°32´N, 102°52´E, then known as Muong Soui; Thewlis *et al.* 1998), and in 1938–1939, his non-Mekong collecting areas outside Bokeo, such as Taloun (presumably at or near today's Ban Kioutloun-Gnai, at 19°35´N, 102°14´E; Fuchs *et al.* 2007), were visited rather briefly and comprised deforested habitat (Delacour & Greenway 1940). Hence, Delacour plausibly never encountered gibbons north and west of Xiangkhouang province except along the Bokeo Mekong. It is possible that his statements of gibbon ranges were shaped by unpublished information from correspondents, e.g. A. David-Beaulieu, who might have had good knowledge of northern highland gibbons (see David-Beaulieu 1944). Mootnick (2006: 113) stated that "there is a hybrid zone of *lu* and *leucogenys*" in Lao PDR: convincing evidence that the animals right on the Bokeo Mekong were hybrids would suggest that Northern White-cheeked Gibbon was not far away, but has not been presented.

Various attempts in Lao PDR to determine, from village information, the species of gibbon present in the area under discussion mostly concluded that this is impossible (e.g. Duckworth 1996b, Johnson *et al.* 2003b, Geissmann 2007b, Hamada *et al.* 2007), and were corroborated by discussions with some local government staff during the present review, and by listings in various charlatans' reports of 'records' of Pileated and Black Crested Gibbons in parts of Lao PDR far from their known range, and even of Agile Gibbon *H. agilis* (see sect. 1.7). Geissmann (2007b: 64) well expressed

reasons for this difficulty, while underplaying its magnitude: "the immense variability of intermediate fur coloration patterns that crested gibbons exhibit during their ontogeny may make interview data on gibbon fur coloration less reliable, especially in areas where gibbons are very rare or have become extinct several decades ago. Interview data may not be reliable to determine which of the two gibbon species is, or was, present in an area". By contrast, HFI (1999: 118) concluded that "two types of gibbon were recorded during the interviews. The villagers were able to give very detailed and specific descriptions of the type of gibbons occurring in the area as they were regularly hunted and traded as pets. Descriptions of the gibbons close to Ban Namon were confirmed as very accurate when a juvenile was captured and brought to the village during the survey". This survey's two areas were either side of the Mekong and supported White-handed and pale-cheeked gibbons respectively.

1.5 AVAILABLE INFORMATION BASE

1.5.1 Historical records

Historical information is taken here to be that from before the resurgence of wildlife survey in Lao PDR, which began about 1988 after the reconnaissance of Sayer (1983). Information from before 1988 was not comprehensively sought for this report, reflecting the limited available time: intervention priorities need to be determined from current circumstances. Historical information is vital context to the current situation, but two factors complicate its use with Lao gibbons. It is a reasonable assumption that gibbons occurred historically throughout the parts of Lao PDR where the climax vegetation is semi-evergreen or evergreen forest. Most of the country held such forest pre-exploitation, excepting areas too dry (where deciduous dipterocarp forest predominates, although it is widely believed that a fair proportion of this is anthropogenic), too steep and/or thin-soiled (a negligible proportion of total area, except in karsts) or too wet (waterbodies and flatlands inundated for lengthy periods each wet season). (The climax vegetation of several other parts of the country has been argued not to be forest, e.g. parts of the Bolaven plateau and the Plain of Jars, but in total these are an insignificant proportion of the national land area.) Historical collection localities are essentially a random series of points within this wide, contiguous gibbonscape, and their exact location relates more to logistics of early expeditions than to gibbon distribution and status. Secondly, given the labile taxonomy of gibbons, all identifications in contemporary sources need fresh evaluation.

The major sources of historical information that exist are museum specimens, scientific papers, and popular accounts. Museum specimens are the most fundamental, in that they can be objectively re-examined, but come from very few Lao localities, hardly more than the 11 sites for the whole country mapped in Delacour (1951). Scientific papers, by comparison with various other tropical Asian countries, are scarce, comprising a few collecting expedition reports (Thomas 1927, 1929, Osgood 1932), some overviews of Indochinese gibbons (Edmond-Blanc 1932 [not checked for this review], Delacour 1933, 1934, 1940, 1942, 1951, Bourret 1946?), side-mentions in faunistic works of other groups (e.g. David-Beaulieu 1944), recent clarifications of the historical record (e.g. Fooden 1987), and a brief attempt to study vocalisations (Goustard 1984). Several other key sources of historical information on Lao mammals contain no gibbon records (e.g. Bourret 1942, 1944). In sum, the authoritative historical base for understanding gibbon distribution in Lao PDR is lamentably limited, reflecting low activity during the main collection-based expansion of understanding of global faunistics from the mid 19th to the mid 20th centuries. This is dramatically illustrated by the detection in the 1990s (sometimes first in adjoining parts of Vietnam) of many mammal species new to the scientific world. These include not

only various small bats, rodents and insectivores (e.g. Francis *et al.* 1999, Jenkins & Robinson 2002, Musser *et al.* 2005), as still are discovered all over the world, every year, far more than the general public realises (e.g. Pine 1994), but also Kha-nyou *Laonastes aenigmamus*, a family of rodent, highly distinctive in external morphology and previously known only from old fossils (Jenkins *et al.* 2005, Dawson *et al.* 2006); Saola *Pseudoryx nghetinhensis*, an entirely new genus of bovid looking like a cross between a cow and an antelope (Vu Van Dung *et al.* 1993, Schaller & Rabinowitz 1995); Annamite Striped Rabbit *Nesolagus timminsi*, a boldly patterned forest rabbit of a genus previously known only from Sumatra (Surridge *et al.* 1999, Averianov *et al.* 2000); and several muntjacs (small deer), although Large-antlered Muntjac *Muntiacus vuquangensis* (Do Tuoc *et al.* 1994, Timmins *et al.* 1998), the only one of the proposed new species that is unquestionably valid, albeit not in a new genus as originally proposed (McKenna & Bell 1997), was known in the 1930s but not named as new (Bauer 1997). This pulse of mammalian discoveries from Lao PDR and Vietnam in the 1990s is unparalleled, anywhere else in the world in recent decades, in the obviousness of many of the constituent species and underscores how thin must be the available information base for gibbons.

As well as the narratives of collecting or surveying expeditions (e.g. Mouhot 1864 [not checked for this review], Garnier 1869–1885 [not checked], Harmand 1878–1879 [not checked], Bassenne 1912 [not checked], Coolidge & Roosevelt 1933, Kerr 1933, Legendre 1936 [not checked], Lowe 1947), there are also several hunters' memoirs on wildlife of Lao PDR, including Cheminaud (1939, 1942) and Fraisse (1955 [not checked]); others may exist. Examination of the first reveals that it is deeply flawed as a primary source, and the chapters are best seen not as factual accounts of specific incidents, but as parables serving to portray the author's perceptions: the extent to which these were informed by direct personal experience is unclear, but is possibly very low, and many accounts conflict with reality (Duckworth *et al.* in prep.). There is also the muddled work of Deuve (1972), based upon Deuve & Deuve (1963). The basis of specific statements is given only rarely, and much content appears inferential, although presented as factual. So much gibbon information in these sources is at variance with validated data (as it is for many other mammals), including the pre-existing Delacour (1951), that the only reasonable course is to caveat, usually ignore, the whole lot (Duckworth *et al.* 1999: 163). Of gibbons, the chief sources of confusion sown (some of which still sometimes rear up, even today) are that:

1. White-handed Gibbon inhabits the Lao Mekong plain from Ban Houayxai to Paklay (whereas the Mekong plain in the northern portion of this stretch is in Lao PDR only east of the river, yet this gibbon occurs only to the west of the river).
2. Pileated Gibbon inhabits Savannakhet province (but this lies wholly east of the Mekong, whereas the species lives only to the west). [Deuve & Deuve 1963, only.]
3. Hoolock *Hoolock hoolock* lives in the west of the province of Louang-Namtha (perhaps a confusion with Western Black Crested Gibbon, although the animals were stated to have white frontal bands; Hoolocks occur only west of the Salween, i.e. are separated from Lao PDR by not just one, but two, major rivers; Geissmann 1995).
4. Black Crested Gibbon (as "*H. c. concolor*") inhabits the province of Houaphan (as "Sam-Neua") (whereas recent surveys have found only Northern White-cheeked Gibbon in this province, and the distribution of gibbons in Vietnam as presented by Geissmann *et al.* (2000) does not suggest that Western Black Crested Gibbon could be in this part of Lao PDR).

5. *Nomascus* sp. *incertae sedis* (as "*H. c. gabrieallae*"): overlaps ("cohabite") with Pileated Gibbon in the province of Pakxe [= Champasak] (they are allopatric, separated by the Mekong, although the former situation on Mekong islands is unclear).

One further catastrophically confused grey-literature source is cited sometimes in the conservation sector and therefore warrants mention: Chazée (1990). It is treated under historical sources because, although prepared in 1990, it is highly derivative of the Deuves and again ignored Delacour (1951). As well as repeating old errors, fresh mistakes relevant to gibbons are:

1. White-handed and/or Pileated Gibbons occur in the provinces of Xekong and Attapu (whereas both provinces are east of the Mekong, and both taxa occur only to its west).
2. Pale-cheeked gibbons (as "*H. c. Leucogenya*" and "*H. c. Galriella*" (sic)) occupy all Lao PDR (whereas they do not occur in the parts of the country west of the Mekong or in an area of unknown total size of the northern highlands).

1.5.2 Modern information: written sources

In 1988 the Forest Resources Conservation Project, executed by the Government of Lao PDR's Department of Forestry and IUCN, of the Lao–Swedish Forestry Programme began field reconnaissance surveys to identify a system of national protected areas, using habitat assessments and village interviews (Salter & Phanthavong 1989, Salter *et al.* 1990, 1991). From 1991, direct field surveys of large mammals (and other biota, particularly birds) were undertaken as part of this programme (e.g. Cox *et al.* 1991, 1992, Duckworth *et al.* 1994). In 1993, the first 18 of the national protected areas (NPAs; often known as national biodiversity conservation areas, or NBCAs) were declared (Berkmüller *et al.* 1995a, 1995b), all but one of which were large (over, sometimes well over, 1000 km²) forest landscapes: prime habitat for gibbons. From 1994 onwards, several international NGOs supported field biodiversity surveys with the Department of Forestry of these areas, continuing a strong focus on large mammals (e.g. Evans *et al.* 1996a, 1996b, 2000, Timmins & Khounboline 1996, Tizard 1996, Davidson *et al.* 1997, Steinmetz 1997a, 1997b, 1998a, 1998b, 1998c, Timmins 1997, Tizard *et al.* 1997, WCS 1997, Boonratana 1998a, Davidson 1998, 1999a, Duckworth 1998, Showler *et al.* 1998a, 1998b, Walston & Vinton 1999, WCS undated) as did those few still directly undertaken by LSFP (Boonratana 1997, 1998b). In the first year's general surveys (October 1992–August 1993; earlier surveys had been focused on Kouprey *Bos sauveli*), quantitative gibbon survey was attempted, but was abandoned as inefficient use of time on surveys with general remit (Duckworth *et al.* 1995; see sect. 1.6.2.1). A few field surveys ranged outside existing and formally proposed national protected areas, such as environmental assessments of hydropower projects (e.g. Evans *et al.* 2000), for the development of Vientiane Forestry College's (now part of the new National University of Lao PDR) field site in Sangthong district, Vientiane (Duckworth 1996a, 1996b) and to outstanding areas not formally proposed as NPAs in the review of Berkmüller *et al.* (1995a), most notably Dong Khanthung (Champasak province; Timmins & Vongkhamheng 1996b, Round 1998) and Phou Ahyon and adjacent parts of Xekong province (Timmins & Vongkhamheng 1996a, Showler *et al.* 1998a).

The final two of these baseline surveys occurred in early 1999, of parts of Nakai–Nam Theun and Xe Sap NPAs respectively (Robichaud & Stuart 1999, Steinmetz *et al.* 1999), just too late for comprehensive inclusion in the overview compiled around the same time (Duckworth *et al.* 1999). Of the 20 NPAs declared by this stage (Robichaud *et al.* 2001), one remained entirely unsurveyed for mammals (Phou Phanang NPA), whilst coverage of a few others had been very patchy in time and/or space: from a

gibbon point of view, the least covered NPAs at this stage were Phou Dendin, Nam Poui (= Nam Phoun in many sources), Phou Khaokhoay and Xe Sap (see effort levels in Timmins & Duckworth: Table I). Even the better-covered areas typically had only a single visit spread over a few weeks, maximum a few months, by a handful of surveyors of various disciplines. Effort was strongly prioritised to direct field searching in most surveys, and in the time available, only a few parts of each NPA could be visited. Where gibbons remained widespread and mostly common within protected areas, these surveys could reliably assess their status. In areas where populations were much reduced with widespread local extinctions (or, perhaps, naturally patchy in occurrence), the ability of these surveys to assess status, or even to detect gibbons at all, was more limited. In many surveys, local information was used primarily as a factor in choice of sites to survey within the larger landscape, rather than being taken to substitute direct information as the primary data source.

Excepting the hydropower studies, which were undertaken under contract to private companies, the aforementioned surveys were all expressly to generate information for the public domain. Most reports were produced under time constraints and, where applicable, the subsequent journal papers, produced after study of museum skins and deeper review of field data (including tape-recordings), provide the definitive findings, although they lack some of the more parochial details. Starting somewhat earlier than these 'public service' surveys, in the late 1980s, were purely commercial contract surveys, usually related to hydropower projects which, when international funding was sought, often mandated some form of environmental impact assessment. The results of many seem not to have been deliberately placed in the public domain, and in many of those traced, the reliability of their biodiversity information, at least at the species level, is execrable (see sect. 1.7).

Progressively during the mid to late 1990s, NGO-supported conservation activities changed from survey (documenting the conservation landscape) to intervention (attempting to influence the conservation landscape). Wide-ranging biodiversity surveys undertaken directly by international personnel of, generally, appropriate experience were replaced by site-based activities where continued generation of wildlife information was arguably the least of the project's priorities. For few, if any, NPAs in Lao PDR is a deficiency in biological knowledge restraining conservation progress; it is sufficiently clear what needs to be done, and that what is needed to do it is the informed enthusiasm of all the various stakeholders (groups of people whose aspirations and activities affect what happens) to do it, sufficient capability and confidence of those who need to play central roles, and supporting resources. This point is not made as a criticism of the reduction in biological data generation in recent years, merely because it is a fact of pivotal relevance to a data collation such as this.

A number of NPAs had management support from the mid 1990s onwards, most only for a few years. Many projects involved wildlife monitoring (Boonratana 1998b, 1999, 2001a, 2003, Steinmetz 2000, Poulsen & Luanglath 2005, Johnson & Johnston 2007, Strindberg *et al.* 2007) with gibbons often selected as a monitoring subject. Two sites even focussed some conservation activities around gibbons: Nam Kan NPA (Geissmann 2007b; J.-F. Reumaux verbally 2008) and Nam Ha NPA (Johnson *et al.* 2003b, 2005, Hansel *et al.* 2004a, Brown 2007); only the first is still operating. Partly reflecting the need for personnel of all-round conservation experience, and partly the many calls on their time, even where international specialists participated in recent surveys, these were generally based around village information with only limited direct survey (Boonratana 2000, Robichaud *et al.* 2002, Poulsen *et al.* 2005, 2006, Hamada *et al.* 2007), although there are exceptions (Duckworth *et al.* 2005, Ruedi & Kirsch 2005, Duckworth 2008); ironically, it has mostly been commercial projects that have deployed experienced surveyors for the longer field periods (e.g. Timmins & Robichaud 2005, Dersu 2008). A number of publications have presented wildlife

observations made during 'time off' from formal, increasingly office- and village-bound, conservation duties (e.g. Evans 2001, Duckworth *et al.* 2002), but these have not usually involved significant penetration of potential gibbon habitat.

There were also several wildlife trade surveys during the 1990s (Martin 1992, Srikosamatara *et al.* 1992, Baird 1993, 1995, Compton *et al.* 1999), culminating in the alarming national overview of Nooren & Claridge (2001). These concerns are beginning to be tackled through a long-term project based in Vientiane Capital City (e.g. Hansel *et al.* 2004b) and episodic work elsewhere (e.g. Singh *et al.* 2006).

1.5.3 Modern information: previously unpublished

This fragmentary written information for 2000 and onwards necessitated a trawl for unpublished information. Gibbons are readily detected and identified (as gibbons, although not to species), stimulating a search on a grander scale than almost any other animal would warrant, including, as well as wildlife surveyors and local forestry staff, other conservation professionals, rural development personnel, nature tourists and, in essence, anyone spending significant time in forest areas. These were traced through personal contacts and several rural-sector email list-servers relevant to Lao PDR. A selection of senior province-level forestry staff, mainly those with responsibilities for NPAs, were met in Vientiane in early July, and many more were contacted by telephone.

Several avenues remained under-explored in the time available. Most notable may be tourist guides, who may be richly informative, given that seeing wild animals (particularly big ones) is high on many international tourists' request lists in Lao PDR (Brown 2007). Phoning the local government staff was hit or miss; gathering such information comprehensively requires site visits. Finally, July–August proved an unfortunate time to trawl international staff: many were on holiday, preparing to depart, or dealing with the workload accumulated during their recent absence. Hence, some information potentially significant was probably not captured, although it is unlikely that any general conclusions need reshaping.

1.6 GIBBON SURVEY METHODS IN LAO PDR

1.6.1 Methods of detecting gibbons

Large mammal survey in Lao PDR needs, and has been using, many techniques to assess overall communities, as is typical in tropical forest areas (e.g. Voss & Emmons 1996). Gibbons are well detected by some methods, not by others. The balance of methods deployed has varied between surveys, reflecting specific aims and habitual preferences of the individual surveyors, so an understanding for each survey of the methods used and their intensity is essential context to findings related to gibbons.

1.6.1.1 Direct contacts of wild animals

Gibbons are best recorded by direct contact, particularly through hearing their loud vocalisations. Most 1990s surveys had intensive dawn–dusk direct diurnal observation as their mainstay, undertaken by people who were primarily bird surveyors. It was assumed during the 1990s that a few weeks in a forest block (such as an NPA) should detect gibbons if present in the areas visited (self-evidently, no conclusions could be drawn about areas never visited), but this is in fact not so for very small, scattered, populations. Tizard *et al.* (1997: 22) stated that "there were no recent reports of gibbons in the area and none were observed. Although they may still exist in small patches, it is likely that gibbons are no longer found in Nam Ha". After there had been several years of site-based conservation activity at Nam Ha NPA, Duckworth *et al.* (1999: 181) wrote that gibbons "appear to have been hunted out: M. Meredith verbally

1999". Yet ongoing intensive site-based work found tiny remnant numbers (Johnson *et al.* 2003b, 2005), within or near areas surveyed in 1997 (Tizard *et al.* 1997: Fig. 2). Distinguishing whether a lack of records might mean a lack of gibbons or simply their being overlooked was chiefly problematic for assessing status relatively within survey areas, because gibbons were confirmed in almost all NPAs and other forest survey areas. Rawson (2004: 134–135) usefully stressed that "the absence of vocalisations on short surveys should not be taken as sufficient proof of the absence of gibbons" at the site in question. His recommendation of "more than one day, preferably closer to four days, within any one area for determining the presence/absence of gibbons" refers to the time necessary to be spent at an individual listening post within an area to have a 90%+ chance of detecting gibbons if present around that post (B. Rawson *in litt.* 2008): it would be highly inappropriate if taken to imply that only a few days were necessary in an entire survey area (a lot more than a few days of survey did not find them in Nam Ha NPA).

Even for surveys using methods with no particular need to travel as close to silently as possible (and which therefore have few direct contacts with mammals), gibbon songs can be heard from well beyond a surveyor's 'disturbance zone', so incidental direct contacts, by ear, should occur when gibbons are present. Provided they sleep within or next to forest, even nocturnal surveyors might well detect gibbons if present. This is not to say that all surveyors note their incidental encounters.

1.6.1.2 Remains in and near the field

Remains of hunted animals are often found in the field; if arm or hand bones are present, gibbon identification should be straightforward, but the smoked animal portrayed in Duckworth *et al.* (1999: Plate 5) was initially recorded, based on perceptions of what the hunter said, as a Douc *Pygathrix nemaeus* (W. G. Robichaud verbally 1999). If only pieces of skin or skulls are available, although museum workers might often have no difficulty in definitive identification, mistakes in on-site identification are likely. The ease with which gibbons are heard makes remains likely to be important in terms of assessing threats, rather than population status.

1.6.1.3 Animals or their remains in trade or in towns

The identification of small pieces of gibbons in wildlife trade could be challenging for all but a few specialists. There has been no evidence that gibbons are significantly and widely traded in this way in Lao PDR. Although there is a risky circularity between these two statements, if significant numbers of gibbons were being traded as dissociated parts this surely would have been detected at the village level. Most records of undoubted gibbons in human possession are of live animals. The location of capture can almost never be confirmed, no matter how certain and persuasive informants might seem.

1.6.1.4 Second-hand information

Collating information from people in the area of interest to a survey, typically local villagers, is widely used in mammal survey in Lao PDR. There are major concerns, never satisfactorily evaluated through controlled testing, over its ability to generate reliable information at the species level in speciose groups such as civets, cats and macaques, but there is reasonable evidence that, when undertaken carefully, it can be broadly reliable at the big-picture level. Duckworth *et al.* (1999: Annex 5) found a good concordance of the results of FRCP interviews during 1988–1993, undertaken with only embryonic knowledge of current distribution of mammals in Lao PDR, with those of field surveys in 1992–1998 for relatively distinct species with restricted distributions and which could be surveyed directly with reasonable fullness, e.g. Red-shanked Douc. The reliability for ubiquitous species (e.g. Sambar *Cervus unicolor*; and

gibbons), or those readily overlooked by direct survey even when present (e.g. Clouded Leopard *Pardofelis nebulosa*) could not, of course, be tested. Gibbons should be readily surveyed by village reports: their rather human appearance, lack of tail, and, most notably, song, render them obviously distinct even from monkeys. Moreover, they are directly encountered (visually and, especially, by ear) more often than are most other large mammals in Lao PDR, allowing villagers to form direct evidence-based perceptions about them. This is reflected in that they seem to be known by a unique Lao name across the country (*thani*, sometimes as variant *sani*), never applied to any other animal, and with no other primary Lao name for the animal (use of homologous *chani* given for some Lao sites by Hamada *et al.* [2007] might indicate Thai influence, either of recorder or interviewees). Therefore, perceptions of habitual forest-goers of gibbon status should be fairly reliable. Powerful indications that carefully-gathered village information is indeed accurate, even at local scales, come from Nam Ha NPA, where village people reported to Hedemark & Vongsak (2003) that gibbons were present, despite various opinions of external surveyors (see sect. 1.6.1.1): listening-post surveys then found gibbons around all four villages which reported them (Johnson *et al.* 2005). However, the influence on village information of factors other than wildlife status was well indicated a little later in Nam Ha NPA by Brown (2007), whose interviews in November 2005–March 2006 also found that villagers averred unambiguously that gibbons persisted, but listening-post surveys (with effort well exceeding that in 2003) detected only one single song bout; he concluded that the villagers were motivated to suppress severe local declines through a project focus on gibbon conservation.

The foregoing interviews were all undertaken under close to ideal circumstances, involving people conversant with the language, customs, and biological species of the area. Less capable personnel generate less reliable information, not infrequently complete rubbish: so the uncritical secondary use of interview information, even for gibbons, is irresponsible (sect. 1.7). The experience at Nam Ha NPA indicates that where very few gibbons survive, the most efficient way to locate them is probably interview then field checks, not cold-searches in the field. Tizard (2000: 27) pointed out that "two sources (one a foreigner fluent in Lao, the other Lao) working in villages in Xe Sap during and after the [1999] survey [Steinmetz *et al.* 1999] have reported that community members in Xe Sap say that they withheld significant information on wildlife [it is not stated whether this involved gibbons] and its use from the [1999] team. The reasons given for this were that they do not trust government staff or government policies in relation to protected area management. This is a factor that has been reported increasingly frequently by a range of workers in the Lao PDR, and which cannot be overlooked by future biodiversity appraisal teams". The searches proposed in sect. 2.6.5 for the rarer gibbons in Lao PDR need to take due account of this possibility.

1.6.1.5 Other methods of mammal survey

Sign-searches (for footprints, faeces, feeding marks), camera-trapping, spot-lighting and live-trapping have been variably employed in Lao PDR mammal surveys; all are irrelevant, directly, to recording gibbons.

1.6.2 Methods of site-level status assessment of gibbons

More useful, and a lot more difficult, than simply confirming presence of gibbons in an area is understanding population patterns in time and space, and levels of threats: how common at the site in question are gibbons now? How has this changed in recent decades? And why is it changing? Compared with other mammals of similar size living in South-east Asian forest, there is a large literature on gibbon survey techniques (e.g. Brockelman & Ali 1987, Whitesides *et al.* 1988, Brockelman & Srikosamatara, 1993,

Nijman & Menken 2002, 2005, O'Brien *et al.* 2004, Fan Pengfei *et al.* 2007), the review of which is beyond the scope of this document; and currently B. Rawson (*in litt.* 2008) is engaged on just such a review. Discussion here focuses upon work in Lao PDR and how to interpret the results generated.

1.6.2.1 Assessing current population status

Most surveys described gibbon status by stating, with varying detail, where, when, and how often gibbons were found. This is about all that can be done when numbers are very low (e.g. Johnson *et al.* 2005), but denser populations allow other options (Brockelman & Ali 1987, Rawson *et al.* in press). Verbal summaries of status were most useful if giving where, within the survey area, gibbons were found, and where (if anywhere) there was meaningful lack of records; and when frequency of encounters was given (rough proportion of days in suitable habitat that gibbons were heard and/or typical number of 'groups' heard per morning). Using such information assumes a broad correlation, not necessarily linear or consistent across species or sites, between numbers of gibbons and of detections. Nothing suggests this is not true at order-of-magnitude level. Such information was gathered within surveys not specifically for gibbons, at little cost to overall aims, and statements like 'heard most days in suitable habitat' give significantly more information than simply 'present' (which might refer to only one record). However, comparisons should not be pushed too far, and, for example, areas where gibbons were 'heard some days' may not support lower gibbon densities than areas where they were 'heard most days'. An 'all other things being equal' approach is inappropriate because the number of registrations may reflect many factors, gibbon and human, other than abundance. For example, in Xe Pian NPA, most observers noticed only 2–4 call-bouts per morning during general wildlife survey, before a listening-post assessment showed 4–8 were actually audible (unpublished data of Duckworth *et al.* 1995). There is a human tendency to blank out, from conscious mental notice and/or field notes, common background noises, as is well indicated by T. Tizard's (*in litt.* 1999) field notes from a 1998 visit to the Nam Ghong PPA: "gibbons heard daily in all sorts of habitat – I just forget to write them down" (23 February) and "heard lots of gibbons in the morning. In fact, heard every morning, except I forgot to write 'em down" (7 March). Around the Houay Kua (Xe Pian NPA), gibbons sounds were audible on average in half the minutes of the first two hours of each morning in December 1992, with levels even higher in May 1993 (Duckworth *et al.* 1995); during general survey they were simply audible wallpaper (and had to be, given the need to assess so many other species' status). This tendency for lax notation should be less problematic in lower-density populations where gibbon song was not a large part of the typical morning background.

Studies, of multiple gibbon species including Yellow-cheeked Gibbon in adjacent Cambodia (Rawson 2004, Rawson *et al.* in press), agree that rain and wind depress calling rates, as evidently does rain the preceding night, even if ceased by day-break, whereas cloud (not associated with rain) and fog seemed unimportant. Effects of temperature seem not well studied. In Lao PDR, the northern highlands and the Annamite range (including flanking areas as low as 300–500 m) can be bitingly cold, especially in December–March, depending on airflow direction. It is plausible that gibbon calling rates might respond directly to day-to-day temperature and/or that there might be a predictable cold-season change of call levels.

The biggest difficulty in comparing different Lao survey areas' gibbon populations, from existing reports, is the lack of understanding of seasonal variation in calling levels, if any. Most areas were surveyed by only a single visit, lasting a few weeks: long enough to ride over chance effects on song output such as bad weather, but not seasonal effects. Some sites were surveyed in the cold season, some in the hot, while one, Xe Bang-Nouan NPA, was surveyed entirely in the wet season. The only site-

level seasonal variation perceived in the 1990s was that song levels around the Houay Kua in Xe Pian NPA (see site account) were much higher in early May 1993 (the hot season, at the turn from dry to wet, and, that specific week, with only one rain-storm) than in December 1992 (the cold dry season). This was assumed to be a cold/hot season difference, but as it concerned only one area and perhaps a dozen groups of gibbons, it might reflect another factor such as site- and/or year-specific patterns of food availability (see Kakati 2004, Rawson 2004, Fan Pengfei *et al.* 2008).

Although a study of song output in Cambodian *Nomascus* (Rawson 2004) concluded that it was low in the rainy season (and so Rawson *et al.* (in press) advised against surveying in the rainy season) and high in the cold season, it would not be appropriate to import these conclusions, even at the coarse level, for retrospective consideration of existing Lao survey results or in the design of new surveys. The effort needed for solid investigation of song levels in relation to all the likely factors is formidable, yet without it, observed variation cannot be pinned onto specific causal factors. Rawson (2004) was based on only three groups followed for only 11 months: so conclusions on seasonality require corroboration before generalisation to other areas or even, strictly, to the same groups of gibbons in other years. These three groups varied between themselves in the proportion of mornings that they called (28%, 37% and 61%, averaged across the year) as much or more than might be expected for seasonal variation, and as well as each individual group's response potentially biasing results (and compromising the validity of all the statistical tests presented through pseudoreplication), the apparently 'seasonal' patterns found could have arisen through a confounding variable because (by implication) no analysis for higher-order effects was undertaken, despite the number of factors stated to affect calling levels. Because gibbon song is presumably energetically fairly expensive, it might be expected at higher levels when food (= fruit) is abundant. A common food of gibbons is figs, many species of which fruit aseasonally (Janzen 1979; and, specifically for Thailand, W. Y. Brockelman *in litt.* 2008). This offers the possibility that even strong 'seasonal patterns' observed, if based on a few groups at one site in one year, might not be observed even on those same groups in other years, if local fig production phenology differs markedly between the years. In sum, without knowledge of the patterns of fruit availability, or effects of any other factor that is likely to affect song output, across Lao PDR, some of the suspected/assumed variation in gibbon status, inferred through relative amount of song, may simply reflect varying calling levels and the brevity of survey at many sites.

A further factor which could affect comparison between areas is that song in *Nomascus* is strongly clustered in the first couple of hours from dawn, even the first hour (e.g. Rawson *et al.* in press), so any surveys where field activity did not typically start until after a leisurely daylight breakfast would significantly under-record gibbons. So far as is known, dawn starts were universal on the 1990s baseline surveys of NPAs and other large landscapes. Surveys by other personnel and for other reasons may have had different patterns; and on those involving night-work such as bat-netting or spot-lighting, the surveyors may have been sleeping soundly through peak gibbon calling time. Rawson (2004: 133) contrasted Yellow-cheeked Gibbon behaviour in Cambodia with that of *Nomascus* sp. *incertae sedis* in south Lao PDR (Duckworth *et al.* 1995): the latter had no "vocal events before dawn" whereas the former recorded them as early as 22 minutes before sunrise. But dawn, the process of getting light, starts at least 20 minutes before sunrise, the time that the sun rises over the horizon, and B. Rawson (*in litt.* 2008) confirmed this was his use of the latter word.

Line transects are widely used to assess primate population status, but the need for dozens of registrations (Buckland *et al.* 2001) and typical encounter rates in Lao PDR meant that they were not seen as a practicable in the 1990s surveys. Listening posts were seen to have more potential for incorporation within a general survey, despite the

high time investment needed. However, the first attempt to use this method in Lao PDR (Duckworth *et al.* 1995) exemplified the point in Geissmann (2007b), that density estimates of *Nomascus* need cautious interpretation through basis on very short surveys, and faced many difficulties, mostly not successfully overcome. Their method for calculating the listening area was not as given in the published paper (it was $2rl + \pi r^2$, not $2rl + r^2$, the omission of the π-symbol being overlooked at proof-reading), although in any case such a rough-and-ready area assessment is highly imprecise. Additional to those drawbacks inherent but not discussed (e.g. guessing the typical proportion of groups calling per day from data on other species in different habitats, and non-random placement of survey lines), and the various ones actually discussed by Duckworth *et al.* (1995), a large flaw in the proposed group densities is that the surveyors did not distinguish male solos (given by unattached, often wandering, individuals, and varying greatly in timing, length and the number of bouts per morning) from songs of settled, territorial, groups, yet the former should be ignored in group density estimation (Rawson 2004, Rawson *et al.* in press). Duckworth *et al.* (1995) concluded, mindful of the then paucity of up-to-date information about all Lao wildlife, and that in any survey area gibbons were simply one of many vertebrate species at risk of local extinction (and by no means the most threatened), that such specific effort was inappropriate. Although a few hours sat quietly at a listening post might seem a fine way to gather ample information on other forest wildlife, the analysis for Duckworth *et al.* (1995), which involved 5–8 observers strung out in a line across the forest at *c*.400 m intervals, showed that seeking other wildlife eroded diligent recording of every gibbon call bout. Every observer failed to note a few bouts that they must (through the records of their neighbours both left and right) have heard; but a couple of people missed many, apparently because they were attending to birds at the same time. In a site like Xe Pian NPA with lots of gibbons and relatively level terrain through which some calls travelled for over 2.5 km (although most petered out about 1.5 km away; raw data for Duckworth *et al.* 1995) absolute concentration for gibbon sounds was needed. Geissmann (2007b) gave an account of a specific listening-post density estimation for Western Black Crested Gibbon in Nam Kan NPA, which, reflecting the experience of the surveyor and single-species survey focus, faced few of the above problems, but, because the survey area was selected non-randomly, it is impossible to extrapolate from the actual surveyed area to the (much more extensive) remainder of the contiguous forest.

Apparently the only other attempt to go beyond descriptive status assessment of wild gibbons in Lao PDR is in Johnson & Johnston (2007: 47), who used occupancy analysis (see, e.g., MacKenzie *et al.* 2005) on line-transect data from small parts of Nakai–Nam Theun NPA. It is difficult for the average reader to know what to make of the conclusion, that "the estimated area of occupancy for gibbon is 81%", without comparable context from more sites or years. However, given the manifold problems in other survey techniques, development of occupancy-based status assessment may hold the most promise for future gibbon surveys in Lao PDR. Similar methods are now also being used in Nam Kading NPA, which might allow extension to density estimation if enough sightings are obtained (Strindberg *et al.* 2007; A. Johnson *in litt.* 2008).

1.6.2.2 Assessing recent trend

No survey has directly assessed population trends in Lao gibbons: resources have not been available for the necessary repeat visits, and the existing data are anyway imprecise. Qualitative information is available from a few sites with multiple visits, but usually different personnel visited in the different years. Differences in apparent status might reflect differences in perception, either of the use of terms such as 'common', or of the gibbons themselves (through differences in attentiveness, areas of coverage,

field protocol etc.; see sect. 1.6.1.1). The strongest comparison was at Nam Ha NPA by Brown (2007) revisiting in 2005–2006 the exact areas surveyed by Johnson *et al.* (2005) in 2003. The base has been laid in Nakai–Nam Theun NPA for intensive monitoring of gibbons (Johnson & Johnston 2007); this NPA is unique in Lao PDR in the money available, not only in annual amount, but particularly in the security of supply over enough decades, to make monitoring (which is a long-term activity) a worthwhile aim.

Under likely forthcoming resource scenarios for Lao PDR, outside Nakai–Nam Theun NPA and any other protected areas which can be confident of long-term external donor support, village information will be the only practicable option for assessing population trends. This situation is not unique to Lao PDR (see, e.g., Danielsen *et al.* 2005). Model methodology is given in Steinmetz (2000), but has not yet been operationalised anywhere in the country. What has occurred is 'after the event' monitoring through village recall of past status. While the reliability of any one response is always doubtful, harvesting opinions from the many villages around a typical NPA makes this a powerful method to determine coarse landscape-level trends, provided it is undertaken by capable personnel. Unfortunately, it has been used to date on rather few Lao surveys: Steinmetz (1997a), Steinmetz & Baird (1998), Steinmetz *et al.* (1999) and Poulsen *et al.* (2005, 2006).

1.6.2.3 Assessing underlying factors behind status trends

The value of assessing the types, levels and effects of threat is stronger than that of assessing precise population status, because it gives direct pointers to management interventions needed. Short- to mid-term threats to Lao gibbons come from harvesting (which may or may not be trade-related) and habitat change. Other potential threats are implausible as drivers of recent decline: biotic pollution, i.e. introduced species (although an alien pathogen might yet occur); abiotic pollution; climate change; or incidental disturbance by people.

Studies of hunting in Lao PDR started in the late 1980s with assessment during reconnaissance-survey village interviews of which species were favoured and used most often (Duckworth *et al.* 1999: Table 1). Site-based surveys of hunting (including the destiny of hunted animals) have occurred in a few areas, but most were either in areas where gibbons were already too rare to be significant human prey (e.g. Nam Ha NPA: Johnson *et al.* 2003a, 2003b) or were undertaken by non-mammalogists where, firstly, the ability to distinguish gibbons within unspecified 'monkeys' may be variable, and secondly, and more profoundly, the ability to detect a biologically significant off-take may be limited. Because of gibbons' low reproductive rate, long life-span and strong intra-group bonds, declines may be driven by off-takes so small as, from a village-economics viewpoint, to be insignificant: Brockelman (1995: 1) speculated that gibbons "cannot withstand the loss of as much as one female and one infant per 100 individuals per year and remain safe from extinction". Because gibbons are hunted directly with projectiles, not indirectly with traps, site-specific threats from hunting can probably be inferred through their alertness and response to people: in the 1990s this differed from abject terror (many areas) to a lack of any significant concern (e.g. the Navang logging road in interior Nakai–Nam Theun NPA). Meaningful studies of wildlife trade are difficult, and are again bedevilled by the problems that numbers of gibbons sufficient to cause population declines might be swamped among the masses of other, more fecund, wildlife currently being moved. Bleisch & Zhang Yingyi (2004) stressed the difficulties of documenting the extent of trade, especially illegal, in rare and/or valuable animals through opportunistic observations or even targeted surveys. Specifically in Lao PDR, Hamada *et al.* (2007) felt that they could not collect reliable information on trade in live or dead primates in a drive of 1450 km through five northern highland provinces, with interviews at 46 villages, during 22–31 May 2006.

Of a number of studies of the Lao forest estate in recent decades, the most recent is by the Department of Forestry (2005). This is based around total forest cover, rather than levels of fragmentation: but, particularly in heavily hunted landscapes, the latter may be as threatening to gibbons as is actual forest clearance (sect. 2.5.4). Forest types and degradation levels are assessed through silvicultural, not mammalogical, prisms. Thus, inference of the effects on gibbons of the ongoing changes in forest cover is difficult.

In sum, almost no precise quantification of threats to Lao gibbons was traced or is likely to be available. The best that can be done is overall assessment of the available information on occurrence and coarse status, in the light of general patterns of human behaviour and habitat change. It was relatively easy to assess whether large blocks (hundreds of square kilometers) of little-degraded forest support reasonably healthy populations of gibbons (audible at least most days in suitable habitat), and if they do not, to infer that hunting is likely to be the bigger problem in that area than habitat change. Going any further is rather difficult.

1.7 QUALITY CONTROL OF AVAILABLE INFORMATION

The quality of information collated in any review of disparate sources is a significant, although generally under-discussed, issue (e.g. Meijaard 1997). Although apparently not popular among the wider community, attempts to segregate information according to reliability are not mere pedantic purism: McKelvey *et al.* (2008) documented how in the absence of adequately controlled data quality, major myths about the current status of several distinctive animals in the U.S.A. had arisen. For example, Wolverine *Gulo gulo* is popularly considered to be widespread and increasing in California, and this is the official stance of the state government: in fact there is not a single verifiable record of a wild Wolverine in the state since 1922, and it has doubtless been extinct as a resident for decades. A regional example concerns Tiger *Panthera tigris* in Cambodia, where a nation-wide collation of interview data considered that the country had a large, healthy, population, among the most important of any country (Nowell *et al.* 1999). Field investigation, including in areas 'shown' by Nowell *et al.* (1999) to have the highest-density populations, painted a very different picture: "restricted to relict, fragmented populations with no known viable population in existence" (Walston 2001: 146).

All sources for the present review were evaluated critically for reliability. Sometimes direct triangulation exposed errors, e.g. one report's presentation of perceived village claims that gibbons were almost gone when, years later, they can still be heard from the houses of the village in question (sect. 2.5.2.7). Because gibbons used to occur throughout Lao PDR, and have survived in some surprising places (through local beliefs: sect. 2.5.1), almost nothing can be dismissed on its own as simply impossible, and information about gibbons had to be evaluated by reference to general faunistic information in the same report, and to information in other reports by the same author or group. Lists which contained records of birds or large mammals highly implausible at the site and season concerned, yet lacked comment by the author(s) that they were aware of this, or caveats that confirmation was needed, were all flagged as of high risk, especially the many sources which contained multiple such records. Mismatched scientific and English names were also surprisingly common, making it impossible to determine to which species the information referred. High-error species lists came from any sort of person: even those with high academic qualifications from internationally respected institutes, and long spells in South-east Asia, badging themselves as 'biodiversity experts', working on projects with more than ample funding, could deliver unusable drivel.

The toughest sources of records to evaluate were those gathered through village information. Simply that village information can be very reliable for gibbons (sect. 1.6.1.4) does not mean that it always is so. For example, along the upper Lao Mekong, "a villager of Don Moun (Lao) informed the presence of several mammals in surrounding forests, including such threatened mammals such as the Pygmy Loris [*Nycticebus pygmaeus*], Saola, Owston's Palm Civet [*Hemigalus owstoni*], Giant Muntjac [*Muntiacus vuquangensis*], Black-striped Weasel [*sic*!; Back-striped Weasel *Mustela strigidorsa*], Small-clawed Otter [*Aonyx cinereus*] and Marbled Cat [*Pardofelis marmorata*]", according to Meynell (2003: 58). No comment is given that several of these species are so unlikely to inhabit this region that this 'drive-by shooting' has delivered, in sum, arrant nonsense, notwithstanding that some of the species–evidently on the list purely by chance–are likely to be present. The only worthwhile information portrayed by this passage, and the reason for its quotation and discussion in the present report, is that surveyors of such fist-chewing naivety, incompetence, and/or lack of interest exist and pollute the written record. Although this passage was omitted from a revised version of the report (Dubeau 2004), this may simply have been to save space, because the latter version still listed *Sundasciurus* spp., a genus of squirrels occurring no closer to Lao PDR than the Thai–Malay peninsula (Corbet & Hill 1992, Timmins & Duckworth 2008), as present along the upper Lao Mekong!

Incorrect listings of mammals pepper the conservation grey literature of Lao PDR, as they probably do in all neighbouring countries. Claims were found of Agile Gibbon (multiple times), Pileated and White-handed Gibbons east of the Mekong (numerous times, from far north to far south) and Black Crested Gibbon across the country (demonstrably in many cases not simply arising through treatment of pale-cheeked gibbons as subspecies of *N. concolor*). Not infrequently, multiple species of gibbons were listed for one site, and a 2002 draft of the Nam Mang 3 hydropower project *Environmental impact analysis and outline social action plan & environmental management plan* (by "Resource Management Research [:] Environmental Impact Specialists", for the China International Water and Electric Corp.) outstripped all others by listing "Black Gibbon, White-cheeked Gibbon, Gibbons, White-handed Gibbon" all among the "mammal species reported or observed in the catchment (including reservoir) or inferred from known distributions": the area under discussion lies entirely within Phou Khaokhoay NPA and the presence of Black Gibbon or White-handed Gibbon is impossible. One can only hope that this text remained right through to the final version (which could not be located), as an alert to the plausibly negligible general reliability of the information incorporated in the report. No doubt if any other of the world's gibbons, or even Chimpanzees *Pan troglodytes* or Mandrills *Mandrillus sphinx*, were included as pictures in the quick-and-dirty interviews pseudo-informing such reports, they would from time to time have been signified as present. Errors may occur even with highly specific, recent, information. As an example, during a wet-season 1996 wildlife survey of Sangthong (Duckworth 1996a, 1996b), other Vientiane Forestry College teams in the field for other purposes were, because of the area's gibbon population's high importance, encouraged to gather information, where possible, on gibbons. One team discovered that I had seen 28 gibbons near Ban Napo, a few days previously. However, these animals were Pig-tailed Macaques *Macaca nemestrina*, not gibbons, and a major misunderstanding had clearly occurred in the passage of the information from the villagers to the survey team, even though both spoke the same primary language, and some villagers had been present at the sighting itself (Duckworth 1996b). One report received in Houaphan province was that 'a decade ago we saw 200 gibbons coming to the river's edge to drink, but now we do not see such numbers' (Aiyako Kandasak and La Khamvongxa verbally 2008). As pointed out by the sources, these animals cannot have been gibbons; presumably they were macaques.

It is beyond the scope of this document to present and discuss all the specific challenges and pitfalls of collecting local reports, beyond underlining that the difficulties in use of this technique relate, generally, more to outside surveyors' treatment of the information they receive, and selection of inappropriate sources from which to mine it, than to any underlying deficiencies in village knowledge systems. Various sources discuss the wider issue in Lao PDR (e.g. Duckworth 1996b, 1997, Evans & Timmins 1996, Evans *et al.* 1997, Tizard 2000, Poulsen *et al.* 2006, Baird 2007) and adjacent Thailand (e.g. Tungittiplakorn & Dearden 2002), and a fine example of a wild-goose chase with forest primates elsewhere is laid bare in Fleck *et al.* (1999). These sources make clear that the collation and interpretation of village information is not, despite widespread perceptions, a quick short-cut to finding out what lives in an area, but a specialised activity, even more demanding of the skills-set among practitioners (solid understanding of wildlife and of local cultural norms, excellent language skills, and consolidated prior experience) than is direct wildlife survey (where practitioners need only to understand the animals), requiring significant time for relationship-building between residents and visitors.

There may now be regions of the country were gibbons have been effectively eradicated for so long that today's generation are no longer familiar with them except as a name. This includes the Vangviang–Kasi part of Vientiane province, where several interviewees in March 2009, all of whom stating *thani* was long-gone, said that it was like *khang* (evidently *Trachypithecus* leaf monkeys) except for having big white patches on the sides of the head and making a loud song; when specifically asked about the tail of *thani*, they said it was very long, like that of *khang*. Evidently this further difference has now been forgotten about by 'common knowledge' in the region. More confidence was placed in documents describing local reports where the actual name in use was given: probably none have ever reported 'gibbons', literally, *contra* the number of reports claiming just that; some Lao or local language name has been used which has been linked to 'gibbon' by the surveyor. Similarly, explicit documentation of what physical and/or behavioural characters were used in making this linkage allows increased use of the results.

Gibbons would seem unmistakable when recorded directly by the surveyors; only very few sight records should be misidentified monkeys, and the loud songs, and some other calls, of gibbons are unmistakable to people with sufficient prior experience. However, Geissmann *et al.* (2000: 85, 2007) recently drew the astounding conclusion that a study of gibbon vocalisations in Vietnam (Rozhnov *et al.* 1986) had actually been of a bird, the Crested Argus *Rheinardia ocellata*. Moreover, Geissmann *et al.* (2007) concluded that local people (it is not clear whether these were indigenous villagers, recent transmigrants, or even officials) in and around Bach Ma National Park, Vietnam, make the same confusion. Crested Argus occurs in Lao PDR only in climatically wetter parts of the Annamite slopes (Thewlis *et al.* 1998, Duckworth *et al.* 1999) and could not of itself be a major confounding problem on baseline wildlife surveys in the 1990s because most gibbon records came from bird surveyors. However, Crested Argus does not sound particularly like a gibbon (to my ears anymore than to those of Geissmann *et al.* 2007), so it is plausible that it would not be only this bird species that might have been mistaken by inexperienced recorders for gibbons: Coral-billed Ground Cuckoo *Carpococcyx renauldi*, widespread and common in Lao PDR's lowlands and lower hills (Thewlis *et al.* 1998, Duckworth *et al.* 1999), could well be another risk. Bourret (*c.*1946) remarked on the similarity between gibbon songs and those of laughingthrushes *Garrulax*, and even Delacour (1942, 1951) draw a comparison between crested gibbon song and that of White-crested Laughingthrush *G. leucolophus*. Perhaps some direct records of gibbons in surveys in Lao PDR by people other than bird surveyors are in error, but it cannot affect the overall national-

level conclusions drawn in the 1990s (given the background of the main surveyors) and seems unlikely to have done so since.

Some documents did not indicate the source of records, and involved people evidently bereft of the most basic relevant knowledge. An unusual one is Seatec International *et al.* (2001), where a 'Dr Steve Berwick' was credited with 'Annex Q: wildlife inventory', for the draft *Environmental Assessment and Management Plan* (*EAMP*) of the Nam Theun 2 area. These 18 pages largely ignored recent surveys and for many species made major misrepresentations of regional habitat use and conservation status. This document is unusual not, sadly, in its level of inaccuracy, but because, perhaps reflecting international critical interest in the Nam Theun 2 project, the study was redone: an entirely different compilation is in the Nam Theun 2 *EAMP* in use today. Other, equally shoddy, reports for less high-profile commercial projects appear to have passed unscathed. Duckworth (2006) alluded to deficiencies in reports of one (unnamed) firm; but document review for the present report exposed a much wider problem.

The decline in overall information available since 1999 (sect. 1.5.2) has been accompanied by more variation in quality of non-commercial sources. The need for capacity building at all levels in conservation in Lao PDR is universally recognised (e.g. Claridge 1998). A necessary part of this, and the only sensible way in terms of wildlife survey, is hands-on experience (= 'learning by doing', 'on-job training', etc.). By definition, this results in evolving quality of data: a concern that is greatly outweighed, in the overall conservation balance, by increased, and increasing, capabilities and sense of ownership among the key conservation actors. Nonetheless, no service would be done by reviews such as this treating the results of early efforts as factual.

The general distinctiveness of gibbons (as a group) allows information from reports containing even seriously questionable information to be, with some misgiving, included here. For few, if any, other mammals in Lao PDR could such a course be justified. The only class of information systematically omitted from this review is where gibbons fell within a list of animals apparently derived from interviews where various almost impossible yet equally distinctive species were purportedly claimed. Confirmed records (where gibbons themselves were seen or heard, live or dead) are distinguished from reports throughout (e.g. in the site listings, Appendix 1). Anything lacking explicit original source of information was treated as a second-hand report.

2 RESULTS AND DISCUSSION

2.1 INFORMATION PRESENTED

Site-by-site accounts are presented of available gibbon information from Lao PDR in Appendix 1. Information not taken from a well-circulated document is presented in greater detail. Records from existing written sources were edited down, but not to result in significant loss of information. Reference to the original document will often be necessary for context such as the survey's duration and spatial coverage, and even the actual location of the area. Time was insufficient to extract all relevant context, let alone seek additional information, which a surprising number of sources lacked in part. The many problems with locations could have been avoided if all reports provided geographic co-ordinates for all sites, in the exemplary style of Davidson (1998). It was sometimes impracticable to determine even a general survey location. Names of villages and natural features on Lao maps often differ from local usage; and if local names are used in reports without linkage to map names or co-ordinates, it may be almost impossible to determine the area under discussion. Also, the system of transliteration from the Lao alphabet into the Roman used in the 1985–1987 series of 1:100,000 map series of the *RDP Lao Service Geographique d'Etat* (RDPL SGE) is not adopted everywhere. Numerous spellings are used even for well-known localities such as Louangphabang. Inconsistencies of spelling hinder computer search for additional mentions of the same place-name to help locate it. Full investigation of the ambiguous place names and other context would not have changed conclusions drawn above the site level, but for any reader concerned with understanding gibbon information at the specific site, it is essential to use the original documents in their entirety, not just the excerpts presented here, and often to seek additional information.

There are various forms of verbally locating records, of which the chief ones used are: geological features such as catchment, hill range or plain name; administrative provinces and their constituent districts; and (if appropriate) the protected area (national-, provincial- or district-level). These classifications are superimposed on the same land area, but locations from one system cannot usually be easily converted into divisions of another. For example, most national protected areas spill over more than one province and all over more than one district; and equally no district, let alone province, lies entirely within a protected area. Including in geological features gives a further dimension of partial overlap. The reviewer is thus left wrestling with multi-dimensional mental Venn diagrams whenever there is a need to try to relate information presented in different sources that is obviously from one general area, but using different locating systems. No doubt in many cases below spatial overlap was missed. Only records with the actual co-ordinates can surely be located within whichever reference system a user wants. Only Round (1998) systematically listed the latitude and longitude for all gibbon encounters; for many other 1990s surveys in South and Central Lao PDR, the effort needed to do so (and for all other species of equivalent or greater conservation concern) would have been prohibitive. Thus, it is entirely reasonable that many reports did not give such detail; but the widespread scrappiness of maps of survey bases and routes, gazetteers of survey sites, and linkage of named sites to map names is inexcusable. Lengthy gazetteers for wildlife sites in Lao PDR, comprehensive for the sites mentioned in the areas they covered (including historical review), were given in Thewlis *et al.* (1996, 1998), Davidson *et al.* (1997), Tizard *et al.* (1997), Davidson (1998), Round (1998), Showler *et al.* (1998a, 1998b), Walston & Vinton (1999) and Fuchs *et al.* (2007), with lengthy supplementary gazetteers, explicitly additional to one of the foregoing, in Duckworth *et al.* (1998, 2002) and Evans *et al.* (2000).

The Forests Law and Wildlife Law in Lao PDR have both recently been revised, and authoritative English translations were released in 2008. Of even greater significance, the entire classification of forest land (which includes most, although not all, potential gibbon habitat) is undergoing revision through the newly established National Land Management Authority (C. Inthavong and V. Vongsihalath verbally 2008). For these reasons, the current land-use class is not given for most gibbon sites, excepting the legally unambiguous National Protected Areas.

2.2 HISTORICAL STATUS OF GIBBONS IN LAO PDR

Table 2. Historical specimens of gibbons from Lao PDR.

Site	Taxon	Data	Key references	Comments
Phongsali*, 1924	Pale-cheeked gibbon	Five: includes NMNH 240490, 240491 & 240492	Osgood 1932, Delacour 1951, Mootnick 2006	Collected by F. R. Wulsin. Current location of two not established
Ban Laophouchai (= Lao Fou Tchai), Phongsali, 21 April 1929*6	*N. leucogenys*	One: FMNH 31760	Coolidge & Roosevelt 1933, Delacour 1951, Mootnick 2006	Collected by R. E. Wheeler on the Kelley–Roosevelts' Expedition
Ban Muangyo (= Muong Yo), Phongsali, 9 May 1929	*N. leucogenys*	Two: FMNH 31769, 31770	Osgood 1932, Coolidge & Roosevelt 1933, Delacour 1951	Collected by R. W. Hendee on the Kelley–Roosevelts' Expedition
Ban Namkeung-Kao (= Ban Nam Kheung), Bokeo, January 1939; some, at least, on 7 January*[1]	*N. concolor*; contains holotype and constitutes entire hypodigm of *Hylobates concolor lu* Delacour, 1951	Six: AMNH 148262; BMNH 1952.142 & 1952.143; MCZ 46288 & 46289; MNHN CG 1952.543	Delacour 1951, Geissmann 1989, Geissmann *et al.* 2000, Mootnick 2006	Collected by J. Delacour, J. C. Greenway Jr and F. Edmond-Blanc; abuts the Mekong
Khao Tam Pha, Bokeo, February 1953	*N. concolor*	One: USNM 296921	Geissmann *et al.* 2000	Collected by R. E. Elbel; abuts the Mekong
Louangphabang, pre 1904	White-handed Gibbon	One collected	Pavie 1904, Kloss 1929	Locality not precise (see text)
Xiangkhouang old town, Xiangkhouang, 1926–1927	*N. leucogenys*	Four collected	Thomas 1927, Delacour 1951	Omitted by Osgood 1932; locality probably not precise*[2]
Muang Khi, near Paklay, Vientiane province, 16 January 1920	*N. leucogenys*, revised type locality*[3]	Two: ZRC 4.698 & 4.699	Kloss 1929, Delacour 1951, Fooden 1987, Weitzel *et al.* 1998, Geissmann *et al.* 2000	Collected by J Bangassar (or Bangna) for H. C. Robinson and C. B. Kloss; abuts the Mekong
Ban Nape, Bolikhamxai, date?*3	Pale-cheeked gibbon	"Collected"	Delacour 1951	Not established
Nakai, 10 January 1932*4	Pale-cheeked gibbon	One: AMNH 87251	Mootnick 2006	Collected by the Legendre expedition
Savannakhet, 1929–1930	Pale-cheeked gibbon	One collected	Thomas 1927, Osgood 1932, Delacour 1951	Collected by Delacour and/or colleagues
Xepon (=Tchepone), Savannakhet, date?	Pale-cheeked gibbon	"Collected"	Delacour 1934, 1951	Not established
Salavan (=Saravan), date?	Pale-cheeked gibbon	"Collected"	Delacour 1951	Not established

Site	Taxon	Data	Key references	Comments
Ban Thateng, Bolaven plateau, Xekong, 10 & 15 December 1931	*N. gabriellae* or *N. sp. incertae sedis*	Two: FMNH 38016 & 38017	Osgood 1932, Delacour 1951, J. L. Walston *in litt.* 2000	Collected by Delacour and/or colleagues at 3000´
Bolaven plateau, 10–13 February 1932	*N. gabriellae* or *N. sp. incertae sedis*	Three collected: AMNH 87252, 87253 & 87254	D. P. Lunde *in litt.* 2007	Collected by the Legendre expedition
"Laos", 1929–1930	Pale-cheeked gibbon	One collected	Osgood 1932	Collected by Delacour and/or colleagues
Champasak province *, before 1934	Pileated Gibbon	One collected	Delacour 1933, 1940	Collected by Delacour and/or colleagues

Locations are listed north to south within taxon. No comprehensive search was made and additional specimens may exist. Together, these localities account for all those listed or mapped by Delacour (1951) for crested gibbons in Lao PDR. His map (Fig. 1) included a spot for *N. leucogenys* at the west border of Phongsali with Oudomxai province. The text suggests this to represent Ban Muangyo; if so, it is far too far south.

Notes:

*[1] Mootnick (2006: 105) discussed the possibility that two, including the holotype, perhaps were collected on 17 January; and then stated, incorrectly, that Delacour (1951) wrote that all six specimens were collected on 7 January; but the latter dated only the 'type' as 7 January. The party did not leave Ban Namkeung-Kao until 21 January (Hennache & Dickinson 2000), so the later date is plausible.

*[2] Some other mammal specimens from this expedition marked as Xiangkhouang were obvious market purchases, and the habitat then around Xiangkhouang old town (see David-Beaulieu 1944) would have been unlikely to support gibbons.

*[3] This locality has been the subject of much past confusion. Kloss (1929: 125) reported it as "the northern neighbourhood of Paklay on the Mekong (lat. 18°12´N)", and restricted the type locality to that area. Fooden (1987) pointed out that the town of Paklay lies west of the Mekong, and thus outside the range of the species, and traced, through reference to original documents, the exact area of the "northern neighbourhood" whence the specimens came, which is, as expected, east of the Mekong. Geissmann *et al.* (2000: 31) clouded the issue by mixing their cardinals, stating that "Kloss (1929) reported that the species was also collected east of the Mekong at Muang Pak-Lay...Fooden (1987) demonstrated, however, that the specimens...were not collected at Muang Pak-Lay, but at Muang Khi, west of the Mekong". This last "west" is a transcription error for 'east', and Kloss did not state the side of the Mekong whence the specimens originated. In sum, it is clear that these specimens came from east of the Mekong.

*[4] Thomas (1929) detailed the mammals of Delacour's 1927–1928 expedition which visited Nakai and Nape and listed no gibbons for either, whereas Delacour (1951) indicated that gibbons were collected at both. His statement that pale-cheeked gibbon had been collected at Nakai might have referred to the Legendre specimen, but no other plausible source is obvious for Nape; so Thomas (1929) and, after him, Osgood (1932), perhaps simply left out Delacour's Lao gibbons from this trip.

*[5] A locality was given as "near Khone [=Khon], on the Lao–Cambodia border" by Delacour (1933: 73) but the "surrounds of Pakxe" by Delacour (1940: 23); because these locations are *c*.120 km apart, it is not clear whether they refer to the same record.

*[6] Misplaced as in Vietnam by Osgood (1932).

* This locality should strictly be considered doubtful, given the analysis of provenance of Wulsin's specimens by Weitzel & Vu Ngoc Thanh (1992).

Only limited information concerning Lao gibbons up to 1988 was traced. Specimens are listed in Table 2; results were available for all the known major collecting expeditions, but additional specimens may exist. The White-handed Gibbon collected from 'near Louangphabang' around the turn of the 19th–20th centuries (e.g. de Pousargues in Pavie 1904, Kloss 1929) lacks authoritative information on origin (T. Geissmann *in litt.* 1998), but close to Louangphabang, i.e. just over the Mekong, is

entirely plausible. The only specific published non-specimen-based records from before 1988 may be those of Goustard (1984), who attempted to study vocalisations in 1974. Limited by the contemporary dangers of travel to most forest areas, he managed 280 hours afield, split between Vientiane province adjacent to Paklay (presumably in Muang Xanakham) and around Ban Pakkading (Bolikhamxai province). These sites were probably chosen as the most accessible, relatively safe, areas retaining gibbons (J.-P. Pedrono verbally 2008). An able and active naturalist stationed in Lao PDR for two multi-year spells in the 1960s and 1980s, W. W. Thomas, recorded no wild gibbons: his natural history was confined to the environs of Vientiane and a few other towns (Duckworth & Tizard 2003).

Narrative comments flesh out the limited specimen record. Osgood (1932: 200) wrote that pale-cheeked gibbons were "evidently common in ... northern Laos". The Kelley–Roosevelts' Expedition in 1929 noted gibbon song as the team marched west into Lao PDR from Vietnam through what is today Phou Dendin NPA, and again as they left Ban Muangyo (Phongsali province); in the latter, song is written as a general occurrence, whereas crossing Phou Dendin may be implied to have been heard only on "one bright, sunny morning" (Coolidge & Roosevelt 1933: 106, 131): perhaps weather on other days was poorer. 'Monkeys' were poorly represented in Tranninh (broadly equivalent to today's Xiangkhouang province plus, to the south-east, a large swathe of adjacent Vientiane province), save for gibbons, which occurred throughout, especially "en région accidentée" (rough terrain) (David-Beaulieu 1944: 37), as corroborated (for gibbons) by Lowe (1947: 32), based on his collecting trip with J. Delacour in 1926–1927: "a most noticeable feature of the forest [in the Xiangkhouang area] is the number of gibbons...". On Phou Bia, which lay in this province, Kerr (1933) noted that gibbons were the largest animals he saw. Delacour (1940) himself wrote that gibbons were seen and heard commonly in all the Lao forests, building on his earlier similar comment (Delacour 1933: 71) that "except in the deforested areas ... gibbons have been heard at all my [Lao] camps". Although the exact text as published was contradictory over whether they were or were not generally numerous, his next overview (Delacour 1934) expanded that gibbons were heard daily at all Lao camps in or at the edge of forest but they were nowhere very numerous. On 6 July 1929, Col. T. Roosevelt & H. J. Coolidge Jr procured a pair of pale-cheeked gibbons, with a youngster, from an administrator in Thakhek, who had had them for several years. Subsequent observations, recorded in captivity in America, shed much light on gibbons' basic biology (Coolidge 1933).

It is reasonable to assume that in the first half of the twentieth century gibbons lived throughout Lao evergreen and semi-evergreen forests, from the level lowlands to the montane forests. Much of Lao PDR is mountainous but there is no indication that any areas would be unsuitable for gibbons simply on grounds of altitude: Delacour (1951) specifically stated that crested gibbons went right to the mountain summits in Indochina, they are known from up to 2287 m in Vietnam (Rawson *et al.* in press), and they occur up to 2900 m in Yunnan province, China (Bleisch & Chen Nan 1991). The highest mountain in Lao PDR, Phou Bia, rises only to 2820 m, and gibbons were recorded at *c.*2080 m on it by Kerr (1933). There are recent records of Lao gibbons up to 1800 m, and survey work has been too limited in higher levels to suspect that gibbons do not occur in them (sect. 2.3). Published information on altitudinal use from Vietnam was reviewed by Geissmann *et al.* (2000), and might be taken to suggest a more restricted range, at least by some taxa. However, in the original sources it is usually unclear whether statements were simply reflecting where animals were found, with no intention to indicate that they would not be found in other areas, were such to be surveyed, as distinct from stating explicit bounds on real occurrence. Geissmann *et al.* (2007: 46) did suggest, however, that "gibbons in Bach Ma [Vietnam] prefer lower altitude forest".

The extent to which gibbons historically occupied Lao deciduous forests is unclear. Recent patterns of habitat use and observations in other countries indicate that they would have been absent from deciduous dipterocarp forest, but probably at least locally present in mixed deciduous forest. Rawson *et al.* (in press) found Yellow-cheeked Gibbons in Mondulkiri province, Cambodia, and (through correspondents) in Cat Tien National Park, Vietnam, in mixed deciduous and even bamboo forest, but considered that at least patches of semi-evergreen forest are required. In their survey area these were mainly associated with river systems, and were possibly vital during periods of low resource abundance in more deciduous forests: extensive deciduous forests, without riverine semi-evergreen forest strips and hill-top semi-evergreen forest patches, seem to lack gibbons The same is quite likely to be true for Lao gibbons and mixed deciduous forest; by contrast, there is no suspicion that populations have ever lived in deciduous dipterocarp forests.

Some previously unpublished records from J.-P. Pedrono (verbally 2008), set in the context that in the 1950s–1960s gibbons were widespread and common, locally abundant, in much of Lao PDR, add to the historical record. Declines during the 1960s and 1970s were obvious, reflecting, at least partly, the number of soldiers living off the land. Decreases within available habitat were even faster between the late 1970s into the early 1990s. His specific records of note include:

1. Louangphabang province, 1971–1972: heard from the main road through the hills between Ban Singun (on the Nam Kan) and the Nam Min.
2. Vientiane province, 1956–1957: heard around the Chinese camp on the Nam Ngum, near Ban Nabong; probably occurring throughout the extensive band of forest into Dong Makheng and even to today's Houay Nhang. These animals disappeared within the next few years.
3. Bolaven plateau, 1958–1962: around the Houay Xai at P.K. 72 (17 km from Thatheng, 22 km from Paksong) excellent old-growth forest remained at 700–900 m, and was extensive even on the plateau. Here gibbons were heard as many groups, every day. Local sources reported that some remained into the 1970s.

2.3 Conservation status of gibbons in Lao PDR during 1988–1999

In surveys from 1992 to 1996 (almost solely south of 19°N), pale-cheeked gibbons were probably recorded across a wider geographical area than was any other diurnal primate (Ruggeri & Timmins 1997). This reflects their broad altitudinal range (sects 2.2–2.3; wider than any macaque other than, perhaps, Stump-tailed Macaque *Macaca arctoides*) as well as occurrence, through one or other form, across nearly the entire country. Perhaps most importantly, their loud calls facilitated more comprehensive recording than with monkeys. The further sites surveyed in 1997–1998 included several in the northern highlands, and Duckworth *et al.* (1999: 179–182) summed up the overall situation broadly as condensed here:

Gibbons were reported in 89% of 1988–1993 village interviews (*n* = 328), from across Lao PDR (Annex 5), and confirmed directly during field surveys in 28 of 31 (90%) forest survey areas; of the exceptions, in one (Nam Ha NPA) they were subsequently found to persist, another (Houay Nhang Nature Reserve, Vientiane) is a small, highly degraded, fragment next to the capital city, and the third (the Dakchung plateau) is rather degraded and was surveyed much less intensively than the other sites. Both interview and field survey sites were picked mostly on expected significance to mammal conservation, so it should not be inferred that gibbons persisted in 89–90% of Lao forests into the 1990s, but (leaving aside the difficulties of defining 'percentage', 'forest' and 'occupied') they clearly were at least well distributed

in remaining forest. They were recorded from the Mekong plains up to at least 1550 m in the Phou Ahyon area, 1650 m in Phou Louey NPA, and 1800 m in Nakai–Nam Theun NPA (Timmins & Vongkhamheng 1996a, Davidson 1998, Evans *et al.* 2000); surveys in higher areas were too limited to define actual upper limits of occurrence.

In many areas, gibbons were patchily distributed and seemed absent across logged or fragmented forest, through habitat destruction or hunting and other forms of human disturbance (Duckworth *et al.* 1995). Although Evans *et al.* (1996b) found small numbers in some areas of Dong Hua Sao NPA where Duckworth *et al.* (1995) had predicted them (on the basis of habitat) to be absent, the general conclusion, that numbers were severely depressed in encroached areas, was supported. Where somewhat protected from hunting (e.g. parts of Muang Sangthong), gibbons were persisting in heavily degraded areas, suggesting that decreases in the other encroached survey areas reflected hunting pressure rather than habitat factors (Duckworth 1996a).

Based on records of calling, highest population densities may have been in Xe Pian NPA, where calling was so intense around the Houay Kua each morning in May 1993 that it was difficult to distinguish individual calling bouts or, except for close groups, to estimate their bearing; these difficulties were also apparent on one of five mornings there in December 1992 (Duckworth *et al.* 1995). "The effect of continuous gibbon calling for about an hour each morning was a truly spectacular one and entirely unlike anything either observer had ever heard before" (Timmins *et al.* 1993b: 40) and–as further sites were surveyed–was ever to hear again in Lao PDR. This area's flat to gentle terrain helps calls carry a long way from all directions, hampering comparison with perceptions in rugged terrain (where high ridges may block out sound from a significant proportion of the 360° arc around the listener), as typical of most surviving Lao forest. Xe Pian NPA–Bolaven Southwest proposed NPA–Dong Hua Sao NPA, and the extensive forested parts of the Nam Theun catchment (notably Nakai–Nam Theun NPA) were assessed as of major global significance for gibbon conservation. North of the Nam Theun catchment, gibbons were rarer than to the south. In the northern NPAs, large populations were found only in Nam Xam NPA and parts of Phou Louey NPA. The pale-cheeked gibbons in Lao PDR were felt to be of major global significance, with Lao PDR supporting most of the world's remaining wild Southern and Northern White-cheeked Gibbons.

2.4 CURRENT CONSERVATION STATUS OF GIBBONS IN LAO PDR

2.4.1 Overview by region

Although there have been many fewer surveys in Lao PDR likely to generate gibbon records after mid 1999 than there were during the preceding decade, they are sufficient to indicate nation-wide declines. The following summary is synthesised from the site accounts (Appendix 1), where can be found more detail for each site mentioned, and references for the information used. Even in the South and Centre, gibbons may no longer be heard daily in sites where they were abundant or common into the 1990s, e.g. Xe Pian NPA and the Nakai plateau. Even so, large populations remain in various areas, e.g. Nam Kading NPA, Nakai–Nam Theun NPA and, probably, albeit at low density, Xe Pian NPA. Post-1999 information traced on several other populations, large in the 1990s, was insufficient to determine their current state: Phou Hinpoun, Xe Bang-Nouan, Phou Xang He, Dong Phou Vieng, Dong Ampham and Dong Hua Sao NPAs; Bolaven Southwest proposed NPA; the Nam Ghong and the Dong Khanthung areas. It is unlikely that populations will have been reduced below viability in many of these areas (Dong Khanthung is probably that at highest risk), but this is not to say that on current trends this will not happen in the mid-term future, or, if

landscape-level conversion of forest to plantation were to occur in the key areas, even in the short-term.

A marked differential remains between northern and southern Lao PDR, separated at about the Nam Theun–Nam Kading catchment. Recent information (including records where gibbons were not found) from North Lao PDR is highly compelling that this pattern is genuine. Field surveys since 1993 in all the NPAs of Lao PDR north of Nam Kading NPA (excepting Phou Phanang) found large populations only in Nam Xam NPA and parts of Phou Louey NPA. Extensive fieldwork in Phongsali province in 2004–2005, including Phou Dendin NPA and two forested provincial protected areas, found gibbons only once (sites and effort documented in Fuchs *et al.* 2007; see also Ruedi & Kirsch 2005). During surveys of rodents in 2000 and the following few years, K. P. Aplin (*in litt.* 2008) camped many nights in upland fields bordering forest of Louangphabang province and never heard any gibbons; he inferred that they were long ago shot out. Around this time, A. McWilliam (*in litt.* 2008) went into many rural areas with remnant forest in the northern highlands and never came across any gibbons. In Stuart Ling's (*in litt.* 2008) agriculture project sites in Muang Meung and Muang Paktha, Bokeo province, villagers aver that some Tigers *Panthera tigris* and Gaurs *Bos gaurus* (among the most decreased species in Lao PDR) persist, but not gibbons. Even if the reports of Tiger and Gaur are not perfectly up-to-date or even, for Tiger, certainly referable to that species, this contrasts with the 1990s situation in South and Central Lao PDR where huge populations of gibbons persisted in various forest areas within which big cats and Gaur were much decreased and even verging on local extinction (compare Appendix 1 with site accounts in Duckworth & Hedges 1998). In recent years J.-P. Pedrono has travelled through some remaining good stands of forest in the northern highlands which would surely have held gibbons in the 1960s, and heard none. Hamada *et al.* (2007) drove 1450 km through Houaphan, Louangphabang, Oudomxai, Louang-Namtha and Phongsali provinces during 22–31 May 2006 and in their rapid interviews at 46 villages perceived positive indications of gibbon presence at only 15–16 (the source's text and map are contradictory). All villages were along main roads, so were perhaps the least likely in the provinces to retain gibbons, and interviews were rapid: (fully 11 villages were covered on 27 May!), with no pre-arrangement (and to arrive unannounced in a village for a couple of hours during daylight is a good way to miss the people most knowledgeable about forest, and its wildlife: those who spend their days within it). Thus, information quality will have been patchy. Perhaps the most informative perspective is that lorises *Nycticebus*, macaques *Macaca* and grey leaf monkeys *Trachypithecus* were each reported at many more villages than were gibbons.

Of the several sites in and south of the Nam Theun–Nam Kading catchment that apparently held low populations even in the 1990s, all the extensive evergreen and semi-evergreen forest landscapes were against the Vietnamese border: Phou Ahyon, Xe Sap NPA, Hin Namno NPA and the Nam Theun Extension proposed NPA. Various report authors felt obliged to try to explain the low numbers in the particular area they were covering, usually fingering poor weather (depressing calling levels), brevity of survey (often combined with the weather), higher than (assumed) optimal altitude in which surveys had concentrated, or overhunting. The location of all these four areas along the Annamite spine suggests a real effect. That two other NPAs on the Vietnamese border both held large populations, even though in both (Nakai–Nam Theun NPA and Dong Ampham NPA) trade-driven hunting to supply Vietnamese traders was reportedly heavy, suggests something more than overhunting. High altitude cannot be the unifying explanation because surveys in Hin Namno NPA and the Nam Theun Extension proposed NPA were concentrated in middle altitudes and even in Xe Sap NPA much work took place at altitudes (1000–1300 m) where gibbons were demonstrably abundant in parts of Nakai–Nam Theun NPA. As clarified by

Steinmetz *et al.* (1999) for Xe Sap NPA and surroundings, the consistency of low numbers from different seasons and multiple teams effectively countered weather or bad luck as explanations for low calling levels. It is possible, therefore, that there is an underlying ecological effect, particularly as densities in Nakai–Nam Theun NPA seem highly patchy without obvious anthropogenic explanation (W. G. Robichaud *in litt.* 2008). One thing noticeable is that across these Annamite spine survey areas, there is almost no overlap of high gibbon numbers with Crested Argus *Rheinardia ocellata* (records as given in Thewlis *et al.* 1998, Duckworth *et al.* 1999, Steinmetz *et al.* 1999). This pattern may even hold within Nakai–Nam Theun NPA: along the Navang logging road in 1994–1996, Crested Argus was scarce but gibbons were common (Thewlis *et al.* 1998, Evans *et al.* 2000), and more broadly in the NPA, W. G. Robichaud (*in litt.* 2008) has noted a similar tendency for high numbers of both species not to overlap. This bird is one of the best, and seasonally most detectable, indicators of the 'eastern Annamites' ever-wet forest (Timmins & Trinh Viet Cuong 2001: Annex 10). Perhaps gibbon numbers are naturally lower in such forest than in the more seasonal ones predominating across Lao PDR. There is no good information after the 1990s from three of these four areas (Phou Ahyon, Xe Sap NPA and Nam Theun Extension proposed NPA), but decline to severely threatened status seems unlikely to have occurred, based on what has been recorded.

A less confident stance can be taken over populations that were already small in the 1990s, because habitat was restricted or discontinuous, notably Sangthong district and Phou Xiang Thong NPA. Small numbers, in general felt to indicate truly very low, or at least very localised, populations, were confirmed recently in several of the northern highland areas, Phou Khaokhoay, Nam Poui, Phou Dendin and Nam Ha NPAs; populations in the latter may be the closest to extirpation in any NPA other than, perhaps, the small and unsurveyed Phou Phanang. Populations in Nam Et–Phou Louey and Nam Kan NPAs are rather stronger. There is no post-1999 information from Nam Xam NPA: this is a severe gap because it had perhaps the highest density populations of gibbons in the northern highlands in the 1990s.

The biggest changes in gibbon numbers since the 1990s may well have occurred, undocumented, outside the NPAs: most blocks of forest of several hundred km² or more, no matter how degraded, probably retained gibbons into the 1990s, even those not included in the NPA system (Duckworth 1996a, Timmins & Vongkhamheng 1996a, 1996b, Showler *et al.* 1998a, Round 1998, Evans *et al.* 2000). Most such forest was never surveyed for wildlife at all. Conversion, fragmentation and degradation rates of these forests in the last decade have presumably been higher than of forests within NPAs. Nonetheless, villagers still report gibbons fairly widely in forests outside the NPA system and their are various direct encounters (e.g. Boonratana 2000, Robichaud *et al.* 2002, Poulsen *et al.* 2005, 2006, Hamada *et al.* 2007, C. Sisomphone verbally 2008; J.W.D.). The number of reports from parts of Muang Taoy, Salavan province, outside Xe Sap NPA suggests a good population there, in particular.

2.4.2 Overview by species

The following summaries are synthesised from the site accounts (Appendix 1), where can be found more detail for each site mentioned, and references for the information used.

2.4.2.1 White-handed Gibbon *Hylobates lar*

The status of White-handed Gibbon in Lao PDR may be perilous. Even in 1997, Boonratana (1997: 18) considered that it was "possibly rare" in Nam Poui NPA, the only NPA within its range. There are only two recent records, although search effort has been very limited. As with Pileated Gibbon, the possibilities of populations outside

one given area (Nam Poui NPA) have not really been investigated, and fuller consideration to the rest of Xaignabouli province (entirely west of the Mekong) is warranted, in case there might remain some large or at least readily conservable populations to be documented. Although Nam Poui is an NPA, it is reportedly under heavy logging, which is presumably accompanied by heavy hunting. Aside from at least one village initiative, there is presently no known active protection of White-handed Gibbon in Lao PDR.

Lao PDR's White-handed Gibbons are, globally, of limited conservation significance to the species, which has a large geographic range. Even the subspecies presumed to inhabit Lao PDR, *H. l. carpenteri*, has a large range, in eastern Myanmar and north Thailand (Groves 2001, Brandon-Jones *et al.* 2004); and there is no suspicion that it might constitute a cryptic species-level taxon, in contrast to the situation with *Nomascus*.

2.4.2.2 Pileated Gibbon *Hylobates pileatus*

There has been no search for Pileated Gibbon in Lao PDR since 1998. There is no national protected area within its small Lao range, although the Dong Khanthung area was recognised by every survey in the 1990s (Berkmüller & Vilawong 1996, Timmins & Vongkhamheng 1996b, Round 1998, Wolstencroft 1998) as of outstanding biodiversity conservation value, and reasonable populations of Pileated Gibbon remained into the late 1990s. Some of it now is of provincial protected area status, but much of the area is dry forest and savannah which held no gibbons even in the 1990s, and the condition of remaining forest suitable for gibbons is unclear. For reasons unrelated to gibbons (e.g. large waterbirds, vultures, wild cattle, Siamese Crocodile *Crocodylus siamensis*), conservation attention to South Lao PDR west of the Mekong has focussed almost entirely on Dong Khanthung, which constitutes (even at its maximum proposed extent) less than a sixth of the land area. The status of Pileated Gibbon in the rest of its Lao range was never evaluated. Much is heavily settled: Cox *et al.* (1991) found that around Phou Ilang (14°58´N, 105°38´E) even in 1991, the plains from the base of the Sayphou Damlek to the Mekong were densely populated. Even if habitat condition is generally poor, culturally-protected groups might persist. However, Khamhou Moukdala (verbally 2008) believes that there are no wild gibbons left in either Muang Champasak or Muang Phonthong (two of the four districts west of the Mekong in Champasak province). No active protection of Pileated Gibbon in Lao PDR is presently known.

The international conservation importance of Lao Pileated Gibbons was considered "probably relatively insignificant" by Phoonjampa & Brockelman (2008: 604), compared with numbers in Cambodia and Thailand; they estimated the latter at *c*.14,000 animals, spread over 7000 km² of suitable habitat, with c.30,000 animals in Cambodia following Traeholt *et al.* (2005). On a strictly numerical basis, this negative assessment may be reasonable: only *c*.500 km² (well under a tenth of the Thai area estimate) of suitable forest was estimated to remain in Lao PDR for this gibbon (Ruggeri & Timmins 1997).

2.4.2.3 Western Black Crested Gibbon *Nomascus concolor*

This gibbon is known from only two areas of Lao PDR. In Nam Ha NPA it seems on the verge of extinction, while Nam Kan NPA holds at least a viable population, potentially a large one, although few data are available since a spatially-restricted survey in 1999. Nam Ha NPA received significant management support from the mid 1990s for about a decade. As well as conventional protected-area management activities, an innovative link to tourism revenue was explored. Brown (2007) considered the tourism component failed to protect the area's gibbons, and it is difficult to read Brown (2007) without concluding that the more general management support also fell short of securing the area's broader conservation values. This is not to say that the project was ineffectual: in the light of rapid conversion and further fragmentation and

degradation of forest in the northern highlands, changes in Nam Ha NPA could well have been significantly worse had there been no support. The Nam Kan area was only recently declared an NPA (March 2008: B Phanthavong verbally 2008), after recommendation as such by Berkmüller *et al.* (1995a). Sustained conservation-related activity at the site has been led by an ongoing tourism venture, '*The Gibbon Experience*', which uses the presence of gibbons to attract visitors (Geissmann 2007b, J.-F. Reumaux verbally 2008). The project has not used development funding, and seems never to have been externally evaluated. As such, and as perhaps the only long-term Lao site-based conservation project that is consequentially securing gibbon populations, a better public understanding of project history and current situation would be a very valuable resource for any existing or future site-based gibbon conservation initiatives in the country. Gibbons are believed to be a good deal more widespread in the NPA than in the current tourism area (which is now a concession inside the NPA), although there are no details (J.-F. Reumaux verbally 2008). The gibbon identity in a wide area of the north-west and central parts of Lao PDR's northern highlands is unknown (Sect. 1.4), so other populations of this species might remain, although this cannot be assumed: across the area forest is fragmented, degraded and host to very heavy hunting.

The international conservation significance of Lao PDR's Western Black Crested Gibbons is very high. The species occurs otherwise only in Vietnam, where the situation is desperate (Geissmann *et al.* 2000, Le Trong Dat & Luong Van Hao 2008), and parts of Yunnan, China (e.g. Jiang Xuelong *et al.* 2006), which may hold about 150 groups (*per* P. Insua-Cao *in litt.* 2008). If the named subspecies *N. c. lu* is taxonomically valid (for which there is no real suggestion; Sect. 1.4), then it is probably endemic to Lao PDR.

2.4.2.4 Northern White-cheeked Gibbon *Nomascus leucogenys*

Pale-cheeked gibbons remain widespread in Lao PDR and, in total, very numerous. Assessing the conservation status of each constituent taxon is tricky, given the uncertainty as to each one's geographic range (sect. 1.4). Northern White-cheeked Gibbon is almost certainly the pale-cheeked gibbon species at the most national risk. Viable populations, identified as this species (through vocalisations) by T. Geissmann (*in litt.* 2008), and a prime expanse of forest habitat, remain in Nam Et–Phou Louey NPA, and at least formerly in Nam Xam NPA. The small numbers in Phou Dendin NPA doubtless belong to this form. Most of the northern highlands lacks information related to gibbon presence other than local reports. Pale-cheeked gibbons persisting further south, in at least Phou Khaokhoay NPA, are plausibly, based on proximity to the type locality of *N. leucogenys* (Muang Khi, Vientiane province; Fooden 1987), this species, but lack objective identification. Equally, gibbons further to the east but at similar latitudes, here treated under Southern White-cheeked Gibbon, in Nam Kading NPA and the Nam Theun Extension proposed NPA (see below), might be found to represent or include Northern White-cheeked Gibbon. If they did, particularly in all or a significant part of Nam Kading NPA, this would greatly increase the species's perceived Lao population. In this species's more safely assumed Lao range, Nam Et–Phou Louey is the only NPA currently receiving significant external management support, built around Tiger *Panthera tigris* conservation (e.g. Johnson *et al.* 2006a, 2008). The activities that secure Tigers incidentally ensure persistence of gibbons.

Lao PDR holds most of the world's remaining Northern White-cheeked Gibbons. The species may even be extinct in China (Geissmann 2007a), although Bleisch & Zhang Yingyi (2004) left the matter open. Yan Lu (*in litt.* 2008) has been able to trace no recent records of this gibbon from China. This has stimulated a search, ongoing at the time of writing: thus far, there have been no convincing recent reports from local people (Fan Pengfei *per* P. Insua-Cao *in litt.* 2008). In Vietnam it is now known only at

a few localities, and is imminently endangered there (Geissmann *et al.* 2000, Geissmann 2007a; B. Rawson *in litt.* 2008).

2.4.2.5 Southern White-cheeked Gibbon *Nomascus siki*

The taxonomic status of the large gibbon population in Nam Kading NPA has not been determined. Several large streams cross the NPA, offering the possibility that it might support more than one taxon: both the Nam Kading itself and the Nam Mouan are, in this area, wide enough to prevent all but exceptional dispersal by gibbons, and the Nam Kading divides different squirrel phenotypes (Timmins & Duckworth 2008). Following the speculation in Geissmann *et al.* (2000: 31), that the Nam Gniap–Nam Chian separate Northern from Southern White-cheeked Gibbons, Nam Kading NPA is treated under the latter species, although this is an essentially arbitrary decision. This large population's future is in jeopardy through the proposed Nam Theun 1 dam which, if built, will ease access into much of the NPA, the rugged hills of which currently deter access. Without excellent control of consequential human entry, therefore, a rapid decline of this population is likely (Timmins & Robichaud 2005). The same question-mark over identity should be seen over the gibbons in the Nam Theun Extension proposed NPA, at roughly similar latitude, but further east. There is no information on their current status, but they seemed not particularly numerous even in the 1990s.

If, as seems likely, Phou Hinpoun and Nakai–Nam Theun NPAs both support Southern White-cheeked Gibbon, this species is currently secure in Lao PDR. Both areas have positive features for long-term conservation. Because of its rugged karst terrain, it is impossible to imagine Phou Hinpoun NPA under any use except as a wilderness area: macroeconomic landscape-level habitat conversion is unlikely, although hunting, subsistence-level forest clearance and explosion to collect raw material for cement occur at local scales. Nakai–Nam Theun NPA forms the catchment for the Nam Theun 2 hydropower project and so there is strong economic justification for retention of forest; it has secured financial resources for decades (Nam Theun 2 Watershed Management and Protection Authority 2005). Finance is only one of many requirements for effective conservation, but at least this gives a base from which to strive. There may be other large populations of Southern White-cheeked Gibbon, but it is not known where the change to *Nomascus* sp. *incertae sedis* occurs. Based on tape-recorded calls (identified by T. Geissmann *in litt.* 2008), it could be as far south as Dong Phou Vieng NPA (no recordings available), but not as far south as Xe Bang-Nouan NPA in the west or Xe Sap NPA in the east (both singing like *Nomascus* sp. *incertae sedis*). If the range of Southern White-cheeked Gibbon spans from Nam Kading NPA in the north to Dong Phou Vieng NPA, as it might well be found to do so, it would probably be the most numerous gibbon in Lao PDR today and, as justified above, have the rosiest long-term conservation outlook.

Southern White-cheeked Gibbon is much more numerous in Lao PDR than in the only other range state, Vietnam (Geissmann *et al.* 2000), whence recent reports, albeit based on brief visits and non-random site selection, indicate low densities in some areas, including the flagship Pu Mat National Park (SFNC/EC 1998, Grieser Johns 2000, Ruppell 2008). In some other areas (e.g. Phong Nha–Ke Bang National Park) they may be less beleaguered (Timmins *et al.* 1999, Ruppell 2007). The global conservation significance of Lao Southern White-cheeked Gibbons is therefore very high.

2.4.2.6 Unassigned pale-cheeked gibbon *Nomascus* sp. *incertae sedis*

The most northerly specimen of a gibbon looking like Yellow-cheeked Gibbon is from Thateng on the Bolaven plateau (Geissmann *et al.* 2000). Somewhat further north, as assessed by field observations, gibbons in Xe Bang-Nouan NPA also show pelage features recalling Yellow-cheeked Gibbon (Timmins & Bleisch 1995, Evans *et*

al. 2000). Songs from this NPA and, at similar latitude, from Xe Sap NPA (recorded by A. J. Stones in early 1999) fit *Nomascus* sp. *incertae sedis*, not *N. siki* (T. Geissmann *in litt.* 2008). Based on identification through song, this gives a large area for *Nomascus* sp. *incertae sedis* in Lao PDR south right to the Cambodian border, within which some large tracts of forest remain. Despite recent declines in the Xe Pian NPA–Bolaven Southwest proposed NPA–Dong Hua Sao NPA population, total numbers must still be large. However, among these areas only Xe Sap NPA, the scarp of the Bolaven plateau, and small parts of Dong Ampham NPA have significant natural terrain-based protection. Resources currently deployed for conservation management are negligible, except at very local scales. This taxon's long-term future of in Lao PDR is therefore in question.

Investigation is not yet sufficient to characterise the taxonomic status of 'this' form, or even to confirm that 'it' is one set form, but 'it' lives over relatively large tracts of Cambodia and Vietnam (Geissmann *et al.* 2000, Traeholt *et al.* 2005, Konrad & Geissmann 2006). Numbers in Lao PDR are highly significant to the global conservation of 'the taxon', but less than for other pale-cheeked gibbons.

2.4.3 Concluding remarks on current gibbon status

Both west-of-Mekong taxa face uncertain futures in Lao PDR. Current status is known for neither, and site-based conservation action is wanting. Without decisive action in the next decade, needing decisions and planning now, these species may approach national extinction. From an international perspective, they are the most dispensable gibbons in Lao PDR: both have relatively large and well secured (by comparison with the international status of other gibbon taxa inhabiting Lao PDR) populations in other countries.

The Lao population of Western Black Crested Gibbon is of very high international significance and it is among the highest vertebrate species conservation priorities nationally. At least one ongoing conservation intervention is in place, but total numbers are probably dangerously low.

For two of the three pale-cheeked gibbons that it supports, Lao PDR unquestionably retains the majority of the global population: Northern and Southern White-cheeked Gibbons. Southern is secure into the mid-term, but Northern is probably not. The third taxon, *Nomascus* sp. *incertae sedis*, is relatively secure for the time being in Lao PDR, which, while supporting large numbers, may not hold the bulk of the global population. More precise evaluations require clarification of taxonomy and ranges.

Hence, internationally the fate of Western Black Crested Gibbon and Northern White-cheeked Gibbon warrant the most immediate attention, whereas Southern White-cheeked Gibbon and *Nomascus* sp. *incertae sedis* need solid foundations laid to forestall future crises. From a purely national point of view, to prevent the extinction of any gibbon species in Lao PDR, Pileated and White-handed Gibbons may both be as imminently threatened as are the two northern crested species.

2.5 THREATS TO GIBBONS IN LAO PDR

Lao gibbons can be expected to be threatened by hunting, which occurs at high levels throughout the country, for subsistence use of the animals and for trade (the balance differing between different sorts of mammals) and habitat loss. There is no precise evidence of threat levels.

2.5.1 Hunting

Harvesting seems to be the leading recent threat to gibbons in Lao PDR. As Geissmann *et al.* (2000: 98) stated, "the contribution of hunting to the dramatic

declines in primate populations in Vietnam is illustrated by the fact that, although significant areas of suitable habitat still remain in the country, even in the north, primate densities in these areas are very low". While gibbon densities are not yet 'very low' in many Lao forest tracts, populations are, widely and perhaps everywhere, below carrying capacity. Within Nam Kading NPA, villagers during 2006–2008 attributed hunting to be the lead cause of gibbon decline, whereas habitat change is likely to be the main problem outside the NPA (C. Hallam *in litt.* 2008). This distinction has probably pertained to much of the country over the last 15 years, although the two factors combine to reinforce each others' effect (sect. 2.5.4). Many cultural factors affect what is hunted, particularly in remote areas, but these may change with time. Consequently, what was seen in a village ten years ago may not be the same today.

Understanding the driving factors behind the hunting of a particular species, who does it, why, how, and when, and recognising that even for a given species these parameters vary between sites across the country and, at any given site, with time (reflecting both the annual cycle and directional trends) are vital underpinnings to any serious effort to reduce that hunting. Harvesting may be for village consumption, consumption by outside poachers, or outside trade: a single hunting event may combine uses, e.g. an adult eaten at home and the infant sold. Throughout Lao PDR, much hunting is opportunistic, for almost any vertebrate larger than a small passerine bird. Large, diurnal, conspicuous, animals like gibbons are therefore at high risk. Many people enter forest and even where their main purpose is not hunting (e.g. collecting plant products), they often carry guns so as not to miss any opportunity. Even directed hunting, which uses a wide range of traps and active direct searching, when for local use tends to be non-specific: what is taken depends upon what is encountered. There are also market hunters who enter remote areas to focus on particular species. Market hunting and trade are greatly more damaging to wildlife populations than subsistence hunting, so are treated separately in sect. 2.5.2, although the distinction is not absolute: someone out hunting for food, if encountering a species of market value, will take that and will often have the links to get it to the trade.

Hunting and eating wild meat is strongly ingrained in the cultures of many Lao ethnic groups, even when there is no dietary need for it and (as in urban situations) when it is more expensive than farmed meat (Srikosamatara *et al.* 1992): and hunting may be stimulated as much by habit as for any economic or health-related need (e.g. Duckworth *et al.* 1999, Hansel 2004; see also Tungittiplakorn & Dearden 2002). By contrast, in many rural areas, particularly hill regions where fishes are scarce and few livestock are reared, steep declines in wild animals mean that human health is suffering (Krahn & Johnson 2007). As in Vietnam (Geissmann *et al.* 2000: 97) the amount of gibbon meat in Lao diets is not well documented. Gibbons tend not to figure in investigations of non-timber forest product use and trade in Lao PDR (e.g. Ellis 1994, Clendon 2001, Foppes & Ketphanh 2001). Their low productivity means that they could not be of dietary significance to villagers but, equally, that off-take levels too insignificant for villagers to mention might drive declines. Over the country, gibbons were not obviously reported as a major village food species during 1988–1993 interviews (Duckworth *et al.* 1999: 13): although aggregated primates were among the three most common wildlife food items in 12.6% of 317 interviews, the larger proportion of these will probably have been monkeys. Moreover, primates were never the first preference item in 215 interviews (nine other sorts of wildlife were so designated by at least one village; six were forms of ungulates). This picture was borne out by several subsequent surveys. Although gibbons are eaten widely in Nam Kading NPA (Johnson *et al.* 2006b), in their perceived value to the village (including aesthetics, income, spiritual and 'conservation' values, as well as food), they fell in the bottom four out of 17 wildlife species discussed in two villages around the NPA (C. Hallam *in litt.* 2008). In Xe Pian NPA during 1992–1993, gibbons were seen fairly

regularly and easily. They usually fled quite quickly, but, in the more remote areas, only for a short distance. Individuals did not seem to respond to other group members' flight as would be expected if they frequently evaded hunters. Hunting of gibbons for food, whilst admitted by local villagers, was thus apparently still at a relatively low level (Timmins *et al.* 1993b). This was corroborated by Steinmetz (1997a), to whom villagers reported that gibbons in Xe Pian NPA were not a preferred food, were taken only opportunistically and were not traded as meat. Gibbon behaviour within the large forest blocks throughout South and Central Lao PDR in the 1990s suggested the situation at Xe Pian to be fairly representative of many other areas. By contrast, in Dong Ampham NPA, gibbons were, in many villages, ranked second only to Red-shanked Douc *Pygathrix nemaeus* in order of preference for meat (Davidson *et al.* 1997). Gibbons were also reported to be hunted and eaten avidly in the central Annamites (Robichaud & Stuart 1999). Gibbons were not cited by villagers in Nam Et–Phou Louey NPA as important for subsistence (Vongkhamheng 2002), although they are hunted for local consumption as opportunity permits; there is no trade out of the NPA and immediate surroundings (Aiyako Kandasak verbally 2008). Across North Lao PDR there seems to be little directed hunting for gibbons, as distinct from opportunistic off-take (J.-F. Reumaux verbally 2008) which, given the precarious remaining populations, is evidently very high.

Gibbon skins were seen in villages on wildlife surveys in the 1990s from time to time, e.g. in and around Nakai–Nam Theun NPA twice in 1994 (R. J. Timmins *in litt.* 1995). A very few households in Nam Ha NPA reported use of gibbons for medicine (Johnson *et al.* 2003a). No survey reported such uses in numbers to indicate a major off-take.

Gibbon remains were found (with various other wild animals) at a military camp along the Houay Khing, Nakai–Nam Theun NPA, active in wet-season 2000 (Boonratana 2001a) and the military were strongly implicated in heavy hunting in Nam Poui NPA (Boonratana 1997). It is probably safe to assume that wherever soldiers are stationed (and this includes a lot of remaining Lao forest, particularly in border areas), hunting is stimulated. Most or all villages in Lao PDR have village militia, legally issued with automatic weapons, and these are used for hunting (e.g. Johnson *et al.* 2006b), probably widely across the country. However, "many Lao hunters do not shoot gibbons because they believe gibbons are closely related to humans, and this traditional belief may help protect gibbons in some areas" (Baird 1993: 22). In Nam Theun Extension proposed NPA, an ethnic Toum villager told W. G. Robichaud (*in litt.* 2008) that he did not kill gibbons because they were 'too similar to people', while the two people were listening, from within the village, to gibbon song. Such sentiments go back a long way: Delacour (1934: 9) wrote that "les indigènes, pour la plupart, ne touchent pas à la chair du gibbon, que la majorité d'entre eux considère comme un petit homme sauvage" [most of the indigenous Lao do not take gibbon flesh; most consider gibbons as little wild men]. For many ethnic minorities in Lao PDR, gibbons traditionally carried hunting and postnatal consumption taboos: they were appreciated for their beautiful songs and were seen as reincarnated ancestors (Johnson 1985, Krahn 2005, Krahn & Johnson 2007), but these are by no means universal, e.g. the Khmu people have traditionally hunted gibbons (Halpern 1960) as have the Laven, on the Bolaven plateau (J.-P. Pedrono verbally 2008). While far from assuring widespread safety for gibbons, at a fair number of known sites such beliefs seem responsible for persistence of some gibbon groups and may retain high-density populations, albeit only in small areas: Table 3 lists those 'discovered' so far, but there may be many others. All sites identified lie in North Lao PDR, but in the South and Centre small preserved populations are less likely to be noticed, given the generally better surviving populations. Notably, in the south, villagers reported to Steinmetz (1997a) a moderate level of cultural protection to gibbons in Xe Pian NPA.

Table 3. Sites where significant or possibly significant cultural protection of gibbons is reported.

Site	Area	Species	Source	Protection level
Hmong villages	Nam Kan NPA	*N. concolor*	Geissmann 2007b; J.-F. Reumaux verbally 1998–2008	Good
Ban Buamfart	Nam Et–Phou Louey NPA	*N. leucogenys*	C. Vongkhamheng *in litt.* 2008	Good
Ban Sakok, 20°11´N, 103°12´E	Muang Viangthong, Houaphanh province	Unknown	Hamada *et al.* 2007	Unknown
Ban Sapi	Xaignabouli province	*H. lar*	J.-F. Reumaux *in litt.* 2008	Good
Ban Wangma and surrounds	Sangthong district, Vientiane municipality	Unknown	Duckworth 1996a, 1996b	Good (1996); presently unknown
Ban Phoukathap	Phou Khaokhoay NPA	Unknown	J. W. K. Parr verbally 2008	Good
Ban Namyouk	Nam Gniap catchment	Unknown	M., S. and A. Watson *in litt.* 2000	Unknown
Ban Phonkham	Muang Bolikhan, Bolikhamxai province	Unknown	Anon. undated, C. Hallam *in litt.* 2008	Good
Ban Phadai	Muang Bolikhan, Bolikhamxai province	Unknown	C. Hallam *in litt.* 2008	Good
Ban Khontao	Muang Viangthong, Bolikhamxai province	Unknown	C. Hallam *in litt.* 2008	Good

This table excludes areas where cultural protection is reported but is known not to have prevented declines to very low levels. 'Good' indicates that gibbons can be heard from village houses in areas where on habitat grounds this would not be expected, and/or are confiding to people's approach when levels of human traffic would push them to terror were no significant protection in action. (By contrast, in remote blocks of little-encroached forest, or villages in such areas, gibbons may show these traits in the absence of any cultural restraints.)

All the 'unknown' sites are likely to hold pale-cheeked gibbons, most or all of which may (especially outside Bolikhamxai province) be *N. leucogenys*.

The extent is unclear to which, if at all, local beliefs about not hunting gibbons extend to not converting their habitats. These taboos are doubtless weakening with changing attitudes among the youth, and in regions of human in-migration, which include many frontier areas retaining gibbons, new settlers are unlikely to share the residents' beliefs. Thus, legal protection status of gibbons was cited by residents in Sangthong as also significant in preventing gibbon hunting (Duckworth 1996b), and the rules for Phou Khaokhoay NPA (Parr 2001) provided for a specific gibbon conservation zone around the culturally-protected population (Article 12) where a main feature is a system of information exchange, whereby villagers aware of outsiders actually or potentially hunting in the zone (not necessarily likely to be found by NPA staff) will report them to NPA staff who will investigate and evict any malefactors (an action beyond the control of the villagers). Similarly, around Ban Phadai (Bolikhamxai province), after interaction with WCS, the village set up a formal gibbon conservation area (C. Hallam *in litt.* 2008). External support in dealing with outsiders, preferably

involving formal village-to-village agreements, may be needed with all culturally protected populations (S. Vanalath verbally 2008). In Nam Ha NPA, village taboos regarding gibbon hunting were reported in seven of the eight villages questioned, but hunting is severe, and interviewees themselves stated the need for gibbon hunting regulations and their enforcement (Johnson *et al.* 2005). Similarly, in Nam Et–Phou Louey NPAs, a number of Hmong villages had strong protective beliefs but these did not prevent heavy hunting of gibbons for food by insurgents (1995) and a Lao–American development project (C. Vongkhamheng *in litt.* 2008). Sustained involvement of outside bodies can encourage villagers to reduce killing of gibbons, e.g. in the villages where the Co-Management Learning Network Project (implemented by the Global Association for People and the Environment, with Xe Pian NPA) works (Ban Kaxe, Ban Phonsaat, Ban Don and Ban Pakbo; Muang Sanamxai, Attapu province), villagers now conserve the gibbons. Only soldiers sometimes kill them (Somphong Bounphasy and I. G. Baird *in litt.* 2008).

Wide collection of guns from civilians in recent years (for civil order purposes) surely has changed hunting patterns, but no assessment was traced. Gun use is still widespread, with regulations circumvented in various ways (e.g. Hansel 2004), and anyway even after gun collection some guns are retained legally in each village, allowing opportunities for hunting by the gun-holders and their friends. W. G. Robichaud (*in litt.* 2008) considers that "in many areas these legal guns may be the greatest threat to gibbons within walking distance of the village". Nonetheless, the situation typical across Lao PDR in the early 1990s, where most groups of people in the forest for whatever reason used guns capable of downing gibbons (e.g. Thewlis *et al.* 1998), has changed, although in some (many?) areas many guns remain in open civilian use, e.g. Phongsali province (Fuchs *et al.* 2007). Decline in day-time gun use (the chief hunting threat to gibbons) seems likely to have spurred compensatory rise in trapping and perhaps shooting by night, to both of which gibbons are largely immune. Tree snares are used for doucs in Vietnam (Streicher 2004); no mention was made whether they also catch gibbons, or if other ways of trapping gibbons exist. No evidence of gibbon trapping in Lao PDR. was traced. Thus, even if overall hunting levels have not changed much in Lao PDR, changes in its style mean that pressures on gibbons probably have declined, at least locally.

2.5.2 Trade

Trade is often stated to be a major threat to Lao gibbons (e.g. Donovan [1998] listed gibbons as a 'major' wild animal entering the international wildlife trade from Lao PDR) and thus a priority to tackle. To use conservation resources effectively, it is imperative to determine whether it truly is a significant threat, and, if so, its underlying cause(s). Most pertinent sources simply state that gibbons were seen in trade, domestic or international, or imply, by absence of their mention, that they were not. Few give any discussion whether such trade could be driving declines. Most trade with Lao PDR's immediate neighbours occurs without report to the Convention on International Trade in Endangered Species (CITES) or anywhere else, and the evidence for such trade of Lao gibbons is insufficient to profile with confidence what seem to be quite complex patterns.

2.5.2.1 Purposes of trade

Gibbons are traded for two main reasons: young animals for captives (= 'pets') and bones for perceived medicinal purposes. There is no evidence of any meat trade outside the village in Lao PDR (sect. 2.5.1) and, for example, J.-P. Pedrono (verbally 2008) has never seen a gibbon in a Lao meat market despite numerous visits to them since the 1950s.

While regrettable from a compassionate standpoint whenever a mother gibbon is shot to allow capture of her infant, this is a conservation issue only if frequent enough to depress populations not otherwise doomed. Nijman (2006) concluded that the large trade in young gibbons in Borneo was an opportunistic by-product of ongoing massive habitat destruction, which displaces gibbons, so people supplement their income by trading them. Curtailing such trade will therefore achieve little, directly, for gibbon conservation (although indirect effects, such as broader public education, or forestalling a hypothetical future fashion for pet baby gibbons, might still be profound). Domalain (1977: 16) held zoos and private collections responsible for "dramatic declines" in the 1960s–early 1970s in wild gibbons, but this is inconsistent with his other statements, that he had a "virtual monopoly" of export of Lao gibbons to the West (p. 84), that he exported "over three hundred" (p. 16) in his four years of activity, and that for each young traded on, ten others die (p. 44). Equating Domalain's *c*.350 exports with perhaps 7000 gibbons lost from wild populations (at 20 deaths per captive infant; Nettelbeck *et al.* 1999), even if most came from Lao PDR (for which he makes no suggestion or implication), this rate (*c*.1800 per year) is surely insignificant compared with all gibbon deaths per year then across the country. Bangkok dealers sold gibbons for USD *c*.200 per animal at that time (p. 64); at this high price they could not have been common pets within South-east Asia.

Geissmann *et al.* (2000: 97) considered that hunting to manufacture traditional medicines "may constitute the most serious threat for survival of gibbon populations" in Vietnam. Bones are also used to treat rheumatism in China (Bleisch & Chen Nan 1991). Given the current general scarcity of gibbons in these two countries, such use could stimulate gibbon trade from Lao PDR, if it has not already done so, through the already excellent wildlife trade links to them from Lao PDR (e.g. Compton *et al.* 1999, Donovan 1998, Su Yongge 2000, Nooren & Claridge 2001, Li Zhang *et al.* 2008, Nguyen Van Song 2008). Domestically, Baird (1995: 11) traced no use specifically of gibbons in an overview of Lao medicines derived from wild biota, but lowland Lao used 'monkey and langur bone' (which might plausibly include gibbons) as an item that "cures fever; improves blood; increases strength; cures disease that makes people thin; cures tiredness; cures tendon pains; cures gonorrhoea". This is evidently quite restricted (S. Vanalath verbally 2008), if it still occurs at all.

2.5.2.2 Domestic trade

Three short surveys of market wildlife in Lao PDR, Martin (1992), Brooks & Sørensen (2001) and Bounma Vongxay (verbally 2008: 2007–2008, North Lao PDR), found no evidence of gibbons or other diurnal primates but each was short enough to have overlooked them. In Attapu province, Singh *et al.* (2006) found diurnal primates (doucs *Pygathrix*, grey leaf monkeys *Trachypithecus* and macaques *Macaca*) prominent in trade, suggesting gibbons, for which they had no records, to be, at most, rare in open trade. It might also indicate gibbon trading to be clandestine (implausible, given naked trade in other primates), wild gibbons to be now too rare in the source areas for regular trade (also perhaps unlikely: in any given survey area in Lao PDR or Vietnam within the range of both, the local status of doucs and gibbons is usually pretty similar; R. J. Timmins *in litt.* 2007), or that they are highly favoured and sold as soon as offered (in which case there should surely be more instances of trade detected, especially from the village end).

Several more substantial market studies made similar findings. A compilation of mammals observed in markets, shops, restaurants, zoos or otherwise in trade in Lao PDR during 1988–1993 included gibbons only as 'zoos' and only in the region composed of Xaignabouli, Vientiane, Vientiane Municipality, Xiangkhouang and Bolikhamxai (Duckworth *et al.* 1999: Annex 1). Nooren & Claridge (2001) in the most exhaustive compilation yet about wildlife trade in Lao PDR, including much new

information, apparently detected no gibbons in trade. Despite plenty of other wildlife, 83 patrols in Vientiane Capital City in February–June 2004 found no gibbons for sale (Hansel *et al.* 2004b), nor did further patrols in April–October 2006 (Stenhouse *et al.* 2006). It is impossible that gibbons, except as small parts, were misidentified: no diurnal primates at all were found. Soubanh Silithammavong and A. Johnson (*in litt.* 2008) checked all unpublished records held by this ongoing project and found no gibbons and very few monkeys. Khamxamay Soukphengxy (verbally 2008) also knows of no gibbons having been found in markets in and around the capital. Over the last 10 years, staff and associates of the WCS Lao programme have recorded and photographed instances of road-side wildlife trade wherever possible and a search through the extensive results (*c*.1200 images) found no indications of recognisable gibbon trade (A. Johnson *in litt.* 2008).

Ban Keun zoo, Vientiane, held a varying number of *Nomascus* gibbons from its establishment in the mid 1990s until the present, and captive gibbons have been noticed across the country. The collated records (Appendix 2) are no doubt highly incomplete, because pets were not generally in formal wildlife survey areas, and so never appeared in reports. Hansel *et al.* (2004a: 5) wrote that "many" gibbons are sold as pets in Lao PDR. Hamada *et al.* (2007) observed no pet or captive gibbons in a drive 1450 km through Houaphan, Louangphabang, Oudomxai, Louang-Namtha and Phongsali, with interviews at 46 villages during 22–31 May 2006, despite specific searches for pet primates. Their unannounced arrival at any time of day into main-road villages is among the best ways to locate pet gibbons, so their lack of records suggests genuine low incidence in that region. J.-F. Reumaux (verbally 2008) also considers that there are few captive gibbons in North Lao PDR. The contrast with numbers of captives in Vientiane and southwards (Appendix 2) probably reflects current rarity of gibbons in the northern highlands, not any disinclination to keep them captive there. The places where pet gibbons were seen fit into several classes: (1) restaurants, hotels and shops, where the animals are presumably often intended as curios, which might tempt a wavering passer-by to enter and purchase, particularly in tourist areas and beside main roads; (2) wats (= temples), apparently as part of their pastoral role, as found elsewhere in the region (e.g. Eudey 1994, Medhi *et al.* 2007); (3) menageries and zoos; and (4) 'pets' in private houses, mostly, it seems, those of foreigners and affluent Lao citizens. Captives in rural villages were rarely seen (particularly given the heavy survey effort relative to other human habitats) and were all or mostly of young animals perhaps not in long-term position; some were explicitly for sale. Not all animals kept by commercial ventures were prominently on view, however: at Ban Napong the animal was easily visible from the road when found, but the next year the cage had been moved to behind the restaurant (J. Johnston *in litt.* 2008). Several temples within and around Vientiane have kept gibbons over many years. Wat Thampulosi (= Wat Pamai or Wat Mai), near Ban Mai (17°59′N, 102°28′E) is set amid secondary forest and scrub. C. Mossberg (*in litt.* 2008) reported perhaps ten wild-living gibbons some years ago, with some present in 2007. Therefore, a short visit was made on 22 August 2008. Two gibbons remain, both free-living, but incapable of foraging for themselves. There were formerly more, as well as free-living monkeys. All gibbons were brought from outside and released in the wat grounds, a practice strongly driven by a single former monk. He is no longer at the wat, which is now reducing the numbers of monkeys and gibbons because they do not really want them: they have bitten people or electrocuted themselves by chewing wires.

The conditions of many captive gibbons make it difficult to apply the word 'pet'. That in the private house at Ban Donmen, Vientiane, in 1999 was in a cage of 1½ m³ (T. Geissmann *in litt.* 2008), the two at Ban Napong were in a cage of only *c*.2×1×1 m (J. Johnston *in litt.* 2008), while those three animals then in Wat Simouang were all together in one cage, with the wooden planks so close that the gibbons could not see

much of their surroundings (T. Geissmann *in litt.* 2008). Later there a pale-cheeked gibbon (young in 2001) died when its arm became infected having been bitten by a Binturong *Arctictis binturong* in the next cage (M. Sly *in litt.* 2008). The two gibbons at Wat Thampulosi, Vientiane, August 2008 were subjected, for the entire 20 minutes they were watched, to a rain of sticks, stones, empty plastic bottles and other debris by a resident lout, who evidently felt his 'daredevil' antics would amuse the visitors. However, sympathy for the animals was quoted by the owner of the Paphai Guesthouse, Louangphabang, as the motivation for nearly buying three young gibbons offered for sale to her in 1998 (T. Geissmann *in litt.* 2008). And a captive acquired when very young by a civil servant in Muang Kaleum in 2007 is allowed to roam freely in the trees around the house, coming down for fruit a couple of times a day, and the owner has made clear he will not sell it, but needs instead to look after it (E. Meusch *in litt.* 2009).

The demand for captives is sufficiently strong that foreigners, when expressing general interest in gibbons to villagers, may be asked if they want to buy them. Local opportunists 25 km from Ban Sapi (Xaignabouli province) enquired thus of J.-F. Reumaux (*in litt.* 2008) in May 2007, as they did of C. Hallam (*in litt.* 2008) in 2007–2008 in Bolikhamxai province. Even allowing that recording of captives is highly incomplete, and that 20 other gibbons may be lost per captive (Nettelbeck *et al.* 1999), it seems unlikely that this level of domestic use is a significant drain upon wild populations at the national level. It might, however, threaten individual populations, particularly small ones (e.g. Nam Ha NPA).

2.5.2.3 Trade out of South-east Asia and with Cambodia and Myanmar

Nash & Broad (1993) analysed 1983–1990 CITES records (during which all gibbons were subject to report), and found reportedly from Lao PDR only 21 White-handed Gibbons imported by USSR. This does not prove their origin: various other species 'originating in Lao PDR' cannot possibly have done so, e.g. several primates endemic to the Sundaic subregion (Duckworth *et al.* 1999: Annex 2). But, CITES records do, however, indicate that legal trade into western countries is limited. Illegal trade, not (by definition) reported to CITES, may be much more significant. A news release from the U.S.A. dated 13 May 2008 and entitled "2 east metro women indicted on smuggling wildlife, possessing anabolic steroids" (USDJ 2008) stated that at a booth in the International Marketplace, St Paul, U.S.A., wildlife in trade was seized, including gibbons. There was a Lao connexion in supply, whether or not those specific gibbons originated in the country. Whether such trade threatens populations is unclear. The mammalogist of the U.S. National Fish & Wildlife Forensics Laboratory remembers 2–3 cases in the laboratory's history that included gibbons from Lao PDR, but the laboratory sees only a very small fraction of wildlife entering the U.S.A. (B. W. Baker *in litt.* 2008). International tourists seem largely unaware of regulations concerning wildlife trade in Lao PDR and for export outside (Starin 2008), and so some gibbons or their parts may leave with such people, without notification to CITES.

Gibbons were imported in high numbers, for pets, to Taiwan in the 1980s until the Conservation Act in 1989. Of 83 recorded by a 2002 survey of captives, only one was a Pileated Gibbon and seven were *Nomascus*, but four of these were Yellow-cheeked Gibbons (Chen *et al.* 2004). Lao PDR was evidently not major source country for Taiwan.

During repeated visits to menageries and zoos, official and illicit, in Cambodia in the last decade, D. Ware (*in litt.* 2008) saw no captive gibbon that was certainly from outside the country, i.e. was neither Yellow-cheeked Gibbon (for this purpose, including *Nomascus* sp. *incertae sedis*) nor Pileated Gibbon. An end destination of Myanmar for any significant number of Lao gibbons seems implausible, and neither

Srikosamatara & Suteethorn (1994) nor Davidson (1999b) mentioned gibbons among the heavy wildlife trade at Tachiliek, on the Lao–Thai–Myanmar border. This leaves Thailand, Vietnam and China as the most likely risks for population-threatening trade of Lao gibbons.

2.5.2.4 Trade with Thailand

Gibbon trade from Lao PDR to Thailand was probably significant up to the early 1990s. Martin (1992) stated that it occurred, and Srikosamatara *et al.* (1992) presented several proven or likely cases: a high-ranking Thai civil servant in Phon Pisai (by the Mekong) reputedly bought a pale-cheeked gibbon in 1991, brought over from the Lao side, quite plausibly Phou Khaokhoay NPA, and when Srikosamatara himself visited this forest (not then a protected area) in January 1991, he (as, presumably, an obvious Thai) was asked by a local villager whether he wanted to buy any gibbons; a vendor at Amphoe Muang, Nakhon Phanom province (opposite Thakhek) said that gibbons were sometimes sold; one at Amphoe Muang, Nakhon Phanom province (opposite Savannakhet) said that live animals could be supplied to order, offering Red-shanked Douc by example, but presumably the options would include gibbons; and at the Chong Mek border crossing (close to Pakxe) a vendor had a poster to facilitate ordering of wildlife, depicting, among the species available, gibbons. An informant near Phou Xang He NPA in 1993 claimed that hunting of mammals for markets was widespread in the south-east of Sayphou Xanghe; female gibbons were said to be shot to collect their young for sale at the Ban Phalan market (30,000 kip per animal; then = USD40) whence they were resold to Thai buyers (Phanthavong & Dobias 1993). Baird (1993) reported that primates were smuggled out of Pakxe to Chong Mek, carried individually so that it could be said, when passing the Lak 7 police post, that they were personal pets. Thai traders in Chong Mek said gibbons could be ordered from Lao traders and delivered to buyers on request. Tunhikorn *et al.* (1994) knew of 34 crested gibbons in Thailand held in larger collections Thailand in 1993–1994, but the total number of gibbons documented in these collections was only 377 of the 2550 then estimated in Thailand. The others were not split according to species, but taking a similar ratio, it would suggest about 250 captive crested gibbons then in Thailand: and as the genus does not occur in the country at all, all must have been imported or bred from imports. Thailand has a longer border with Lao PDR than with any other *Nomascus* range-state. J. Murray (*in litt.* 2008) considers that infant gibbons were much traded in Thailand into the early 1990s, but sees them as a by-product of forest activity by loggers, *Aquilaria* harvesters, and hunters shooting for the pot, stating that the new Thai wildlife law in March 1992 (see Morin 1995) sparked such public panic over the presumed sudden illegality of captive wildlife that lorises were being released in Bangkok parks. In essence, the large trade depended on the almost unhindered public display of animals for sale, and when that was restrained, by 1994, gibbon trade (although not that in lorises and doucs) to urban and tourist centres collapsed. Border regions continued to find sentimental impulse buyers for a few more years. This timing accords with the afore-cited several reports and apparent absence in subsequent ones of mention of gibbon demand from Thailand. Most noteworthy is the fit with Steinmetz's (1997a) finding that villagers reported a gibbon pet trade out of central Xe Pian NPA (close to Pakxe and with good links to Thailand) in the late 1980s–early 1990s, which had diminished greatly by 1996. Similarly, people in and around Nam Kading NPA said in 2006 that gibbons were previously sought for the pet trade, but this is now opportunistic (Johnson *et al.* 2006b). W. Y. Brockelman (*in litt.* 2008) concurs that there is now rather little trade in gibbons in Thailand, and knows of no captive *Nomascus* there excepting a few in zoos, where they have been breeding well (*per* J. Murray *in litt.* 2008). Current gibbon demand from Thailand would thus appear negligible.

2.5.2.5 Trade with Vietnam

Many sources indicate gibbon trade from Lao PDR to Vietnam. Bones and infants (for pets) leave from Dong Ampham NPA (Davidson *et al.* 1997). Exploitation of Nam Xam NPA's wildlife was considered by Showler *et al.* (1998b) to be exacerbated by a thriving market on the Vietnam border, due east of Viangxai, and a mere 8 km north of the NPA boundary. Vietnamese traders came to this market and NPA villages to purchase wildlife, primarily for use in medicine, but also animals such as young gibbons for the pet trade. Villagers in the east of the NPA revealed that Vietnamese traders passed through some villages almost daily. Ban Dan villagers said that such traders paid 50,000 kip (USD *c*.10–20; equivalent to the price per kg of live pangolins) for a young gibbon. Trade in primates to Vietnam from Nam Xam NPA still occurs but levels are now lower, perhaps simply reflecting decreased source populations (Aiyako Kandasak verbally 2008).

In the Nam Theun Extension proposed NPA, Vietnamese traders during 1997–1999 sought firstly turtles (Chelonia) and pangolins *Manis*, with gibbons, doucs and otters (Lutrinae) in the next band of desiderata; Lao questioned around the Nam Chat in 1997–1998 repeatedly talked of incursion by armed Vietnamese poachers specifically seeking diurnal primates (Robichaud & Stuart 1999). A survey in Lao PDR in April–May 1998 found that gibbons were coming through Bolikhamxai province, but because they were only very rarely detected, "it [was] assumed that they are transported with great secrecy" (Compton *et al.* 1999: 4); it is not discussed how it was clear that they did not simply come only infrequently. A trader in on the Vietnamese side, in Huong Son, told Compton *et al.* (1999) that he could obtain gibbons from Lao PDR (VND 1.5 million [USD *c*.115] per baby), and another two small shops "provided information on three gibbons" (p. 13) for VND 2 million per animal (USD *c*.154). More recent evidence suggests that these earlier assessments much overestimated the level of trade in gibbons along this route, or alternatively that it has collapsed, despite ongoing huge volumes of animals like turtles and pangolins. Phoukhong Panyanouvong (verbally 2008), head of the Ban Lak-20 (= Lak Xao) branch office of the Nam Theun 2 Watershed Management and Protection Agency, who has overseen confiscations of wildlife at this important trade node for three years to date, has never seen any live or dead whole gibbon in any consignment, although gibbon bones might plausibly be among the unspecified 'monkey bones' transported along this route. Around Hin Namno NPA, where gibbon bones are sought, there is no evidence of trade demand for live gibbons (P. Phiapalath verbally 2008).

Evidence of transport of live primates from Lao PDR to Vietnam comes from the receipt of a Lao Leaf Monkey *Trachypithecus francoisi laotum* at the Endangered Primate Research Center (see Nadler 1996, Dang Huy Huynh 2004): this taxon occurs only in Lao PDR. However, only one has arrived over the *c*.15 year history (U. Streicher verbally 2008). There is no other evidence of significant volumes of live primates leaving Lao for Vietnam, and T. Nadler (*in litt.* 2008) and U. Streicher (verbally 2008) both doubt that they do.

The situation with Vietnam-bound trade in gibbon bones is much less clear. Bones of monkeys and gibbons are highly sought in Vietnam for manufacture of medicinal 'balm' or 'glue' (Nadler *et al.* 2004), especially in and north of the Phong Nha limestone block (B. Long *in litt.* 2008). The bones of different higher primates (gibbons, macaques and colobines) are sought indiscriminately (B. Long *in litt.* 2008) and they are mixed and traded together around Hin Namno NPA (P. Phiapalath verbally 2008. Reports from several eastern border areas of Lao PDR indicate a high demand and it is clear that at least locally this is a significant threat. Around Hin Namno NPA, Phiapalath & Suwanwaree (in prep.) estimated that from eight study villages there went to Vietnam in 2007 four gibbons (compared with 750 colobines, about 2:1 doucs :

François's Leaf Monkeys s.l.). People in and around Nam Kading NPA identified middleman demand (by traders primarily seeking scrap metal) for gibbon bones for Vietnam as ubiquitous, the sale price being about 50,000 kip per 1 kg of bone (Johnson *et al.* 2006b). Several informants (some requesting anonymity) stated that bones tend to go direct from the hunter to the small-scale Vietnamese trader, and are carried across the border manually in rucksacks. Detection in vehicles is thus unlikely. The hunting of gibbons involves guns, so the Vietnamese themselves rarely engage in it (penalties of being caught with a gun are far higher than for snaring), but pay Lao, often ethnic minorities, to shoot gibbons for them.

The Education for Nature – Vietnam (ENV) Wildlife Crime Database has a total of 27 cases involving gibbons in trade so far. None of these was identified as having a Lao origin (Tran Thu Hang *in litt.* 2008).

2.5.2.6 Trade with China

Gibbon trade with China is even less well clarified than with Vietnam. Dried bits of *Nomascus* gibbons were seen for sale in Yunnan in a trade survey in the 1990s (Li & Wang 1999), but in a study then of wildlife trade across the Lao–China border, the 56 species of mammals detected included no gibbons (Yang Qing *et al.* 2000). Identifications such as Slender Loris *Loris tardigradus* and Red Deer *Cervus elaphus* indicate that the trade included farmed animals, animals from far away from South-east Asia, and/or misidentifications, but the results do suggest that gibbons were not traded in volume from Lao PDR over the routes studied. China now has many 'wildlife display parks' as well as formal zoos (J. Compton *in litt.* 2008); gibbons are always popular in such places, but there has been no investigation of change in trade demand. As U. Streicher (verbally 2008) points out, the many captive gibbons in southern China include a significant number of *N. leucogenys* and *N. siki*; the latter cannot have come from within China and the former probably did not. There could be significant trade of Lao gibbons into China.

2.5.2.7 Concluding overview concerning gibbon trade

The inconclusive results concerning trade with neighbouring countries can be cross-checked by examining village demand: if the trade in gibbons is strongly demand-driven, this should be well known, and acted upon, among villagers widely in Lao PDR. Investigations at the village end generally suggest low trade demand, recognising that the balance between eating killed gibbons at home (sect. 2.5.1) and selling them reflects various factors such as the ethnic group (C. Hallam *in litt.* 2008). Foppes (2001: 17) wrote that "some products in Nakai–Nam Theun NPA have been harvested so intensively that they are almost finished... e.g. certain wildlife species (e.g. gibbons). These are all commercially harvested products, and their depletion is a direct result of market penetration". This statement is spurious, at least with respect to gibbons: they remain widespread and locally numerous in the NPA, including around the village (Ban Navang) which Foppes (2001) credited with deploring recent population collapse (see site account). Villagers in Nam Et–Phou Louey NPA reported in 1998 that gibbons are occasionally hunted for the pet trade (Davidson 1998), but gibbons were not cited by villagers in there as important for trade revenue (Vongkhamheng 2002); and by 2008 Aiyako Kandasak (verbally 2008) and T. Saythongdam and colleagues (verbally 2008) all felt that trade-driven pressures here are low. Demands from areas such as Nam Kading and Hin Namno NPAs seem to be somewhat higher (sect. 2.5.2.5), but still not enough to have made gibbons difficult to find in these areas.

High trade demand would presumably be reflected in high asking prices. There is no evidence for these. Around Hin Namno NPA, gibbon bone prices went from about USD 1 to USD 6 per kg between 2004 and 2008, the same as the prices for colobines and monkeys; this is in the same order of magnitude as the per-kg price of deer

(Cervidae), wild pig *Sus* and porcupine *Hystrix* / *Atherurus* meat, and is less than a tenth of the price for conventionally high-value wildlife such as pangolins *Manis* (Phiapalath & Suwanwaree in prep.). A young gibbon in Ban Siangkin (Nakai–Nam Theun NPA) was offered, presumably opportunistically, for kip 30,000 (then USD *c*.35) in 1994 (R. J. Timmins *in litt.* 1995). In the Nam Chat area of Nam Theun Extension proposed NPA, in 1998, the asking price for infants was kip 60,000 (USD 24) and for bones, kip 2000 (USD 0.80) per kg. In 1997, prices (taken from WCS 1997) were for infants USD 6 per animal, and for bones USD 1.50 per kg (Robichaud & Stuart 1999). Wild changes in exchange rate (the 1997 Asian currency slide occurred in the interim) forbid any conclusions from the differences between years, but the Lao informants repeatedly indicated that live primates were specifically sought for Vietnam (W. G. Robichaud *in litt.* 1998). A single live gibbon at Ban Nahin (route 8A; the operations site of Theun Hinboun) had an asking price of 3000 baht (= USD *c*.70) in 1998 (Compton *et al.* 1999). Sales prices seem now to be generally low: although during 2007–2008, J.-F. Reumaux (*in litt.* 2008) was offered gibbons by traders for 3,000 baht (USD *c*.90) in Xaignabouli, the price was only 200,000 kip (USD *c*.25) in South Lao PDR, and these were a middleman's starting prices, from which a buyer would be expected to bargain down. These figures suggest that the original hunter would receive little or no more than 'average wildlife prices' for gibbons supplied. Particularly if information is gathered by Europeans or otherwise affluent-looking people, the starting price may well be inflated. For example, C. Hallam (*in litt.* 2008), an Australian, left discussion feeling that baby gibbons, to rear as captives, from Nam Kading NPA could be purchased for around USD 50, whereas Lao personnel asking around independently were quoted kip 150,000 (USD *c*.17). As C. Hallam (*in litt.* 2008) himself pointed out, most traders will start high, just in case the potential buyer has more money than sense and replies 'sure! I'll take five!'.

In sum, it is unclear if trade is a conservation issue to Lao gibbons at more than local scales. The highest identified risks are through bone trade to Vietnam (which seems locally significant), and of trade (in any form) to China. Demand from Thailand may have been high into the early 1990s, but is no longer so. C. Sisomphone and V. Vongsihalath, both of Vientiane, and Souligna Sengdala, of Phongsali province, which borders both China and Vietnam (verbally 2008, separately), all consider that gibbons are not leaving even to these countries in numbers significant for their conservation. Gibbons are evidently not currently valuable enough in Lao PDR to suffer run-away trade-driven hunting, the control of which would prove very challenging. The good numbers of gibbons in some eastern border areas (sect. 2.4.1) indicate that even the bone trade to Vietnam is not yet a widespread pressing threat. This might change rapidly with a drop in Vietnam's own supply or a rise in retail price, so the existence of this demand is a major conservation concern.

2.5.3 Habitat deterioration

Gibbons are obligate forest-dwellers and over 70 years ago Delacour (1934) postulated that forest destruction was the greatest threat to Indochinese gibbons. They may be affected by outright conversion of forest to non-forest habitats; fragmentation of forest; and degradation of forest. These processes tend to co-occur, but each has its own effects, and conservation interventions, which should be specific to be effective, require an attempt to untangle their effects.

Gibbons are generally portrayed as requiring little-degraded forest. While populations often survive better in little-encroached areas than in logged ones, there is no evidence this reflects habitat differences *per se*, not the differences in hunting which almost inevitably accompany logging (sect. 2.5.4). Geissmann *et al.* (2000: 37), reviewing information from Vietnam, stated that gibbons were "mostly absent from disturbed forests", without speculating why. In fact, several studies have indicated that

where hunting is restrained, gibbons can survive logging rather well. Kakati (2004: 3, 134) found that "Hoolocks often exist in small and degraded forests and even in village groves" in Assam, in an area where "hunting [merely] *could be* a factor likely to be affecting Hoolock populations at *some* of the surveyed sites" (emphasis added); she found that populations in fragments of 20–30 km² showed no evidence of problems for long-term survival, although gibbons marooned in small fragments (less than 5 km²) did. Javan Gibbons *Hylobates moloch* are also highly tolerant of habitat disruption (Indrawan *et al.* 1997). Around the Sepaku River, Kalimantan (Indonesian Borneo), gibbon densities were in fact higher in 1-year low-intensity logged forests than in primary forest (Wilson & Wilson 1975) and Johns (1986: 690) even concluded that White-handed Gibbon in Malaysia showed "a remarkable degree of flexibility" to logging. A population of White-handed Gibbons in entirely fragmented and degraded, and largely deciduous, forest in northern Thailand was studied by Yimkao & Srikosamatara (2006), while pale-cheeked gibbons in Bach Ma National Park, Vietnam, lived in an area bereft of primary forest, with some groups even inhabiting the 'poor'-category vegetation (Geissmann *et al.* 2007). Rawson *et al.* (in press) found that Yellow-cheeked Gibbons in Mondulkiri province, Cambodia, survive a reasonably high degree of habitat disruption when not hunted out. In the majority of studies in Borneo reviewed by Meijaard *et al.* (2005), gibbons showed a neutral or negative response to logging, but underlying factors (hunting or habitat) were not segregated. One study even showed a sharp positive response, but survey did not last long enough to determine whether this was simply a temporary effect of no population significance.

Merely that gibbons use heavily encroached habitat does not prove such areas to support viable populations: they may be sinks, reliant upon dispersing animals from better quality habitats (see Pulliam 1988); and (particularly because gibbons are long-lived and faithful to their home range) time lag between habitat change and population collapse may be long (see Cowlishaw 1998). The rapidity of habitat change in Lao PDR hinders conclusions on adaptability of Lao gibbons to it. A high-density population of crested gibbons in a small area centred on Ban Wangma, Sangthong district, in 1996, used forest very heavily logged by State Forest Enterprise 9 in the 1980s which had regenerated largely with giant bamboo, although relict forest flanked water-courses (Foppes 1995, Duckworth 1996a, 1996b). Four groups of White-handed Gibbons were found in 2007 near Ban Sapi in an area of 6 km² dominated by grass, with only 2–5% comprising secondary forest (J.-F. Reumaux *in litt.* 2008). In these two extreme cases, the animals had survived, for a decade, perhaps more, post-logging, through local disinclination to hunt them, as has a group around Ban Padai, Muang Bolikhan (18°40´N, 103°42´E) in largely secondary forest (C. Hallam *in litt.* 2008). The several surveys that found gibbons at much lower density in logged than in old-growth forest (e.g. Dong Hua Sao NPA lowlands, Xe Bang-Nouan NPA lowlands, Phou Khaokhoay NPA; Duckworth *et al.* 1995, Payne *et al.* 1995, Timmins & Bleisch 1995, Evans *et al.* 1996b) could not disentangle the effects of habitat and hunting factors in generating the pattern.

Logging increased dramatically in Lao PDR after the 1997 Asian economic crisis and in 1999–2000 (i.e. after most of the field surveys reported here) was underway in NPAs (Chape 2001). The forest in northern Lao PDR was, in general, more fragmented and more degraded than in southern and central Lao PDR by the 1990s (Thewlis *et al.* 1998) and since about 2001 conversion of remaining forests there, ranging from young secondary to old-growth, to grow rubber for the Chinese market has been extensive and rapid (e.g. Vongkhamor *et al.* 2007, Shi Weiyi 2008). Across Lao PDR, plantations, particularly with foreign investment, of crops such as rubber, acacia, eucalyptus, cashew, cassava and pulp softwoods are currently expanding rapidly. As well as the direct loss of habitat, most require non-local labour in establishment and early running,. Hunting is thus likely to escalate in remaining natural

forest. Many hydropower projects are in place or under consideration in Lao PDR, and these usually locate their reservoirs in areas of low human population density, i.e. forests (Chape 2001), and also stimulate hunting in remaining forests.

2.5.4 The interaction between habitat deterioration and hunting

Disentangling the effects of habitat deterioration and hunting upon gibbons in Lao PDR is challenging because almost invariably the agents of the former are either themselves hunting, or causing others to hunt for them, for food. Unless there is strong deterrent, elevated hunting outlives the logging, facilitated by increased access. Habitat deterioration and hunting are also linked in that any given level of hunting is more damaging in small habitat patches than in large ones: the populations within the smaller remaining blocks of forest are more readily hunted to local extinction (e.g. Brickle *et al.* 2008). Larger habitat patches support bigger populations, so are more resilient; and even if populations are eradicated from part of the area, recolonisation is possible from the rest of it. If the patches have significant proportions more than half-a-day's travel from any settlement (through sheer size or ruggedness of terrain) this is particularly beneficial because human penetration into areas where it is necessary to pass the night is much lower than in areas within easy single-day access (Berkmüller *et al.* 1995a: 21). The role of large blocks of contiguous forest in maintaining gibbon populations was dramatically evident at several surveyed areas in Lao PDR in the 1990s: gibbons were audible from village houses where these abutted large contiguous blocks of forest, even in longstanding large villages populated by many hunters, e.g. Xe Pian NPA, the Nakai plateau, Nam Kading NPA and Nam Theun Extension proposed NPA (Duckworth *et al.* 1995, WCS 1995b, Timmins & Evans 1996, Robichaud 1998) and this is still so up to the present in forest-girt Ban Navang, Nakai–Nam Theun NPA (W. G. Robichaud *in litt.* 2008). Gibbons were even readily audible 20 minutes' walk from the forest edge, from the paddies around the large, long-established, town of Ban Phapho, Xe Pian NPA, in 1992–1993 (Timmins *et al.* 1993b). Gibbons were never heard from villages abutting or within only small forest patches, even much younger and smaller villages, except where there was specific cultural protection. V. Vongsihalath (verbally 2008) considers that fragmentation, specifically, is the biggest habitat-related threat to Lao gibbon populations in current circumstances (i.e. widespread hunting) and the distribution of surviving gibbons strongly supports that it is.

It is not necessary to clear large areas of forest to damage gibbon populations: roads or reservoirs easing access into large habitat blocks formerly remote thereby allow more efficient extraction and thus, more hunting (e.g. Timmins & Robichaud 2005). These factors are particularly problematic when a culture of effective hands-on protection of wildlife is still evolving: Duckworth *et al.* (1995: 26) stated that "the [NPAs] now legally protected receive little active management due to shortage of qualified personnel. The gibbons' only real protection lies in the sheer size of remaining forests and the availability of easier prey for the hunters". This is still an accurate description today for most of Lao PDR.

The disparity in gibbon conservation status between North Lao PDR and the South and Centre is a genuine pattern, reflected both by gibbon status in adjacent Vietnam and Thailand (Geissmann *et al.* 2000: 92, Tungittiplakorn & Dearden 2002: 63) and by some other sensitive forest species in Lao PDR, e.g. Black Giant Squirrel *Ratufa bicolor* (Timmins & Duckworth 2008), leaf monkeys (Duckworth *et al.* 1999), hornbills and parakeets (Fuchs *et al.* 2007). It is due to patterns of both hunting and use of forest habitat for agriculture, in turn stemming from the differing ethnic make-up across the country. It is unlikely to reflect any inherent property of forests, climate, or external human factors, although proximity to China of the North no doubt exacerbates the existing pattern.

2.5.5 Small-population effects

Reducing animal populations to very low levels introduces various additional extinction risks through chance effects (e.g. freak weather wiping out an entire population or at least all potentially breeding individuals of one sex) and 'inbreeding depression' (genetic deterioration through loss of intra-population variability). The relationship of decreasing population size with increasing chance of these effects is poorly understood. These effects could not have caused conservation problems for any Lao gibbon species, but might inhibit recovery if driving threats were successfully reduced. The fragmented, degraded, forest patches increasingly created across Lao PDR by various factors must contain many isolated gibbon populations too small to survive. Most of those outside protected areas must be written off from active conservation interventions, because available resources are insufficient for the magnitude of the challenge to conserve even just the NPA populations. Provided their forests are not converted and gibbon hunting is prevented, no NPAs is so small as to risk small-population effects for gibbons. But because these threats still occur, gibbon populations in some NPAs may already be at risk of small-population effects: Nam Ha and Phou Phanang are the most likely, then Phou Dendin and Nam Poui, and the likelihood for Nam Xam, Phou Khaokhoay and some others cannot currently be assessed. Province and district protected areas vary widely in size; some rival NPAs (e.g. Nam Ghong), but many are too small to support gibbon populations (not that this invalidates their contribution to wider conservation aims).

Both Pileated and White-handed Gibbon might be so reduced that all remaining Lao populations risk small-population effects, as might Western Black Crested Gibbon (but there is hope that in Nam Kan enough still remain). If it does not extend south-east as far as Nam Kading NPA, it is even possible that all Lao populations of Northern White-cheeked Gibbon are, or might soon be, at risk through small-population effects. There are multiple populations of Southern White-cheeked Gibbon and *Nomascus* sp. *incertae sedis* in Lao PDR well above the size where small-population effects could be problematic, but, without active intervention, they will not last indefinitely.

2.6 IMMEDIATE CONSERVATION NEEDS OF GIBBONS IN LAO PDR

The factors threatening Lao gibbons are common to many natural resources: over-extraction of the species and destruction of habitat. Gibbon conservation in Lao PDR will thus require two main outcomes:

1. protection of areas of habitat adequate in size and quality to support populations of hundreds of gibbons in each; and,
2. within each area of habitat, reduction of hunting to levels low enough that populations are not in decline. The extent to which active control of trade will be necessary to attain the second outcome is unclear: and it may anyway change rapidly.

2.6.1 Sites for site-based conservation

Because gibbons depend upon forest, site-based habitat conservation measures are essential to prevent their extinction from Lao PDR. Two forms of site-based support seem appropriate. For conservation of large populations viable into the long term, there is no alternative to successful control of threats over areas each of a hundred or more, preferably many hundred, square kilometers. Additionally, the opportunities offered by sites where gibbons receive local protection are outstanding but certainly not indefinite (sect. 2.5.1). Such areas as are currently thus protected are too small to conserve populations large enough for long-term viability, but may well be the best sites from which to build larger protection, because one key stakeholder group, local

residents, is already positively predisposed; and under current government staffing, detection and thus reduction of outsiders' hunting is only likely to be successful with strong local involvement and, thus, support.

Conventionally, protection of forest species is seen within a protected-area framework, but any land classification and use that retains forest of native tree species could conserve gibbons. Low-impact logging as envisaged under, e.g., the Suford project (Government of Lao PDR, Government of Finland and World Bank Sustainable Forestry and Rural Development Project; see Poulsen *et al.* 2005) would not render forests unsuitable habitat for gibbons (see Duckworth 1996a, Robichaud *et al.* 2002). The important role of gibbons in tree seed dispersal means that for the long-term ecological health of Lao forests, their conservation is needed throughout Lao's natural forests, not just protected areas. In all cases, gibbon conservation aims need to be seen and set within overall biodiversity needs (B. Phanthavong verbally 2008). Securing populations even at pilot sites is a short- to mid-term operation.

Several factors are important in selecting areas for long-term support to gibbon conservation; perhaps paradoxically, current gibbon status is not pre-eminent. Prospective projects are better compared through their intended stable end points (how many gibbons could the area support when threats have been removed?) and likelihood of getting to them (how readily can threats be removed, preferably permanently?) than their starting point (how many gibbons are there now?). With at most a few exceptions, all Lao gibbon populations are sliding downward to extirpation. How far a given population is, now, along this trajectory, and how fast it is travelling, is not the best guide as to how readily reversed is the decline. All other things being equal, a large population in only slow decline gives a project more time to succeed than a small population in rapid decline, but all other things rarely are equal, and factors other than current or even potential biodiversity values are more important in site selection when the criteria are, as they should be, maximising future conservation gains. Such factors include the pressure from competing alternative land uses, the origins of these pressures, and the relative financial gains from them; any positive predisposition for, or strong antipathy to, project aims among key stakeholders; possibilities for rapid consolidation of support among all key stakeholders; and logistical factors (e.g. in Lao PDR's decentralised government administration to provinces and districts, projects sited solely within one district are logistically more feasible, and operationally far more efficient, than those involving multiple districts). Various other equally significant factors could be thought of, and should be, at the time of drawing up lists of possible candidate sites; and they should then be investigated in considerable depth. All that is needed about the gibbons themselves is a week or so's walk though the area to show that a potentially recoverable population exists.

Currently, three of the four crested gibbon species of Lao PDR inhabit sites with ongoing conservation management support. Although only Western Black Crested Gibbon has a programme pivoted upon gibbons (in Nam Kan NPA), the general goals in areas holding Northern and Southern White-cheeked Gibbons will, if projects (in Nakai–Nam Theun, Nam Kading and Nam Et–Phou Louey NPAs) reach these goals, secure large populations. Lao PDR's other three gibbon species may not inhabit a single area with ongoing conservation support of a style and duration likely to enhance their long-term outlook, although this cannot be ruled out: the longer-term effects of small-scale short-term interventions may, by fateful combinations of circumstances, be far wider than the scale of direct intervention. The declaration of national protected areas has outstripped the evolution of effective systems to manage them, and simply inhabiting an NPA is no long-term guarantee of future survival. Ample time remains to select areas to secure the Lao future of *Nomascus* sp. *incertae sedis*, but from a national perspective, it may be urgent to identify potential sites for at least one representative population of Pileated and White-handed Gibbons in Lao PDR.

Additional sites could be considered for each species, but the overall future situation would best be enhanced now by focussing on how to institute effective conservation at sites.

2.6.2 Site-based conservation management

The first 18 NPAs were legally established in 1993, and a fair number of internationally collaborative projects have supported their functioning. Progress on all fell short of expectations and hopes for conservation. Any prospective site-based project for gibbon conservation in Lao PDR should be fully informed, from the earliest design, by review of the plentiful literature on outcomes of these projects. Key documents include Boonratana (1999, 2001b), Berkmüller (2000), Schweithelm *et al.* (2000), Tizard (2000), Berkmüller & Southammakoth (2001), Chape (2001), Nooren & Claridge (2001), Poulsen & Luanglath (2005) and, particularly concerned with gibbons, Brown (2007). As of March 2008, with the addition of Nam Kan, there are now 21 NPAs (although two, Nam Et and Phou Louey, are managed as a single unit), providing in principle a firm basis for biodiversity conservation in Lao PDR (Robichaud *et al.* 2001). The Department of Forestry has a very modest target of 15 full-time staff per NPA but even this is far from being met. As systems evolve, the current best protection for hunted animals, like gibbons, will continue to be the protection afforded by large blocks of habitat (sect. 2.5.4): maintaining their large size will require continuous strong, but flexible, stakeholder consultation, livelihood support, awareness-raising and enforcement, year after year after year (C. Sisomphone verbally 2008): a humdrum outlook for donors intent on funding innovative projects that grab attention through their novelty, and who seek to fund short (3–5 year) interventions that leave a sustainable outcome, i.e. one that will not relapse back to the pre-project baseline, over a slog with no end in sight (e.g. Leisher 2001). Thus, maintaining natural protective forces, i.e. large forest tracts with no easy human access, is the over-riding site-based priority for gibbon conservation in Lao PDR; to this end, road-building into remote forest, and piecemeal clearance at its edges, should be minimised (Timmins & Duckworth 1999).

2.6.3 Public awareness

During a study in northern Thailand, "villagers in all [Hmong] communities expressed sorrow over [gibbons] absence", having sustained no problems from gibbons (unlike macaques), and missing their 'evocative calls' " (Tungittiplakorn & Dearden 2002: 63). It is likely that throughout their world range, gibbons enjoy a relatively benign, even positive, perception among the rural people (not just Hmong) with whom they share their forests, because they are not pests of crops, predators of livestock, competitors for forest resources, or otherwise detrimental to rural livelihoods. Hmong informants in Nam Kan NPA told Geissmann (2007b) that the taboo against hunting gibbons, which was introduced only in 1975, was because gibbons are basically harmless (do not raid crops) and nice (singing a pleasant song in the morning). Similarly, during Bergman's (1995) interviews with villagers, a frequent characteristic attributed to gibbons was that they were harmless to crops. S. Vanalath (verbally 2008) considers that throughout Lao PDR people of all ethnic groups are broadly happy with gibbons and is aware of nowhere that they are seen as problematic.

Readily perceivable direct benefits of gibbons, and therefore of attempting to conserve them, to rural people are rather low. Inherently low reproductive output means that they could never be, long-term, significant sources of rural protein, unlike wild pigs *Sus*, muntjacs *Muntiacus* and squirrels (Sciuridae), or of income to market hunters. The drastic reductions in gibbon populations across Lao PDR by hunting have probably benefited no-one, even in the short-term (unlike the riches provided by, e.g.,

Tiger, timber and turtles), and so the opportunity costs to rural people of ceasing gibbon hunting are probably small enough not to be problematic. There may, therefore, be little need for awareness campaigns to target the rural populace to change their perceptions with respect to gibbons. More appropriate would be a pride-based campaign highlighting how Lao PDR is almost uniquely special for gibbons, in ways that the average forest-dweller is not aware. Also, as relatively large frugivores, gibbons are likely to be important in tree-community dynamics for healthy forests, yet this positive role is probably not well perceived. A pride-building, rather than wrist-slapping, awareness programme focussing on such factors has recently been implemented around large hornbills in Bolikhamxai province to great effect (Vannalath 2006, Philakone in press), and gibbons possess all the desirable characters to benefit from a similar undertaking (S. Vannalath verbally 2008) and have therefore very recently been added to the ongoing campaign in this province (M. Hedemark verbally 2009). People further from significant forest, living in towns and farmland, may have little notion of the characters or even existence of gibbons. As for villagers in forest areas, reduction of gibbon hunting does not carry significant direct or opportunity costs. Intensified public awareness of gibbons' positive role in forest ecology, threatened status, and the global uniqueness of Lao PDR in gibbon conservation could build a strong national constituency.

Some gibbon public awareness initiatives are already undertaken in Lao PDR. The Wildlife Conservation Society supported a poster for distribution across the country depicting each species of Lao gibbons, with basic information on geographical distribution and conservation needs; a children's story-book; and, a little later, a gibbon T-shirt for distribution across the country; and direct interaction (various types of activities) with rural people, and village gibbon conservation signs, in the focal villages of Nam Ha NPA (Hansel *et al.* 2004a). The Global Association for People and the Environment (GAPE) recently created a video, *Let the gibbons live!*, in Lao and Brao languages for use in the Co-Management Learning Network Project in Champasak province (I. G. Baird and M. Sly *in litt.* 2008). This covers the basics of gibbon natural history, status and threats: it emphasises that there are no wild gibbons in most of the world, that without conservation their survival in Lao PDR is threatened, and that gibbons are not in conflict with people. It is thus has much wider relevance than the original project area (indeed, throughout Lao PDR), and those interested in obtaining copies for distribution should contact GAPE's Lao office in Pakxe. Further awareness-raising activities should build upon these already undertaken.

The Achilles's heel of the foregoing is that successful gibbon conservation needs not just reduction of hunting, but conservation of forest landscapes. Rapid forest conversion has enriched many people, although it has usually had the opposite effect upon the marginalised rural people dependent upon forest products for long-term subsistence security. There are significant short-term opportunity costs to some stakeholders (unfortunately, generally among the most powerful ones) of maintaining natural forests rather than logging or converting them to plantations or other agriculture. At the same time there are even more significant, but longer-term (and thus, at the present time, less tangible), direct costs to Lao society as a whole of widespread such conversion (see, e.g., ICEM 2003). The public awareness aspects of the need for general forest conservation are beyond the scope of this report, but need to be addressed by any gibbon-centred interventions.

2.6.4 Other non-site-based interventions

All Lao gibbons are already protected at the highest national level (sect. 1.2), and, excepting Pileated Gibbon, they all have sufficient forest habitat within NPAs. A protected area holding Pileated Gibbon is important, but for all other species the priority is to translate these existing species and area regulations into on-ground

reality. The level of trade in gibbons in Lao PDR today is not well understood. It may be low enough, from a gibbon-centred viewpoint (in direct contrast to one of general biodiversity of Lao PDR, where tackling trade may be the single highest conservation need), not to be a priority to tackle the trade aspects. Further information is necessary for more informed judgement.

2.6.5 Information needs

Better information allows better conservation, but conservation is often not served through a focus on the gaps in available information rather than its strengths. Phrases such as 'fiddling while Rome burns' and 'counting animals into extinction' have recently been used to describe perceived inappropriate fixations upon documenting wildlife status when the broad conservation needs are already clear. It is the strongly held personal opinion of this author that, excepting certain specific gaps, further clarification of gibbon field status in Lao PDR is a low priority. In corroboration of this, perusal of the reviews of 1990s site-based conservation projects in Lao PDR (cited in sect. 2.6.2) never leaves the reader with a feeling that project goals were missed because of insufficient information on what the wildlife was doing. By contrast, there was often evidently far too little understanding of what key stakeholder groups were up to, still less what they were planning to do, what they thought about biodiversity conservation, their broader values, and a host of other human-related factors. The genuine, specific, information needs identified by this review build on a general recommendation made by Geissmann (2007a), for field surveys throughout the range of pale-cheeked gibbons, including the collection of sound recordings, genetic data and photographic recordings at each site, to determine the number of taxa involved and clarify the distribution of each one. Until this is done, there remains the concern that a cryptic taxon with urgent conservation needs could be overlooked (although there is as yet no reason indicating this to be the case). Whilst in a world of limitless resources a full, gibbon-specific, survey of Lao PDR would be ideal, much could be learnt through encouraging survey and conservation personnel in the field for whatever reason to record qualitative gibbon information on the side. Resources specific to gibbons in Lao PDR would best be used for actual conservation interventions, rather than survey. The genuine, specific, information needs identified so far comprise:

1. Current Lao status of Pileated and White-handed Gibbons and location of areas potentially suitable to conserve them. This warrants rapid survey of Lao PDR west of the Mekong, investigating actual gibbon status in surviving large blocks of forest (pre-identified by inspection of aerial imagery) and seeking areas where gibbons benefit from cultural beliefs that they should not be hunted. If rapid direct survey of areas selected through habitat extent is not locating gibbons, then location through village interview of remnant groups will be urgent. LOW INTERNATIONAL but HIGHEST NATIONAL IMPORTANCE.

2. Location of additional surviving Western Black Crested Gibbons, set within the uncertainty of the species's Lao geographical range. This should start with the parts of Nam Kan NPA currently unknown and expand through Bokeo, Louang-Namtha and Oudomxai provinces into the western two-thirds of Louangphabang. Animals outside Nam Kan NPA are probably in small, scattered, remnants, so the most efficient way to locate them is through village interview, prioritising those villages in or close to blocks of forest, no matter how degraded, over 50 km² or more. The habitat thresholds (size and level of degradation) are deliberately set low because cultural disinclination to hunt gibbons is probably the more important factor allowing any persistence. The

difficulties in interpreting villager information to gibbon species require all reported gibbons to be sought for direct contact, and tape-recorded for identification. If it is possible to photograph them and collect faeces for DNA investigation, so much the better, but both of these are significantly more challenging than sound-recording. HIGHEST INTERNATIONAL and NATIONAL IMPORTANCE.

3. Determination of the range boundary between Northern and Southern White-cheeked Gibbons and assessment of taxonomic status of these populations. This probably falls somewhere in eastern Vientiane province, south-eastern Xiangkhouang province and/or Bolikhamxai province. This may seem a luxury, in that areas supporting both species are already under conservation management, but Lao records in the border between Southern White-cheeked and Yellow-cheeked Gibbons started the surprising finding of animals here called *Nomascus* sp. *incertae sedis*. All gibbons reported by villagers and others should be sought for direct contact, and must be tape-recorded for identification. Photographs and faeces for DNA investigation would also be useful. HIGH INTERNATIONAL and NATIONAL IMPORTANCE.

4. Determination of the relative merits of areas from which to select one that is suitable for conservation of *Nomascus* sp. *incertae sedis*. Following the rationale of sect. 2.6.1, this should focus more on assessing the operational realities within which conservation interventions would work, assessing gibbons only insofar as persistence per candidate site. MODERATE INTERNATIONAL and HIGH NATIONAL IMPORTANCE.

5. Clarification of the threat posed by trade to Vietnam and China in Lao gibbons. This review's tentative conclusion about trade, that it is not a significant driver of national-level decline for Lao gibbons, has only a thin information-base. HIGH INTERNATIONAL and NATIONAL IMPORTANCE.

6. Searching for gibbons in areas close to Vientiane Capital City, with a view to developing an area where city people can hear and see wild gibbons. This should start with reinvestigation of populations confirmed during the 1990s, in Sangthong district and Phou Khaokhoay NPA and, at the same time, confirm their taxonomic identity. National-level support for gibbon conservation is likely to be best built by actual encounters. MODERATE INTERNATIONAL and HIGH NATIONAL IMPORTANCE.

7. Trawling of tour guides for information about accessible gibbon groups anywhere in the country. A number of tourism-based activities in Lao PDR are built around primates which can readily be seen, e.g. the leaf monkeys close to a village in Dong Phou Vieng NPA (Duckworth 2007). There seems to be no natural register of such situations, yet they may offer among the best chances to protect primate populations at the local scale. In Nam Ha NPA alone, five local trekking companies operate about 30 active trails in and around the NPA, yet there is no compilation of their wildlife knowledge (S. Schipani *in litt.* 2008). MODERATE INTERNATIONAL and HIGH NATIONAL IMPORTANCE.

8. Clarification of the location and nature of the boundary (if that word be apt) between Southern White-cheeked Gibbon and *Nomascus* sp. *incertae sedis*.

Gibbons should be sought for direct contact, and tape-recorded for identification; photographs and faeces for DNA would also be useful. Wherever the boundary lies, large and potentially conservable populations of both forms are already known. MODERATE INTERNATIONAL and NATIONAL IMPORTANCE.

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APPENDIX 1. GIBBON RECORDS FROM LAO PDR, 1980S–PRESENT TIME

Localities are arranged roughly north to south in two sections, west of the Mekong (genus *Hylobates*; section A) and east of the Mekong (genus *Nomascus*; section B). Data, including species identifications, in square brackets relate to provisional, in some cases inferred, information.

The site name includes the land-use status, where known: this is complete only for declared national protected areas, and gives the year when each was legally established.

Locator: this is given precisely, as the range of the protected area (not necessarily the actual area surveyed) where known or, failing that, as a 'centred-on' (c.o.) point. The latter is not necessarily either the mathematical centre of the area or a point where gibbons were found; these sometimes cannot be determined even crudely from the report (see sect. 2.1).

Level of evidence: this comprises two classes, 'confirmed' where gibbons (not necessarily identified to species) have been seen or heard directly, and 'reported', where information is at best second-hand. While these should be considered as provisional records, most are likely to be broadly correct.

Last positive information: the year given relates to the last evidence of gibbon presence, if in square brackets via second-hand reports (and not to the year in which the reports were received). Given that each site is not surveyed each year, this date has far more to do with patterns of survey than with anything about gibbon status. In particular, a long-ago date of 'Last positive information' does not imply a low likelihood of current persistence, or a small population.

Notes: to make full use of these, reference to the original document may be necessary (see sect. 2.1).

SECTION A. WEST OF THE MEKONG (GENUS *HYLOBATES*)

Muang Khop, Xaignabouli province

Locator: c.o. 19°45′N, 100°30′E

Level of evidence: reported

Last positive information: [2001]

Notes. Gibbons (presumably White-handed Gibbon) were reported from around Ban Phadeng in about 2001 (Suphab Denphoukhao verbally 2008).

Muang Hongsa, Xaignabouli province

Locator: c.o. 1945′N, 101°30′E

Level of evidence: reported

Last positive information: [1970s]

Notes. Villagers reported that in the area of Napong and Nam Ken gibbons (presumably White-handed Gibbon) had last been found in the early–mid 1970s (Bergmans 1995). Hmong villagers in Ban Donmai, *c*.9 km east of Hongsa town, said in 2008 that there used to be gibbons further east near Ban Namseng, near to the Muang Chomphet border in old forest, but they have not been heard for many years now (Stuart Ling *in litt.* 2008). However, these responses do not give complete coverage of the district.

Muang Xaignabouli, Xaignabouli province

Locator: c.o. 19°20´N, 101°30´E

Level of evidence: confirmed

Last positive information: 2007

Notes. Gibbons were reported around Ban Phaxang in about 2001 (Suphab Denphoukhao verbally 2008). At Ban Sapi (almost on the border with Thailand) three wild White-handed Gibbons were seen during 18–20 May 2007, in an area where several others were heard. With a local guide, a total population of 18 individuals (four groups) was estimated within an area of 6 km². Those gibbons are protected by a local taboo, but in the last 20 years have decreased from about 60 individuals perhaps because of the poor quality of the habitat: within the 6 km², only 2–5% is secondary forest, the rest is dominated by grass. Reports were received of other populations nearby, but these were less accurately located. See also Muang Phiang, M. Xaignabouli and M. Paklay.

Muang Phiang, M. Xaignabouli and M. Paklay, Xaignabouli province (parts of)

Locator: a 66,472 ha area to the east and north-east of Nam Poui NPA, within 18°36´–19°12´N, 101°30–45´E.

Level of evidence: reported

Last positive information: [1999]

Notes. Nn 1991 eight of nine villages around the then Pasak Xaignabouli potential NPA reported gibbons (presumably White-handed Gibbon) in their area (Salter 1991d); some of these lie in areas which became part of the Nam Poui NPA (which see). In the 66,472 ha area, placed in the late 1990s into the Hipa Licence Area, Division Three, restricted interviews in August–September 1999 found general statements that gibbons were no longer present in their areas; they were believed perhaps to persist a little north of the Nam Poui (HFI 1999).

Nam Poui National Protected Area (1993) (= Nam Phoun in Berkmüller *et al.* 1995a)

Locator: 18°12–47´N, 101°04–29´E

Level of evidence: confirmed

Last positive information: 2007

Notes. Respondents in 14 of 16 villages questioned during 1989–1993 reported gibbons from their area (Salter 1991d, Duckworth *et al.* 1999: Annex 5). Further villages in the area which became this NPA were questioned under the Pasak Xaignabouli proposed NPA (see under Muang Phiang, M. Xaignabouli and M. Paklay). A combined training-cum-survey in mid 1997 did not cover most of the NPA but concluded on the available information that gibbons (some confirmed as White-handed Gibbon) were "possibly rare" (p. 18) and to be threatened by hunting for food. They were heard only towards the Lao/Thai border in the west of the northern region, and in the remoter central core of the NPA. In the north, an army patrol reportedly shot a gibbon during the third week of May 1997, apparently from the extreme northern part of the central region. Army personnel reported gibbons as common in the south-western part of the NPA (Boonratana 1997). No gibbons were recorded directly in a repeat visit in early 1998 (Boonratana 1998b); those mapped in various sites in the NPA (Fig. 4.1) were based on indirect reports (R. Boonratana *in litt.* 1998). A picture of a dead adult gibbon was seen in c.2007 which had been killed in the NPA; no gibbons

were heard on recent field trips, which although they entered some good semi-evergreen forest, were brief (only odd days) and perhaps did not go far enough from villages: Human activity was evident everywhere, including areas with lots of clearance (K. Khounboline & G. Baird verbally 2008). A brief visit to parts of the NPA in May 2007 heard gibbons only one morning, when two groups of White-handed Gibbons were heard from the military road from Nam Poui to Ban Thongmixay; overall numbers are clearly very low (J.-F. Reumaux *in litt.* 2008). P. Phiapalath (*in litt.* 2008) also received reports, in 2008, that the NPA's gibbon population is now very low, following heavy hunting, much related to various large-scale activities which have also disrupted the habitat. V. Vongsihalath (verbally 2008) also considered that surviving numbers within Nam Poui NPA are low, but that at least one larger population survives outside, but near, the NPA. Gibbons were audible from the NPA office in the late 1990s, but it is not clear if this remains so.

Muang Soukhouma, Champasak province

Locator: c.o. 14°35′N, 105°40′E

Level of evidence: reported

Last positive information: [c.1998]

Notes. Gibbons (presumably Pileated Gibbon) were reported from all villages where presence was checked in 1988–1990 (Duckworth *et al.* 1999: Annex 5; sites mapped in Salter *et al.* 1990). Gibbons were reported from the area around Ban Nachalot at least a decade ago (Khamhou Moukdala verbally 2008).

Dong Khanthung, Muang Mounlapamok, Champasak province

Locator: 14°07–32′N, 105°12–45′E

Level of evidence: confirmed

Last positive information: 1998

Notes. Gibbons (presumably Pileated Gibbon) were reported from all villages where presence was checked in 1988–1990 (Duckworth *et al.* 1999: Annex 5; sites mapped in Salter *et al.* 1990) and were reported in April 1996 as still present in all seven villages investigated; it was often noted that several troops could be heard calling at the same time. No particular stronghold could be identified (Berkmüller & Vilawong 1996). In a short field visit in May 1996, Pileated Gibbons were heard on in two areas on 2 May, to the south west of Nong Laha and from Nong Na. One or two distant groups were heard on 4 May to the south-east of Ban Po, and a black individual was seen in degraded Semi-Evergreen/Evergreen Forest in the same area. The low number of records did not necessarily indicate low populations: fieldwork focussed on habitats other than dense forest, and gibbon calling may have been reduced by rain (Timmins & Vongkhamheng 1996b). In a short visit in early 1997 many Pileated Gibbon were heard in the same two areas (as Timmins & Vongkhamheng 1996b), camp 2 and camp 3, and also along the Nam Lepou (= Xe Lampao) 5 km west of the Houay Khem confluence. None was heard at Camp 4 nor along the logged lower reaches of the Nam Lepou (west or east of Ban Tahin) but survey effort was not high enough to affirm absence. It was concluded that gibbons might only inhabit the less disturbed evergreen and gallery forests west of the Ban Tahin road (Wolstencroft 1998). Assuming all calls represented territories, 16–18 Pileated Gibbon territories were recorded during a fairly intensive February–March and July 1998 survey (Kadian 4; Takang 2–3; Paeo 7; Tahin 1 and Khem 2–3). Gibbons seemed to be at low density and were patchily, though widely distributed, presumably due to the fragmented and disjunct nature of the semi-evergreen forest. Most were located within 300 m of permanent streams where the better quality evergreen forest was found. Numbers may

also have been reduced by hunting for meat, especially by soldiers, in the western part of Dong Khanthung because no animals were heard during two days (12–13 February 1998) camped in tall, good quality, evergreen forest on the upper Houay Asam. Although male solo calls were heard at dawn on a few occasions, more usually gibbons remained silent until at least 09h00, with most pair duets being heard between 10h00–11h00. Specific records were as follows (Round 1998; all co-ordinates are 14°N, 105°E, and all dates are 1998):

Kadian A pair-duet was heard 500 m west of Nong Soumhoung (17´20˝N, 40´35˝E) on 27 February. Two groups were heard north-east of Nong Soumhoung: one on the west bank of the Houay Laok Noi at c.17´55˝N, 41´30˝E; and one on the east bank at c.17´35˝N, 42´40˝E. Male solo calls were heard south of the Ban Kadan–Ban Nong Nga road at c.23´30˝N, 37´50˝E, close to the boundary with the Paeo Sector, 10 March.

Takang At least two, possibly three groups were present on the Takang Ridge. Male solo calls were heard north-east of Nong Kok at the south end of the ridge (c.08´40˝N, 39´00˝E) on 23 February. One, possibly two, groups were heard (at least one pair-duet) at c.10´20˝N, 39´30˝E) on the east flank of the ridge, 8 July.

Paeo Three groups were heard calling north of the Houay Daan Gnai and Houay Daan Noi confluence on 6 March (two at c.24´15˝N, 34´30˝E and one at 24´27˝N, 33´24˝E). One animal heard about 7 km north-west of Ban Tahin (west of the Houay Kadan) at c.12´25˝N, 33´25˝E. Two pairs were duetting simultaneously during 3–4 March, one near the Houay Phaak–Houay Man Kaeo confluence and one about 500 m to the north-east. Some individuals in both families were seen. Female 'great calls' were heard north of Nong Khout, in evergreen forest on the west bank of the lower Houay Phaak, 21 February (c.11´26˝N, 31´57˝E).

Tahin A group was heard less than 500 m west of camp 11 on the Nam Lepou (= Xe Lamphao), evidently very close to the river, on 12–13 July. It was difficult to be sure whether the family were in Lao or Cambodia.

Khem 2–3 groups were believed present in the extreme south-east of this sector. Male solo calls were heard south-east of camp 12, on the Houay Khem, and another south-east of 06´27˝N, 22´51˝E on 21 July. Either one of the same, or another group, was heard at 06´30˝N, 23´30˝E on 22 July.

P. Phiapalath (*in litt.* 2008) received reports in mid 2008 that the area was sustaining heavy hunting, some of it related to logging and speculated that these activities are probably threatening the area's gibbon population (if any in fact remain).

SECTION B. EAST OF THE MEKONG (GENUS *NOMASCUS*)

Phou Dendin National Protected Area (1993)

Locator: 21°40´–22°18´N, 102°00–40´E

Level of evidence: confirmed

Last positive information: 2005

Notes. Respondents in all of six villages questioned in March 1992 reported gibbons from their area (Salter 1992a, Duckworth *et al.* 1999: Annex 5). In a May 1995 reconnaissance, local people (from Ban Hathin and Ban Sopkhang) again reported that gibbons within the NPA; none was found but the daily rain hinders any conclusion on gibbon status (Robichaud & Sounthala 1995, Evans *et al.* 2000). A series of visits in 1996 and in 2004–2005 (sites covered and effort invested are detailed in Fuchs *et al.* 2007) gave only four records: gibbons were heard at the mouth of the Nam Khan on 19 March 1996; the ridge north-east of Ban Tan on 22 March 1996; on the ridge north of the trail from Ban Tan to Ban Tatoung on 24 March 1996; and from Ban

Laophouchai on 23 March 2005 (one group), to the south-east of the village (Duckworth *et al.* 2005). D. P. Lunde (*in litt.* 2008) and Ruedi & Kirsch (2005), who undertook additional surveys in the NPA in 2004–2005, heard no gibbons. This is a very low number of records for the time in suitable habitat; Duckworth *et al.* (2005) speculated that the lack of records in December 2004 might reflect cold weather, but records were few even in the warmer surveys of March 1996 and 2005. There may have been a decline in the intervening decade, because all three sites with records in 1996 were visited in 2005 (albeit briefly) without gibbons being found. NPA inhabitants were unanimous in stating that the local black gibbons had white cheeks in both 1996 (T. Tizard *in litt.* 1998) and 2004–2005 (Duckworth *et al.* 2005). In this latter survey, villagers in both the north and the south of the NPA consistently reported the presence of gibbons (although often not near their villages). The pelt of a black gibbon was found in Ban Soppha, and its owner said the species has white cheeks. At Ban Tatoung, there were said to be none in their area, probably because they had been shot out. At Ban Hathin, up until the mid 1990s gibbons were found in a patch of forest directly across the Nam Ou from the village. There are reportedly still many up the Nam Nu, but none up the Nam Sin, and old people in the village say there never were, because the spirits do not let gibbons live on that side of the river. The informant telling this said that the more likely reason is wrong habitat: the upper Nam Sin has little good forest at the expense of much grassland. Gibbons were said by residents of both Ban Laophouchai and Ban Houangtaye to be present locally (Duckworth *et al.* 2005).

Elsewhere in Phongsali province

Locator: c.o. 21°30′N, 102°30′E

Level of evidence: reported

Last positive information: [2008]

Notes. Villagers reported that gibbons persisted around seven of 13 villages in which questions were asked in May 2006, spread between Muang Khoa, M. Samphan, M. Phongsali, M. Boun-Nua and M. Boun-Tai (Hamada *et al.* 2007). Recent reports, apparently based on villager information, come from Ban Chalonglee, Ban Mookin and Ban Na-ma, all in Muang Boun-tai (Souligna Sengdala verbally 2008). All these are relatively close to Nam Lan Provincial Protected Area, within which a number of survey visits in 2004–2005 failed to hear any gibbons (sites covered and effort invested are detailed in Fuchs *et al.* 2007, Ruedi & Kirsch 2005; also A. Hassanin *in litt.* 2008). However, none of these was specifically a large-mammal survey and most of the PPA was not entered. J.-F. Reumaux (*in litt.* 2008) received 2008 reports of gibbons from the following three areas (locations within the province not traced): Ban Houaypa, until 10 years ago; Houay Vang, Ban Naboua, Ket Muang Mai (road to Vietnam), 2–3 years ago, gibbons could still be heard; Houay Vang Kang, Houay Vang Sout, Ban Cheng Ye, gibbons can be seen after one day of bush walking. The map in Geissmann (2007b: 56) of gibbon distribution shows two small areas, one in the Muang Boun-tai (Phongsali)–Muang Nammo (Oudomxai) border area and one around the border area of Muang Boun-nua and Muang Gnot-ou, for which it was not possible to trace the basis to mark them as apparently retaining populations.

Nam Kong Provincial Protected Area, Louang-Namtha province

Locator: c.o. 21°11′N, 101°25′E

Level of evidence: reported

Last positive information: [1997]

Notes. There may still be a small gibbon population in the eastern Nam Kong PPA: there were reports from four villages, including Ban Boten and Ban Kouysung (both near the Chinese border), in 1997 (Tizard *et al.* 1997, Ling 1998).

Houay Nam Loi, Louang-Namtha province (former potential NPA)

Locator: c.o. 21°00´N, 100°50´E

Level of evidence: reported

Last positive information: [1991]

Notes. Interviews were held at five villages in 1991, of which four reported the presence of gibbons (Salter 1991b).

Nam Ha National Protected Area (1993)

Locator: 20°32´–21°03´N, 100°52´–101°28´E

Level of evidence: confirmed

Last positive information: 2007

Notes. Respondents in only five out of 11 villages in the then Nam Ma proposed NPA questioned in February 1991 reported gibbons from their area, with one further village reporting extirpation; a low proportion compared with most other forested landscapes in the country that were similarly investigated in this era (Salter 1991b, Duckworth *et al.* 1999: Annex 5). Tizard *et al.* (1997: 22) wrote, after a general biodiversity survey in early 1997, that "although they may still exist in small patches, it is likely that gibbons are no longer found in Nam Ha. This may be because of the predominantly secondary growth forests and ... high historical hunting level". Ling (1998) wrote that a population may persist on Phou Thonglat, a limestone hill east of Phou 2094, and that a villager from Ban Eng (on the Viangphouka road) had described to him how villagers heard two gibbons in 1996. When asked where they were now, he replied that they had been shot and eaten, and that none has been heard since. During 19 March–9 April 2002, residents of Ban Cha Kurn reported encountering gibbons on the day before a survey team arrived. Villagers of Ban Phimhoe (Muang Long) and Ban Thonglat Mai reported small numbers of gibbons near the Houay Nam Louang Noy in September–October 2001. By contrast, in Ban Namkong the n° 3 headman reported that gibbons had not been seen since the late 1980s. He also reported that the Akha hunted them for food and fur. Reports from Unesco and villagers in Ban Mokchong, Muang Nale, stated that gibbons were heard calling near a garden house close to the NPA boundary in October–November 2001 (Hedemark & Vongsack 2003). As a result of these reports, a specific search for gibbons was made in January–March 2003, based at eight villages in the NPA: four reporting gibbons to survive, two reporting no records in the preceding decade, and two apparently reporting long-term absence. In all four villages where gibbons were reported, surveys found them. The three locations holding gibbons were well spread across the western half of the NPA (in or within a few kilometers of places surveyed by Tizard *et al.* 1997: Fig. 2). Gibbons were heard in five of 12 morning surveys, involving five groups; sonogram analysis confirmed them to be Western Black Crested Gibbon. The team also visited villages, but found no compelling reports and so did no surveys, in the north-east and centre of the NPA. Other small populations may be present, but overlooked, in the NPA (Johnson *et al.* 2005). During a 2005–2006 resurvey for the groups found in 2003, gibbons were heard only once, on 21 January 2006, c.7 km north of Ban Phouyaemai. A decline seems surely to have occurred between 2003 and 2006: five groups were detected over 12 days (c.42 hours of survey) in 2003 but only one group in 25 days (c.70 hours) in 2005–2006. Villagers were reporting gibbons at roughly similar levels as in 2003, but this was felt no longer to be accurate (Brown 2007). A patrol out of Ban Phouyaemai

on 13–22 November 2006 heard gibbons on two consecutive days, involving two groups, whereas the next patrol out of this village, on 4–13 January 2007, did not (Cooper 2007). During March–June 2007, team leaders for patrols in May indicated that gibbons were heard calling in both Muang Viangphouka (Team 1) and Muang Long (Team 2). The former encountered two groups calling and the second team only one group calling (van der Helm & Nouansyvong 2007). Corroborating that gibbons are now very rare in Nam Ha NPA, A. McWilliam (*in litt.* 2008) ventured several times during 2002–2006 into extensive areas of forest but never heard them. S. Schipani (*in litt.* 2008) heard rumours of a group of gibbons in the NPA's south core zone, in the triangular area between Muang Viangphoukha, Muang Nale and Ban Namha, and as far from the road as possible within this area. External support to conservation management of the NPA ceased in 2007 and since then resources have been insufficient to continue patrols. Gibbons in Nam Ha NPA are therefore highly imperilled.

Louang-Namtha province

Locator: c.o. 21°00′N, 101°00′E

Level of evidence: reported

Last positive information: [2006]

Notes. Villagers reported that gibbons persisted around four of 14 villages in which questions were asked in May 2006, scattered across the province (Hamada *et al.* 2007); there may be overlap with Nam Ha NPA, Nam Kong PPA and/or Houay Nam Loi (which see). Brown's (2007) experiences in verifying village reports of contemporary gibbon presence in Nam Ha NPA urges extra caution over these reports. Moreover, Singphone Louangleuxai (verbally 2008) has heard gibbon reports from nowhere in the province except within Nam Ha NPA.

Muang Beng, M. Xai, M. Namo and M. La, Oudomxai province

Locator: c.o. 20°40′N, 102°00′E

Level of evidence: reported

Last positive information: [2008]

Notes. Villagers reported recently that gibbons probably persist in Muang Beng and Muang Xai, but no details are available (V. Vongsihalath verbally 2008). Boonlouang Bangsengthong (verbally 2008) has heard recent reports (both from about 2004) of gibbons in the province only from the Phou Lipi area and the Phou Dongving Provincial Protected Area (Muang Namo). In January 2008, villagers reported gibbons to persist around Ban Houayxou (Muang La; 25 km from Oudomxay); around Ket Phou Ten (30 km further on), especially on Phou Bood; and around Ban Houaynamphap, but said there was none left around the Nam Bak (J.-F. Reumaux *in litt.* 2008). Although Hamada *et al.* (2007) reported no gibbon sites from Oudomxai province, their survey method, of travelling along main roads and arriving in villages, with no pre-arrangement, for an interview, was not best suited to picking up relict populations. The map in Geissmann (2007b: 56) of gibbon distribution shows a small areas in the Muang Boun-tai (Phongsali)–Muang Nammo (Oudomxai) border area, for which it was not possible to trace the basis to mark it as apparently retaining populations.

Nam Kan National Protected Area (March 2008)

Locator: 20°20–46′N, 100°38–54′E

Level of evidence: confirmed

Last positive information: 2008

Notes. A reconnaissance survey in May 1994 found that only four out of eight village interviews reported gibbons (Berkmüller *et al.* 1995a), and an October 1996 survey also found evidence of them (Maurer & Reumaux 1996). In early 1998 some gibbons were videotaped by Peter Livermore (Geissmann *et al.* 2000). During 14 full days within 6–19 March 1999 surveying the Nam Kan catchment (in the south of the NPA), Geissmann (2007b) used eight listening posts registering, in total, 62 song bouts of Western Black Crested Gibbon. At least 13 groups were involved in the c.6 km² surveyed. Gibbons were twice seen: both times they fled immediately. The local Hmong said there is a taboo against hunting gibbons in the area, introduced only in 1975, because gibbons are basically harmless (do not raid crops), and give a pleasant song in the morning. During 2004–2006, J.-F. Reumaux (in Mootnick 2006) knew of 11 families in a portion of Nam Kan, with credible reports of a further seven; but most of the NPA has not been evaluated for gibbon status. In 2007–2008, in several sightings the gibbons have not been very shy (compared with their typical 1999 reaction), suggesting a reduction in their fear of people (J.-F. Reumaux verbally 2008). Boonphanh Bounthansty (verbally 2008) has heard gibbon reports from nowhere in Bokeo province except within Nam Kan NPA.

Lower Nam Tha, Bokeo and Oudomxai provinces

Locator: c.o. 20°08′N, 100°39′E

Level of evidence: reported

Last positive information: [2008]

Notes. Geissmann (2007b) interviewed villages along the lower Nam Tha (south of Nam Kan NPA) during 21–23 March 1999; at Ban Paktha (where the Nam Tha joins the Mekong), two upstream villages up to 13 km north-east, and four further villages up the Nam Hat tributary. Gibbons were said to be long gone from most villages, perhaps in the 1960s; but one hunter reported that he saw a group in the early 1990s at Ban Hanly; this lay too far upstream for a visit to be practicable. Villagers stated in January 2008 that gibbons were present on the right bank of the Nam Tha river upstream of Ban Pakhad (continuous with the Nam Kan NP, and one of Geissmann's interview villages) until a decade previously. Gibbons can still be found in front of Phak Kho (J.-F. Reumaux *in litt.* 2008).

Muang Ngoy, Louangphabang province

Locator: c.o. 20°40′N, 102°45′E

Level of evidence: reported

Last positive information: [2008]

Notes. J.-F. Reumaux (*in litt.* 2008) received reports in January 2008 that gibbons occur around Muang Ngoy Kao, in at least three sites, Pha Deng, Pha Man and Pha Noke.

Muang Viangkham, Louangphabang province

Locator: c.o. 20°30′N, 103°00′E

Level of evidence: reported

Last positive information: [2008]

Notes. J.-F. Reumaux (*in litt.* 2008) received reports in January 2008 that gibbons with black cheeks still occur in Muang Viangkham, a small part of which lies within Nam Et–Phou Louey NPA (which see). (Sites in Hamada *et al.* (2007: 163) located in

"Muang Viengthong, Louangphabang province" are covered under Nam Et–Phou Louey NPA, and this district (Viangthong) is in Houaphanh province, not Louangphabang.)

Nam Et–Phou Louey National Protected Area (1993)

Locator: 19°50´–20°50´N, 103°00–53´E

Level of evidence: confirmed

Last positive information: 2008

Notes. Respondents in many, but by no means all, villages questioned during 1989–1993 reported gibbons from their area: five out of six in the Nam Et sector, 14 out of 20 in the Phou Louey sector, and six out of 11, with three further reporting extinction, in the then Muang Hiam potential NPA (not all of which lies in the area eventually accorded NPA status) (Salter 1991c, Duckworth *et al.* 1999: Annex 5). Xiangkhouang province staff surveying mai long leng (conifer wood) in 1996, in the Nam Chat catchment (Muang Phoukout), heard gibbons (Sing Souphagna verbally 2008). Field surveys were undertaken from mid March to late May 1998 (Davidson 1998, 1999a). In the Nam Et sector, one group was heard from a camp west of Ban Houayha at 20°36´N, 103°45´E in early April. Villagers reported gibbons in the forests of south-eastern Nam Et sector, part of the Nam Neun catchment. In the Phou Louey sector, one group of at least three was heard and glimpsed in semi-evergreen forest at 1450 m on a ridge to the south-west of Ban Namneun in late March. One group were heard in semi-evergreen forest at 1200 m adjacent to cultivated poppy and maize plots, 4–5 km north-west of Ban Namneun, also in late March. Up to six different groups could be heard from the south-eastern slopes of Phou Louey in May. Village interviews recorded gibbons as persisting around 12 of 15 villages; they were said to be extirpated at one, and the situation was unclear for the other two. Villagers in Ban Nampoung reported that Hmong people frequently hunted gibbons for food in the upper reaches of the Nam Poung, and so gibbons were now rare there: corroborating this, none was heard there during four days of survey. To the south-east of Phou Louey, gibbons were reported from the area around Ban Phanlo, which was not surveyed. Villagers at Ban Sopkhao reported that gibbons were formerly present in their area, but that none had been seen or heard for some years. Most villages consider gibbons to be one of the most highly reduced species of local wildlife: elders often spoke of the past as having many more gibbons (Davidson 1998, 1999a). A tape-recording from the Phou Louey sector survey confirmed the identification as Northern White-cheeked Gibbon (T. Geissmann *in litt.* 2008). Field surveys in 2000–2002 encountered gibbons only rarely. In interviews in those years, villagers considered a 60–90% decline over the previous 10 years, a rate which lay in the top quarter of speed of decline by the wide selection of large mammals of the mammals assessed (Vongkhamheng 2002). This survey's field records were mainly from pristine evergreen forest and quite remote from villages, near Phou Nampa (in the north-east); the vicinity of Phou Louey (west), and in the southern portion of NPA. The only group audible from a village was around Ban Baumfart. Moreover, Xang Sanaphone (verbally 2008) has heard recent gibbon reports from nowhere in Houaphan province except within Nam Et–Phou Louey NPA: they are particularly numerous in the Nyot Nam Noy (headwaters of the Nam Noy). Villagers reported in May 2006 that gibbons persisted around Ban Sakok (20°11´N, 103°12´E), where people believe that gibbons are closely related to people so have a taboo against shooting or eating them (Hamada *et al.* 2007, who erroneously located the site and district in Louangphabang province). Villagers may also have reported gibbons around Ban Namsat (20°07´N, 103°20´E) to Hamada *et al.* (2007), but inconsistency between map (Fig. 9) and text (see Muang Houamouang, Houaphan province) makes this unsure; these villages are in and on the

border of the NPA. T. Saythongdam and colleagues (verbally 2008) who have undertaken Tiger-related surveys annually in the NPA since 2003 have heard gibbons in scattered places over most of the NPA, although none was heard in the north-east part during survey in 2007–2008. In some parts of the NPA, one needs to walk for two days from the nearest village to be sure to find gibbons. But in Ban Baumfart they can be heard from the village, and from Ban Sacko it is necessary to walk only for half-an-hour or so. In the areas which still hold gibbons, they are typically heard most days, but rarely involving more than one group per day.

Muang Xiangkho, Houaphan province

Locator: c.o. 20°50´N, 104°10´E

Level of evidence: reported

Last positive information: [2008]

Notes. J.-F. Reumaux (*in litt.* 2008) received reports in January 2008 that "a few" gibbons persist in this district as well as around Samla.

Muang Houamouang, Houaphan province

Locator: c.o. 20°06´N, 103°45´E

Level of evidence: reported

Last positive information: [2006]

Notes. Villagers may have reported in May 2006 that gibbons persisted around each of Ban Soblab, Ban Kangkhao and Ban Nakeng (Hamada *et al.* 2007); however, the text sates that they were found in four (of 19) sites in Houaphan–Louangphabang–Oudomxai provinces, whereas the relevant map (Fig. 9), from which the site names were taken, gives five sites; so one of these may be bogus. A small part of this district lies within Nam Et–Phou Louey NPA (which see)

Nam Xam National Protected Area (1993)

Locator: 20°02–14´N, 104°18–53´E

Level of evidence: confirmed

Last positive information: 1998, [2000]

Notes. Respondents in all 11 villages questioned during 1989–1993 reported gibbons from their area (Duckworth *et al.* 1999: Annex 5); this is a high proportion for an area in the northern highlands. During a January 1998 survey, in Nam Xam East three gibbon groups were heard calling daily from the Phou Long ridge, and single groups were watched on the central north facing slope; at the east end of Phou Long ridge; and south-west of the Phou Long ridge on slopes of Phou Pavi. Three groups were heard daily from hills 6 km west of Ban Na-me, with a further two groups heard en route for Ban Houatan. In the south of the NPA, old-growth evergreen forest around the head of the Houay Poung (800–1000 m) was estimated to hold at least 4–5 groups. In Nam Xam West, at least four groups were heard daily and a male was observed at 1490m in broadleaf evergreen/Fokienia forest around Phou Xang Khom. Villagers reported that gibbons persisted widely, even though they also highlighted the incessant demands of itinerant Vietnamese traders to buy wildlife, specifically including infant primates, from them (Showler *et al.* 1998b). Tape-recordings from this survey confirmed Northern White-cheeked Gibbon in the NPA (T. Geissmann *in litt.* 2008). During 1999–2000, there were village reports of gibbons from Muang Xam-Tai, especially at Ban Khouanamxam-mai, Ban Longkhem, Ban Xamtaikhason, Ban Muangphao and Ban Phouxangkhon, and in Muang Viangxia, from Phou Samliang

where they were reported to be common (Aiyako Kandasak and La Khamvongxa verbally 2008). Both sources however placed a caveat on the identifications (sect. 1.7).

Northern Xiangkhouang province

Locator: c.o. 19°50′N, 103°20′E

Level of evidence: reported

Last positive information: [2008]

Notes. Gibbons were reported by respondents in some of the forests adjacent to various open and degraded areas in the province, some of which may have been between Ban Phonsavan and Ban Keoleuk (=Ban Nyawt Liang; 19°49′N 103°45′E) (Schaller & Robichaud 1996). The Pung Chong–Phou Sabot area of Muang Nonghet and Muang Kham reportedly still has gibbons (Sing Souphagna verbally 2008). Specifically, S. Schipani (*in litt.* 2008) received reports of gibbons persisting, in 2008, one day's walk from Ban Pavai in Muang Nonghet.

Southern Xiangkhouang province

Locator: c.o. 19°00′N, 103°40′E

Level of evidence: reported

Last positive information: [1996]

Notes. Gibbons were reported by respondents in some of the forests adjacent to various open and degraded areas in the province, some of which may have been in areas to the south of Ban Phonsavan (Schaller & Robichaud 1996). There are recent village reports from Muang Phaxai (V. Vongsihalath verbally 2008).

Muang Hinheup, M. Feuang, M. Vangviang, M. Kasi and M. Met, Vientiane province

Locator: a 122,333 ha area, mostly part of the Nam Lik catchment, within 18°39′–19°07′N, 101°55′–102°21′E.

Level of evidence: confirmed

Last positive information: 1999

Notes. In this area, close to the type locality of Northern White-cheeked Gibbon, and which was placed in the late 1990s into the Hipa Licence Area, Division Seven, gibbons were reported to occur throughout Division 7, but each group of hunters knew of only one group in the area they regularly hunted in. Gibbons were heard calling only once, from the south of the Nam Lik c.8 km east of Ban Namphouk, at 11h30 one morning between 20 August and 3 September 1999. In Ban Namon, a juvenile was captured and brought to the village during this period and shown to the survey team (HFI 1999).

Muang Xanakham, Vientiane province

Locator: c.o. 18°10′N, 101°40′E

Level of evidence: reported

Last positive information: [2003]

Notes. Along the route of the proposed Na Sack–Knockhao Do road upgrade, villagers reported in late 2000 that ten years previously they had often heard gibbons, but that they have since declined rapidly and in recent years, "the wind must blow just right" for one to hear their calls, generally coming from the area around Phou Phoo. The field part of the survey (22 October–3 November 2000) had no direct contacts, but was very

brief (Hedemark *et al.* 2000). In 2003 K. Khounboline (*in litt.* 2008) was told by villagers that gibbons persisted in the west of the district, which is predominantly evergreen forest admixed with bamboo.

Muang Sangthong, Vientiane municipality

Locator: c.o. 18°20′N, 102°10′E

Level of evidence: confirmed

Last positive information: 1996

Notes. Following reports from villagers given in Foppes (1995) of gibbons in Sangthong, at least six groups were found around Ban Wangma in February 1996, with four audible from the village itself; another group was heard north of Ban So, on Phou Van Yap, on 8 July 1996. Villagers claimed that gibbons occurred very locally at scattered other sites in the survey area, even in the south around Ban Napo: although this could not be confirmed by field survey, the number of days there was insufficient to conclude that they were extirpated. Other specific reports were from: north-west of Ban Namiang; near the Nam Nyong, Ban Napo; from Ban So in Dong Phakhen (common) with several groups closer to the village (all several km away) particularly to the south-west and north, to the east of the Nam Sang [where occurrence was confirmed during the survey], with smaller numbers south of the village and east of the Nam Sang, e.g. Phou Hoyyin; and from Ban Kuai, with the closest gibbons 6–7 km to the east-north-east on the forested ridge called Nyong Khong (the watershed of the Nam Nyong), where they had been heard in 1996. Only in Ban Houaytom did villagers consider that there were no gibbons in their area. The groups actually heard during the field survey were all in heavily logged forest. Villagers were adamant that they did not kill the species because of the risk of heavy fines (Duckworth 1996a, 1996b). In about 2005–2006 many (perhaps 200) families moved from around Louangphabang into the Ban Wangma area and are undertaking shifting cultivation (C. Sisomphone, V. Vongsihalath verbally, separately, 2008) and the current status of these gibbons must be tenuous, if they persist at all.

Phou Phanang National Protected Area (1993)

Locator: c.o. 18°15′N, 102°20′E

Level of evidence: reported

Last positive information: [1983]

Notes. Gibbons were said by local people during interviews in 1983 to occur (Sayer 1983). It is unclear whether gibbons persist there (Khamxamay Soukphengxy verbally 2008). This NPA has apparently never been surveyed for wildlife, despite its proximity to Vientiane and cultural significance.

Phou Khaokhoay National Protected Area (1993)

Locator: 18°14–34′N, 102°44′–103°29′E

Level of evidence: confirmed

Last positive information: 2007

Notes. Gibbons were said by local people during interviews in 1983 to be common (Sayer 1983). They were reported by respondents in 14 of 16 villages questioned during 1989–1993 (Duckworth *et al.* 1999: Annex 5). Gibbons were heard calling in Nam Poun forest (roughly level with km 34 on the Muang Hom road) in mid May 1993 (Walsh 1993). One party was heard north of Ban Nakhay, probably in dry evergreen forest, on 2 April 1994 (c.500 m), and two groups were heard in five days of fieldwork

around the Nam Mang in October 1994 (150–500 m) (Evans *et al.* 2000). During rainy season 1994, gibbons were heard calling on the east bank of the Nam Mang near Phou Khonhouat (Payne *et al.* 1995). One group was heard in 'ecotype 5' during June 1996 assessment work for the Nam Leuk hydropower project; gibbons were reported slightly more widely in the NPA by hunters, but not in most 'ecotypes' (M., S. and A. Watson *in litt.* 2000). Guillén *et al.* (1997: 6) "had very little time, aside from the bat surveys, to search for other wildlife", but on 4 and 5 June 1997 heard a group of calling gibbons far from any of the 1994 records: around Dan Phokeng, several hundred meters south-west from the main Muang Hom road, about 3 km before the road to the dam site. No lengthy survey has been conducted in Phou Khaokhoay NPA, ironically in view of its proximity to Vientiane, but piecing together the available records and in the light of specific effort to find gibbons (discussed in Payne *et al.* 1995), Evans *et al.* (2000: 80) concluded that "densities seemed to be particularly low in Phou Khaokhoay NPA by comparison with other areas surveyed in Lao PDR in 1992–1996". A fairly dense population of pale-cheeked gibbons, totalling at least 11–12 groups (estimated by locations of singing animals) was found around Ban Phoukathap in the rugged terrain in the Longxan valley (along the east part of the northern edge of the NPA) in the 1999–2000 dry season, where a local tradition prevents hunting of them; gibbons seemed then to be absent from forest (apparently suitable on habitat grounds) in many other areas of the NPA (J. W. K. Parr verbally 2008). Major Phouvanh Lolaxan (verbally 2008) heard at least five groups of gibbons in this same area in 2007. This was after a big forest fire which destroyed or damaged much of the habitat (K. Schwettmann *in litt.* 2008). The gibbons in this area are still locally protected from hunting (Major Khamphan Douangvilay, per K. Schwettmann *in litt.* 2008).

Nam Gniap catchment, Bolikhamxai and Vientiane provinces

Locator: c.o. 18°50′N, 103°30′E

Level of evidence: reported

Last positive information: [2008]

Notes. During early 1999 assessments in the Nam Gniap catchment, which were rather fragmentary based on security concerns, gibbons were apparently never observed or even heard directly. In most of the six villages reporting gibbons (Ban Muangbo, Ban Hatyuen, Ban Muangmai, Ban Sopphoun, Ban Namyouk and Ban Sopyouk) the nearest animals were said to be 1–3 hours walk away. Hunting was openly admitted, using guns, and five of the six villages said it was now hard to find gibbons, and becoming yet harder. The other, Ban Namyouk, said it was easy to find gibbons, and also averred that no hunting of them took place (M., S. and A. Watson *in litt.* 2000). In 3–4 visits in the "last few years" by J.-P. Pedrono (verbally 2008) to forest along the Pakxan–Xaisomboun road, no gibbons have been encountered directly, despite some suitable-looking habitat and villagers' assurances (e.g. at Ban Sopyok) that gibbons remain. Some of the catchment lies in Muang Bolikhan (which see).

Muang Bolikhan, Bolikhamxai province

Locator: c.o. 18°45′N, 103°45′E

Level of evidence: confirmed

Last positive information: 2006

Notes. Gibbons were heard about 1 km south of Ban Phonkham [= Ban Namkham] on 22 April 1998 at 07h30. Villagers said that a group lives close to the village and that there is a "village rule to control hunting of them". Gibbons were also reported from Ban Xienxien and Ban Xiengleu (Anon. [1998]). The forest habitat was then in good condition around Ban Phonkham, which was reached by foot from Ban Phadai

(18°40´N, 103°42´E). In Ban Phadai itself, two groups of pale-cheeked gibbons, which are protected by village tradition, were found in about 2006, of which one inhabits largely secondary forest (C. Hallam *in litt.* 2008). Much of this district lies in the Nam Gniap catchment (which see).

Muang Viangthong, Bolikhamxai province

Locator: c.o. 18°42´N, 104°10´E

Level of evidence: confirmed

Last positive information: 2008

Notes. One was seen during a brief visit to Pha Khok (18°44´N, 104°13´E) in early 1995 (WCS 1995b, Evans *et al.* 2000). Near the northern margin of the NPA, Ban Khontao (18°40´N, 104°08´E) still has intact hunting and eating taboos for primates, although this is changing with new generation. Gibbons are heard right beside their rice fields, and at least six groups live within 10 km of the village (C. Hallam *in litt.* 2008). Some of this district lies in Nam Kading NPA (which see).

Nam Kading National Protected Area (1993)

Locator: 18°11–39´N, 103°54´–104°44´E

Level of evidence: confirmed

Last positive information: 2008

Notes. Respondents in both villages questioned in December 1991 reported gibbons from their area (Salter 1991e, Duckworth *et al.* 1999: Annex 5). In December 1994–April 1995, numbers of gibbons were high in the NPA forests (and many sightings showed that they are pale-cheeked gibbons), with typically 2–3 groups heard from a fixed spot each morning. Even from within the houses of Ban Kengbit (then on the north bank of the Nam Kading by the inflow of the Nam Ao), animals could be heard calling in forest on the opposite side of the Nam Kading, in January 1995; but they were not heard from this village during substantial time in March–April, after construction of the Theun–Hinboun dam, with necessary influx of workers, had begun. They were heard throughout the interior areas of the NPA surveyed except around Ban Donme and the north slope of Phou Ao. Around Ban Donme, the site of a longstanding village now occupied intermittently, they may have been eradicated. They may also not occur in two areas abutting the southeast of the NPA, the Nam Ao forest (calls heard in this area probably originated from the slopes to the southwest) and the Nadee Limestone area, where none was heard (WCS 1995b, Evans *et al.* 2000). In early 2005, parts of the NPA were again surveyed. Nine campsites were established along the Nam Kading river between 18°15´53˝N, 104°27´41˝E (roughly midway between the Theun–Hinboun dam and the Nam Mouan mouth) down to the mouth of the Nam Tek. At each of the first eight sites, that is, all of them downstream as far as Ban Donme, 1–3 groups of gibbons were heard calling in the morning. Beyond Ban Donme, no more were heard (and in the two mornings spent near Ban Donme, gibbons were heard just once, distantly upstream, deeper into the NPA). This resembles encounter frequency and distribution in 1995. A female was seen on the south side of the river (Sayphou Phapet [southwest NPA] survey sector) between Ban Donme and the Nam Tek mouth. Gibbons were heard (from three different sites) on three mornings of five spent in the Sayphou Talabat [northwest NPA] survey sector; twice two groups were heard and once one group, none close. On the single morning spent in the Sayphou Ao [southeast NPA] survey sector, 3–4 groups were heard. None was heard from the Nam Xouang above the Nam Hinlat. In other areas, surprisingly, at least three groups were heard one morning fairly close to a new Hmong village in the Nam Mut area (this is far from those villages listed in Table 3). This included one

group calling from forest at the edge of the Nam Tek headwaters sector and at least two groups calling at the edge of the Sayphou Talabat sector. Villagers in Ban Namtek (where no mornings were spent) said that gibbons could usually be heard from the village. Only a single very distant group was heard from the Nam Xouang–Nam Mouan confluence, on one of the two mornings there. In sum, gibbons are evidently widely depleted, doubtless through hunting, with natural densities now only in remote parts of the NPA, where populations remained broadly stable between 1995 and 2005 (Timmins & Robichaud 2005). During 2006 and 2008, gibbons were recorded in many parts of the NPA, including the north-west, north-east, west, centre, east and south-east, but survey has not yet been spatially comprehensive enough to be sure that they persist throughout the NPA or that the areas without records in those years actually lack gibbons; local personnel considered that populations were declining during the preceding five years and assessed them as absent from some substantial parts of the NPA (Hedemark *et al.* 2006, Johnson 2006b, C. Hallam *in litt.* 2008).

Nam Theun Extension proposed national protected area (relatively equivalent to Nam Chat–Nam Pan Provincial Protected Area), Bolikhamxai province

Locator: 18°21–48′N, 104°45′–105°12′E

Level of evidence: confirmed

Last positive information: 1999 [c.2007]

Notes. Only two brief song bouts, possibly from the same party, were heard during nine days spent at 600–900 m in January–February 1994 (Evans *et al.* 2000). Expanded coverage of this area in 1996, including the 'Nahoua logging road' within the PPA and the Nam Gnouang area outside it, to its west, found gibbons only along the Nahoua logging road, where one group of pale-cheeked gibbons was observed on 14 April. Calling was heard much less frequently than in any other large forest tract surveyed in Lao PDR during 1992–1996 excepting Phou Dendin and Phou Khaokhoay NPAs (Tizard 1996, Duckworth 1998). In February–May 1997, a solitary female was seen above the Nam Dthang on the trail to Vietnam (900 m) and a presumed family group was encountered nearby (720 m amsl). Despite good weather, no calling was heard in apparently ideal habitat on Phou Chomvoy (800–1800 m) or along the Nahoua logging road (800–1200 m). One or two groups were heard on most mornings throughout the Nam Chat catchment (Nam Chat, Nam Theung and Nam Dthang; 500–650 m). The species thus occurs across much of the PPA, but at low densities (WCS 1997). Gibbons were heard on six mornings during several short forays into the area in 1998–1999, and once were glimpsed near the Nam Ta. Not all mornings were conducive to hearing gibbons however. On two mornings gibbons called from a forested hill just across the Nam Chat river from Ban Vangban. An old Hmong man carrying 19 box turtles Cuora and one skinned dried gibbon carcase was encountered along the lower Nam Ta (Robichaud & Stuart 1999). There are recent reports from Ban Thongphet, Ban Nahoua and Ban Naheuang (Keovongdouan Phanthanouxee verbally 2008). In sum, all surveys noted low densities, sometimes proposing that the weather at time of survey had reduced calling levels, but WCS (1997), spending longer in the area, with much good weather, still recorded only rather little calling and speculated that the low densities reflected hunting pressure. This may be too simplistic (sect. 2.4.1) and relatively low densities have been found in all other 'wet evergreen forest' areas surveyed in Lao PDR.

Phou Hinpoun (= Khammouan Limestone) National Protected Area (1993)

Locator: 17°26′–18°05′N, 104°25′–105°10′E

Level of evidence: confirmed

Last positive information: 2008

Notes. Respondents in all of 14 villages questioned in December 1991 reported gibbons from their area (Salter 1991e, Duckworth *et al.* 1999: Annex 5). In 1996, gibbons were heard on all mornings except those in the Phou Onghon area. Highest calling densities were in the Khuadhin area, with at least four and five (possibly seven) groups heard on the two successive mornings here. These calling densities approach the highest ever found in Lao survey areas. In the 'Southern Habitat Link', groups were heard from both the escarpment and the limestone (Timmins 1997). Gibbons were reported as persisting at all 12 villages interviewed in January 1998 (Steinmetz 1998c). During 12 March–5 April 1998, they abounded throughout the central forest area, especially at Khuadhin where the highest calling densities (2–3 groups per morning, compared with 1–3 groups daily at Tham Pai) were heard and the most groups (two, both confiding) were seen. At Tham Pai, a group was seen in tall Lagerstroemia-dominated mixed deciduous forest. They were less prominent at the Khoaun Huy site, although still common, being largely restricted to semi-evergreen forest up on the karst and cliff tops, with calling bouts less discernible to observers down below (Steinmetz 1998b). Gibbons were heard on 2 February 1998 from the Tam Pha Tok camp: dense semi-evergreen forest, lightly logged, around 18°02´N, 104°24´E (Robinson & Webber 1998). Villagers reported in May 2005 to J. Johnston (*in litt.* 2008) that gibbons can be heard all year around Ban Konglo (Konglo Caves) and S. Schipani (*in litt.* 2008) heard them there in 2008.

Nam Theun Corridor (national protected area status)

Locator: 17°46´–18°10´N, 104°48´–105°06´E

Level of evidence: confirmed

Last positive information: 2004

Notes. During early 1995, gibbons were heard from forest upstream of Keng Louang (keng: 18°11´N 104°44´E) (Evans *et al.* 2000). No gibbons were heard on the two mornings spent in early 1996 along the Nam Theun downstream of the (then, future) Nam Theun 2 dam-site (Timmins 1996). In about 2004, R. Mollot (*in litt.* 2008) heard a group of gibbons around the location of the proposed Nam Theun 5 project.

Nakai plateau (partly National Protected Area, 1993)

Locator: 17°36´–18°00´N, 104°52´–105°32´E

Level of evidence: confirmed

Last positive information: 2008

Notes. Respondents in all of 42 villages questioned during 1989–1993 reported the species from their area (Salter 1990a, Duckworth *et al.* 1999: Annex 5); some, perhaps most, of these were elsewhere in the Nakai–Nam Theun NPA. Surveys in two consecutive years found that pale-cheeked gibbons (confirmed by many sightings) were widespread and locally numerous in January–April 1994 and February–March 1995, with typically 1–3 calling groups heard from a given spot per morning. The animals could even be heard from within the huts of Ban Nam Xot (in 1995), Ban Khawhiang (1995), Ban Soupen (1994) and other villages. However, they seemed scarce in some areas: in 1994, none was heard near Ban Kha-oy on four mornings, where one hunter said that they were not found, although another said they could often be heard nearby. No more than two groups were heard on any morning on a three-day boat trip up the Nam On, which was quite surprising given the distance from villages and the apparent suitability of habitat (R. J. Timmins *in litt.* 1995). The population in the Nakai–Nam Theun NPA away from the Nakai plateau is probably

larger than on the plateau itself, and the combined population was adjudged to be probably one of the largest remaining of any crested gibbon in the world (WCS 1995c, Evans *et al.* 2000). Subsequently, during 5 and 10–16 February 1996 gibbons were heard daily (Timmins 1996), and Francis *et al.* (1996; C. M. Francis *in litt.* 2008) saw a troop of at least five at the edge of the escarpment near the origin of the Nam Thon during 24–30 April 1996. In the next decade there was very little wildlife recording on the plateau, but D. Van Gansberghe (*in litt.* 2008) heard gibbons around Ban Thalang (= Ban Namtheun) in March 2006. During a survey of the plateau's rivers, mostly in the forest parts, in January–early April 2007, gibbons were heard on only 16 (out of well over 60) mornings; only on one of these was more than one group heard, with singles at two different points. There were multiple records from along the Nam On, the Nam Theun both upstream of the Nam Noy and downstream of Ban Thalang, and the Nam Mon (Xot), with single records from the Houay Xot (Noy), the Nam Noy, the Nam Xot and the Nam Yang. A group of six was seen in the Thousand Islands area on 3 April 2007. Singles were seen above the Nam Gnala and in the Thousand Islands area on 4 and 5 June 2007 respectively. Prolonged song was heard from north-east of Nong Bian, on 27 April 2007, which lies south/west of the Nam Theun, the more heavily settled part of the plateau; but the animals were presumably to the north/east of the river. There were evidently steep declines between 1994–1996 and 2006–2007, given the paucity of sites from which multiple groups were heard calling in 2006–2007, and the relatively large number of sites in outwardly suitable habitats where groups were not heard (Dersu 2008). During 2007–2008, G. C. Coffmann (*in litt.* 2008) heard gibbons calling in both 'Zone A' and 'Zone B' almost every morning that she camped in the forest; e.g. quite a few were audible near constructed wetland A3 on 27 January 2008. Part of the Nakai plateau lies within Nakai–Nam Theun NPA, but all records are treated here given its ecological unity (as in, e.g. Thewlis *et al.* 1998).

Nakai–Nam Theun National Protected Area (1993)

Locator: 17°36´–18°23´N, 105°02–46´E

Level of evidence: confirmed

Last positive information: 2008

Notes. Respondents in all of 42 villages questioned during 1989–1993 reported the species from their area (Salter 1990a, Duckworth *et al.* 1999: Annex 5); some of these were on the Nakai Plateau. In a lengthy and wide-ranging survey in January–April 1994, gibbons were recorded throughout the visited sectors of the NPA. The highest calling densities seemed to be in the dry evergreen forests of the Central Mountains in April (1000–1600 m; including along and around the Navang [unused] logging road), where 2–4 parties were heard each morning. The highest record was of a male sighted on Phou Laoko at 1800 m. Within earshot of less remote sites around the Nam Kata valley (January), middle Nam Xot (January) and Nam Pheo, calling was typically heard from 1–3 directions per morning, but only a few minutes at the first two (Timmins & Evans 1996, Evans *et al.* 2000); in the Southern Mountains none was heard from within villages (although little forest remains within earshot, except at Ban Guner and Ban Poung), but at Ban Guner, two calling groups were heard at dawn from a vantage point a few hundred meters from the village on the one morning spent there (Timmins & Evans 1996). Timmins & Evans (1996: Figure 21) mapped the locations of all records and the few sites where no gibbons were heard but habitat appeared to be suitable. Males had whitish, rather than buff, whiskers, more extensive than shown by males in Xe Bang-Nouan NPA, reaching up to approximately the level of the eye–ear line. Captive Northern White-cheeked Gibbons from northern Vietnam (held at the Bronx Zoo, New York, U.S.A.) viewed shortly afterwards had far more extensive white cheeks, reaching higher than the eye-ear line. Thus, morphologically,

these animals were suspected to be Southern White-cheeked Gibbon (Timmins & Evans 1996), an identification corroborated by calls tape-recorded on these surveys (T. Geissmann *in litt.* 2008). In April–May 1996 up to four groups were seen almost daily along the last few miles of the Navang logging road (which remained unused by vehicles); in this area gibbons (as most mammals there) were unusually confiding by comparison with other Lao sites (Duckworth 1998), as they had been in 1994, when in four observer-days there were at least ten sightings involving three or more groups. They were neither particularly shy nor alert when found (the observer often detected them before they detected the observer), presumably indicating a history of low hunting pressure (R. J. Timmins *in litt.* 1995). In 1995–1996, N. L. Ruggeri estimated a density of 0.95–2.2 groups of gibbons per km² in this part of the NPA (WCS 1996). In February–May 1997, two separate males were observed along the Navang (still unused) logging road (900–1200 m) and five groups were observed in the Houay Morrow and Nam Mon valleys (2–5 individuals; 700–900 m). Up to six calling individuals or groups could be heard from single points along the Navang logging road (700–1300 m), even in fairly degraded forest around the trail to Ban Thaphaiban (650–700 m). Several individuals or groups were also heard on most mornings in the Nam Mon and Houay Morrow valleys. In these three areas gibbons appeared to be shy but common. Calling was heard only three times in montane evergreen forest near the disused logging helipad in the upper Nam Xot valley (1500–1600 m) (WCS 1997). Survey of this NPA in the next few years was much less extensive than it had been in 1994, 1996 and 1997. Calls heard from a camp along the Houay Tong (in the dividing hills, just west of the Nam Theun mainstream) in 1998 indicated three groups in that area, and calls were also heard from Phou Laem (Boonratana 1998c). Gibbons were heard calling at various sites on eight mornings of survey in 1998–1999, but many other mornings were not conducive to hearing gibbons: some were spent inside houses, some were alongside rushing streams, and there were some several-day periods of very high wind and/or rain (Robichaud & Stuart 1999). Gibbon remains were found (with various other wild animals) at a military camp along the Houay Khing, active in wet-season 2000 (Boonratana 2001a). Gibbons were among the wildlife most often recorded by patrols, throughout much of the Nakai–Nam Theun NPA, in 2000–2002 (Boonratana 2003). In the Nam Chae area of Nakai–Nam Theun NPA between about December 2006 and June 2007, gibbons were heard almost every morning for about 80+ days, and were sometimes seen (J. Johnston *in litt.* 2008); contacts were more frequent than the observer had ever had anywhere else in Lao PDR. They were also seen in the Nathon area, up the Nam San (while camera trapping) during March–May 2006, where they seemed much less numerous than in the Nam Chae area; and the camera trap team reported hearing them almost every morning in the Nam On area in October 2006 (J. Johnston *in litt.* 2008). Gibbons are one of eight focal species monitored by forest transects in the NPA by the Watershed Management Protection Authority from 2006 onwards. Compared with the low encounter rates for most arboreal mammals and forest hornbills reported by the patrols in the Navang and Xonglek sectors in 2000–2002 (Boonratana 2003), the detection of these species in the Nam Chae sampling block was relatively high and "the estimated area of occupancy for gibbon is 81%" (Johnson & Johnston 2007: 47); this figure is based upon 295 transects (totalling 526 km) which provided 0.05 sightings per km walked (28 sightings) and 0.33 vocal detections per km walked (173 independent records of gibbon vocalisations). Between these areas, the objectives, methodology and training of people out walking the forest were very different, preventing conclusions about relative status from differences in recorded encounter rates. More generally, across the NPA's forests, gibbons remain widespread, but at uneven densities: they are encountered on most surveys, but not all survey days; and around Phou Vang they seem to be very scarce (W. G. Robichaud *in litt.* 2008). The pattern of patchy

abundance right back to 1994 suggests that natural factors may be important in producing such patterns: low densities should not be assumed necessarily to reflect high hunting pressure (see sect. 2.4.1). Up until at least 2006, when electricity came, and with it loudspeakers and pop music, gibbons could heard from within Ban Navang, one of the largest villages in the NPA and one of the few connected to a road, and which therefore might be expected to have manifest the strongest of hunting-induced declines (W. G. Robichaud *in litt.* 2008). Records from the Nakai plateau within the NPA are treated under the Nakai plateau.

Hin Namno National Protected Area (1993)

Locator: 17°15–40′N, 105°43–106°09′E

Level of evidence: confirmed

Last positive information: 2008

Notes. During a brief reconnaissance in early January 1996, gibbons were heard distantly from the Houay Clocc site on 2 and 3 January, where two animals were also seen on 2 January, and two groups were heard on 9 January from the Houay Talee site. Such a low number of records was "rather surprising given the commonness of other primate species", but may have resulted from the frequent heavy cloud and wind depressing calling levels, rather than genuinely low densities (Timmins & Khounboline 1996: 16). A more intensive survey of the NPA during 9 February–3 March 1998 found again only rather low numbers; the calls tape-recorded on these surveys are of Southern White-cheeked Gibbon (T. Geissmann *in litt.* 2008). In the north of the NPA, single groups were heard in the headwaters of the Nam Ngo and on Phou Chuang. In its central part, single groups were heard on Phou Khaonok (a few kilometers south-west of the NPA boundary) and along the Houay Gouan Xiem, and at least three groups were heard from the higher slopes of Phou Louang (also a few kilometers south-west of the NPA boundary) on the different occasions. The Houay Gouan Xiem site was the only area of limestone where gibbons were heard, but the detailed survey site map (Fig. 4) makes clear that most of the NPA was barely entered. However, sufficient survey was carried out, in the dry season, to make a confident proposal that gibbon numbers in Hin Namno NPA are at least patchily low, and apparently (given the numbers of other primates) this is for natural reasons. In the mid-2000s P. Phiapalath (*in litt.* 2008) investigated the status of monkeys and apes in the Houay Khalo–Pha Khandai area of the NPA, an area of rather flat (but still limestone), lowlands; he found only five groups of gibbons in 143 km of transect. There were also records off transects across a wider area. A group of six was observed in the Pha Khandai foothills (east of 17°29′N, 105°52′E) in February 2008, and gibbons are heard and seen on Pha Kandai (17°27′N, 105°54′E) itself often. Around Kuang Nong (17°31′N, 105°54′E) gibbons were heard daily in February–March 2007. There are also sporadic records from the Houay Kalo around 17°24′N, 105°50′E. Two groups were found around Nong Ban Na (17°25′N, 105°49′E). Gibbons, probably two groups, were commonly heard around Ban Vangmaner (17°31′N, 105°50′E), including close to the village in 2007, although probably less so in 2008. A group was seen around Kuanthoun (17°30′N, 105°49′E) in July 2007.

Muang Boulapha, Khammouan province

Locator: 17°15′N, 105°45′E

Level of evidence: confirmed

Last positive information: 1998

Notes. Gibbons were heard (and tape-recorded, the songs fitting Southern White-cheeked Gibbon; T. Geissmann *in litt.* 2008) on three consecutive mornings during 27

February–2 March 1998 around West camp 1, i.e. c.15 km south of Muang Boulapha, and 20 km SW of the Hin Namno NPA boundary (Walston & Vinton 1999). The area between Ban Thaplao and border with Hin Namno NPA holds at least five groups of gibbons (P. Phiapalath *in litt.* 2008). See also Hin Namno NPA and Xe Bangfai headwaters.

Xe Bangfai basin, Khammouan province

Locator: c.o. 17°15′N, 105°40′E

Level of evidence: reported

Last positive information: unclear

Notes. Villagers reported (presumably in the late 1990s or 2000) gibbons to persist at least some parts of the basin (Shoemaker *et al.* 2001).

Dong Phousoi production forest, in Muang Xebangfai, M. Mahaxai and M. Xaibouathong, Khammouan province

Locator: c.o. 17°12′N, 105°09′E

Level of evidence: reported

Last positive information: [2005]

Notes. Gibbons were reported as persisting in only one of four villages interviewed in June 2002, Ban Nakhamchouang-tai (Robichaud *et al.* 2002), and present at 30 and extirpated in 22 of 56 villages interviewed in 2005 (Poulsen *et al.* 2005).

Nongkapat production forest, in Muang Mahaxai, M. Xaibouathong and M. Boulapha, Khammouan province

Locator: c.o. 17°08′N, 105°51′E

Level of evidence: reported

Last positive information: [2005]

Notes. Gibbons were reported present at one of two villages interviewed in 2005 (Poulsen *et al.* 2005).

Xe Bang Fai headwaters (former potential national protected area), Khammouan province

Locator: c.o. 17°05′N, 106°18′E

Level of evidence: confirmed

Last positive information: 1998

Notes. during a short visit in February 1998, gibbons were heard during the sole morning around Ban Houayhat (St Valentine's day 1998); a group of three was seen in forest at Ban Khoaymep; and song was heard on three consecutive mornings from within primary hill forest on Phou Lennik, to the south of the Xe Bangfai (Walston & Vinton 1999). P. Phiapalath (*in litt.* 2008) believes that the area retains many gibbons.

Muang Vilabouly, Savannakhet province

Locator: c.o. 16°57′N, 106°03′E

Level of evidence: confirmed

Last positive information: 2008

Notes. In October 2000 and January 2001, the villagers in the 'Northern Study Area', in the catchment of the Nam Kok, variously said that gibbons had gone by the mid-1970s or that they still persisted in Phou Padan/Hinsom (the latter is "the most easterly peak of the range" of Sayphou Padan; Crome *et al.* 2001: 1). The nearest forest capable of supporting gibbons was assessed to be "a long way east of Phou Hinsom itself" (Crome *et al.* 2001: 14). However, this statement reflects the erroneous belief that gibbons do not inhabit heavily degraded forest (see sect. 2.5.3), and Crome & Woxvold (2006) later received further reports in early 2006 from Ban Muangluang of gibbons still in Phou Padan; and at least two groups of gibbons were heard and seen on the eastern lower slopes of Sayphou Padan (16°57´N, 106°03´E) on several occasions in late November 2008. They were also heard to the east of Ban Houayhong (17°02´N, 106°10´E) on 8 December 2008 (J.W.D. and Outhai Vongsa unpublished data). Gibbons are still present around Phou Kambung, east of Phou Hinsom, and have also been heard at the mining exploration camp in the Houay Bang area 2 km north of the Phou Padan area (S. Langdon and Chanthone Naovalath *in litt.* 2008). During a 2007–2008 interview survey of part of the district (spatial overlap with the foregoing not established), gibbons were reported in none of seven villages covered (C. Sisomphone verbally 2008). In early 2009, A. Mellor (per C. Hallam *in litt.* 2009) saw a captive Nomascus (apparently a young female starting the moult from black immature pelage to buff adult pelage) at Ban Vangngang (16°56´N, 105°59´E), about 2km south of the Sepon mine complex; it had reportedly been captured near the village and was destined for sale to Vietnamese traders. See also Phou Xang He NPA.

Phou Xang He National Protected Area (1993)

Locator: 16°42´–17°04´N, 105°19´–106°06´E

Level of evidence: confirmed

Last positive information: 2003 [2008]

Notes. Respondents in 10 of 11 villages questioned in January 1991 reported gibbons from their area (Salter 1991a) and in further interviews in 1993 gibbons were reported from 13 villages areas, extirpated in two more, and not reported at all in one (Phanthavong & Dobias 1993). During a field survey in March–April 1993, gibbons appeared to be distributed rather unevenly in the forests of both the NPA's hill ranges, Sayphou Xanghe and Phou Hinho. Up to five groups were heard each morning, but often none was heard. Those sighted were moderately cautious and shy; probably few were present within 2 km of villages, where most forest was heavily degraded (Duckworth *et al.* 1995). Vocalisations in early 1998 indicated two groups in the Ban Nalay area (Boonratana 1998b). In October 2000 and January 2001, villages to the north of the NPA said that gibbons were still common in the Phou Lon (in the Phou Hinho section) and Phou Xang He itself (Crome *et al.* 2001). Crome & Woxvold (2006) received reports in early 2006 from Ban Namkhip and Ban Napo (Muang Vilabouly) of gibbons persisting in Phou Xang He NPA. J. Johnston (*in litt.* 2008) received reports from villagers in Ban Nasalo and Ban Paphaknao (Muang Vilabouly) that gibbons persisted, and heard himself a few distant calls in from Ban Nasalo in November 2003, probably on the shaded northern steep side of the Sayphou Xanghe. During various other visits to the top of the range, near those villages, during March 2002 to November 2003, he heard gibbons no other time. Yet P. Phiapalath (*in litt.* 2008) received reports, in 2008, that the NPA's gibbon population remains quite high. There are reports within the last few years from around Ban Songhong in Muang Atsaphon (Phoutavong Sithidhet verbally 2008).

Dong Nathat conservation area, Savannakhet province

Locator: c.o. 16°38´N, 104°50´E

Level of evidence: reported

Last positive information: [pre-1990]

Notes. Gibbons were reported absent from one village and extirpated by another village, of two interviewed in 1990 (Salter 1990b), and given the small extent of remaining habitat (Evans 2001) are doubtless extinct.

Dong Kapho production forest, in Muang Phin, M. Phalanxai and M. Xonbuli, Savannakhet province

Locator: c.o. 16°32´N, 105°39´E

Level of evidence: reported

Last positive information: [2005]

Notes. Gibbons were reported present at 13 and extirpated in six of 23 villages interviewed in 2005 (Poulsen *et al.* 2005).

Dong Phou Vieng National Protected Area (1996)

Locator: c.o. 16°26´N, 106°58´E

Level of evidence: confirmed

Last positive information: 1997 [2008]

Notes. At an informal interview in 1990, a long-term resident in the Keng Samathai area (in the north-west of the NPA) reported gibbons to persist (Salter 1990b). Four villages in the originally declared area of the NPA were interviewed in April 1997: gibbons were reported to persist by all of them, but only at 2–20 % of their levels 10–30 years ago, among the severest declines of an animals discussed (Steinmetz & Baird 1998). During survey, gibbons were not found at either of two camps in this sector over 6–15 June 1997, but were located daily in the Phou Lapeung extension during 13–18 May 1997, where they were common (Steinmetz 1998a, R. Steinmetz *in litt.* 2008). In the original sector, populations were reported in 1997 to persist in village-protected patches of semi-evergreen forest such as around Ban Vangsikeo (R. Steinmetz *in litt.* 2008). There are recent reports from around Ban Saveu in Muang Nong, and Ban Dongko and Ban Yang in Muang Phin (Phoutavong Sithidhet verbally 2004). Confiding leaf monkeys evidently under no serious hunting pressure were found here in a brief visit in 2007 (Duckworth 2007) but this was too short to determine whether gibbons also persisted. P. Phiapalath (*in litt.* 2008) received reports in mid 2008 that the NPA's gibbon population remains quite high.

Xonbuly Eld's Deer Sanctuary (provincial protected area; 2004), Savannakhet province

Locator: c.o. 16°22´N, 105°32´E

Level of evidence: not assessed

Last positive information: n/a

Notes. Hallam *et al.* (2006), citing Vongkhamheng & Phirasack (2002), stated that gibbons were absent from this area, even though the habitat should be able to support them. In fact, the cited source does not state that gibbons are absent, and it is unclear if their status has been satisfactorily assessed. Gibbons would be expected to be highly patchy in this area, predominantly of deciduous dipterocarp forest, and so could easily be overlooked (cf. Nam Ha NPA). Supporting one of only two populations of

Eld's Deer *Cervus eldii* found in Lao PDR on recent surveys, and that with the better conservation prospects (Hallam *et al.* 2006), any gibbons in the area could potentially be secured with minimal additional effort.

Dong Sithouan production forest, in Muang Songkhon and M. Thapangthong, Savannakhet province (former potential national protected area)

Locator: 15°56′–16°20′N, 105°16′–106°11′E

Level of evidence: reported

Last positive information: [2005]

Notes. Boonratana (2000) spent a week and a half at a field base within this area, yet gibbons were never seen or heard, although of 20 villages, they were reported still to be present by 16, to have been formerly present but with no recent records in two, and to have been never known to occur in two. However, it is not clear from the report how much time was actually spent in the field, and much of Dong Sithouan is deciduous dipterocarp forest unsuitable for gibbons, so they could be easily overlooked even if still locally common. Gibbons were reported as present at all of six villages interviewed in 2005 (Poulsen *et al.* 2005).

Muang Nong, Savannakhet province

Locator: c.o. 16°20′N, 106°40′E

Level of evidence: reported

Last positive information: [2007]

Notes. During a late 2007 interview survey, gibbons were reported in only one of eight villages covered, Ban Phonthong (16°23′N, 106°32′E), where inhabitants reported that some persisted still, at the forest of Tamouhon, near the Phou Lakpeung sector of Dong Phou Vieng NPA. Much rosewood cutting is going on in most of the interview area (C. Sisomphon verbally 2008). See also Dong Phou Vieng NPA.

Muang Somoy, Salavan province

Locator: 16°15–25′N, 106°40′–107°10′E

Level of evidence: reported

Last positive information: [2008]

Notes. During a January 2008 interview survey, gibbons were reported in all nine villages covered (distance refers to village estimate of distance of gibbon area from village): Ban Pin A, on Phou Leloy (8 km) and Phou Khaneo; Ban Lalang, on Phou Amoy and Phou Tamoum (1 km); Ban Atuk, on Phou Asou (2 km), Phou Kan (1.5 km) and Phou Takoi (6 km); Ban Lakai-akong, on Phou Khamoum (4 km) and Phou Kaloi (4 km); Ban Tangko, on Phou Khamoum; Ban Achingleng (10 km from the border of Xe Sap), on Pha Phep (3 m) and Phou Kalang; Ban Lavatai, on Phou Leloy (6 km) and Phou Khadiyep (4 km); Ban Achingngai, on Phou Amay (5 km) and Phou Phaphep (5 km); Ban Pin B, on Phou Leloy (5 km) and Phou Amphay (5 km) (C. Sisomphon verbally 2008). The area overlaps with Xe Sap NPA, which see.

Muang Taoy, Salavan province

Locator: 15°30′–16°03′N, 106°20′–107°15′E

Level of evidence: confirmed

Last positive information: 2007

Notes. During a late 2007 interview survey, gibbons were reported in four of six villages covered: Ban Lapeuang, Ban Gang, Ban Chalaviang and Ban Doub; they were actually heard during short field walks from the latter two (C. Sisomphone verbally 2008). P. Phiapalath (*in litt.* 2008) heard at least five groups of gibbon near Ban Sanyayon (= Ban Ya Yon) on 24 March 2008; and around this time received village reports that gibbons persisted around Ban Kamouan, Ban Donglai, Ban Leukdong and Ban Sanyayon. Gibbons are reported to survive in Ban Phathen, Thong Saat and Houay Hua, all outside Xe Sap NPA (Ekasai Inthalaphet verbally 2008). The spatial relation of these sites with Phou Talava (which see) is unclear. Much of the district lies within with Xe Sap NPA, which see.

Xe Sap National Protected Area (1996)

Locator: 15°56′–16°19′N, 106°41′–107°28′E

Level of evidence: confirmed

Last positive information: 1999 [2008]

Notes. No gibbons were heard in a couple of forays into the NPA from Muang Somoy, totalling about two weeks afield (Schaller & Boonsou 1996). In early 1998, gibbons were reported to occur in the NPA by villagers from Ban Angouas and Ban Dasak. Distant calls of gibbons were thrice heard from Ban Proy, from a forested hill over the Xe Kong river. This is a remarkably low total of direct records, even though the survey spent relatively little time at the NPA (Showler *et al.* 1998a). In early 1999, one group was heard calling at each of the Phou Glem, Phou Abourl and Phou Leng survey areas, while at the Phou Ma Nai site, two widely separated groups were heard. The lowest calling frequency (two of five days) was at Phou Abourl, and the highest (six of eight) at Phou Leng. At all sites, gibbons were heard in hill evergreen forest over c.1000–1400 m, except at Phou Ma Nai where one of the groups called from semi-evergreen forest below 1000 m (Steinmetz *et al.* 1999). A tape-recording (from the Houay Alee, c.1240 m, 16°09′N, 106°55′E, 3 March 1999), shows that they are of *Nomascus sp. incertae sedis* (T. Geissmann *in litt.* 2008). Steinmetz *et al.* (1999: 39) went on to speculate on reasons for these low calling densities. All other surveys into this area, visiting various sites at various seasons, heard gibbons similarly infrequently, warranting the conclusion that "the scarcity of calling records and sightings indicates a low absolute density of gibbons, and is not an artefact". A combination of two factors was suggested to account for low densities. First, villagers in Ban Baten (near Phou Leng) reported a strong decline over the previous 30 years, which they attributed largely to hunting, by local people for subsistence, and by Vietnamese who have had a strong presence in many regions of Xe Sap, especially in the past decade. The second speculates that much of the area surveyed may have been rather too high, i.e. over 1000 m, for high density populations of gibbons; but high numbers in parts of Nakai–Nam Theun NPA contest this explanation. It seems possible that low densities may be natural in this sort of wet forest (sect. 2.4.1). J. Johnston (*in litt.* 2008) was a regular visitor to the Muang Taoy sector between March 1999 and October 2000 and never heard or saw any sign of gibbons. Gibbons certainly persist in the Thongpongsat area of deep forest in Muang Taoy and Muang Kaleum (Sathda Keoduangxee verbally 2008) but it is not clear whether this is in the NPA, and many are reported in the parts of the NPA in Muang Somoy (around Ban Sihai) and Muang Taoy (Ekasai Inthalaphet verbally 2008)

Phou Talava production forest, in Muang Salavan, M. Toomlan, and M. Taoy, Salavan province

Locator: c.o. 15°47′N, 106°30′E

Level of evidence: reported

Last positive information: [2005]

Notes. Gibbons were reported as persisting by the only village interviewed in June 2002, Ban Taleo (Robichaud *et al.* 2002), and present at 18 of 20 villages interviewed in 2005 (Poulsen *et al.* 2005).

Muang Kaleum, Xekong province

Locator: c.o. 15°50′N, 107°10′E

Level of evidence: confirmed

Last positive information: 2008

Notes. Gibbons were reported during December 1993–January 1994 from five villages: Ban Loy-Nua, Ban Dakling, Ban Vak-Nua, Ban Tjrok and Ban Tin; calls were heard on 17 January from near Ban Tin (Bergmans 1995). P. Phiapalath (verbally 2008) heard five groups of gibbons from one point near Ban Sanygnou, on the opposite side of the Xe Kong from Phou Ahyon, in October 2007, at 400–700 m, but (in litt 2008) considers that overall the area's gibbon population is much depleted. He received village reports in March 2008 that gibbons persisted in Ban Talouy, Ban Lem, Ban Proh, Ban Thambeng and Ban Paksay. A young gibbon recently photographed in Muang Kaleum town was reportedly taken locally. According to local reports, gibbons are still common in some forested areas away from the river, but are becoming rare along the river itself (E. Meusch *in litt.* 2008). During more specific discussion in mid 2008, villagers in Ban Trak, on the Xe Kong a little downstream of the district town, said that gibbons used to be quite common, but now there are only very few left (E. Meusch *in litt.* 2008). Much of the district lies within with Xe Sap NPA or Phou Ahyon (which see), and it perhaps overlaps with the Xe Kong Pine Forest former potential NPA (which see).

Phou Ahyon (= Phou Ajol), Xekong province

Locator: c.o. 15°43′N, 107°11′E

Level of evidence: confirmed

Last positive information: 1996

Notes. In 1996, single gibbon groups were heard calling on the mornings of 11, 14, 17, 18 and 20 May, and a male and a black immature were seen on 14 May at 1550 m; all records may have come from a single group. The paucity of records is surprising, and may partly reflect survey timing in the early rainy season. The two individuals seen resembled Yellow-cheeked Gibbon in facial features, with small angled buffy sideburns (Timmins & Vongkhamheng 1996a).

Xe Bang-Nouan National Protected Area (1993)

Locator: 15°44′–16°01′N, 105°53′–106°18′E

Level of evidence: confirmed

Last positive information: 1994 [2008]

Notes. Respondents in 25 out of 28 villages interviewed in 1988–1993 stated that gibbons occurred in and around Xe Bang-Nouan NPA (Salter 1989b, 1990a, Duckworth *et al.* 1999: Annex 5). During May–July 1995, gibbons were widely recorded and reported in the Central Hills and Sayphou Houong/Phou Thauw (300–700 m). Up to four singing groups were audible from a given point during a morning in the Houay Nan sector, and there were five sightings there. Elsewhere, records were far more patchy. Single groups were heard on one morning (of two) spent at Phou Salar on the western edge of the Central Hills and one group was heard from hill

forest south of Ban Naxan (= Ban Nalan), on one of three mornings spent at a listening post. South-west of Ban Konglur, 1–2 groups were heard from the periphery of the Central Hills on the three rain-free mornings this area was visited, but none was heard during one morning spent in the Central Hills at Houay Tolee. None was heard or seen on Phou Houong, although they were reported to be relatively common there. None was recorded on Phou Thauw although again locals reported their presence. They were not in evidence around either Keng Sung or Houay Sadam; habitat around the former is mainly unsuitable. They were generally shy but could be watched if approached cautiously. They were probably largely absent from the dense lowland forests, which were already logged by 1994. Observed males had buff sideburns, which appeared darker than those of gibbons seen in Xe Pian NPA (Timmins & Bleisch 1995, Evans *et al.* 2000), and tape-recordings identify the animals as *Nomascus sp. incertae sedis* (T. Geissmann *in litt.* 2008). P. Phiapalath (*in litt.* 2008) received reports in mid 2008 that the NPA's gibbon population remains quite high, but the basis for this is not given and Duckworth (2007) found massive habitat encroachment of the western lowlands in November 2007, with at best tiny populations of large mammals. Given this, it seems unlikely that the hill forests of the NPA would still widely support good populations of gibbons, or of any hunted species. There are recent reports of gibbons from Phou Phakeo in Muang Vapi (Sathda Keoduangxee verbally 2008) but it is not clear whether this is in the NPA.

Phou Xiang Thong National Protected Area (1993)

Locator: 15°19–56´N, 105°25–47´E

Level of evidence: confirmed

Last positive information: 1996 [2008]

Notes. Respondents in seven of eight villages questioned in November 1989 reported gibbons from their area, one stating that they were locally extinct (Salter 1989b, Duckworth *et al.* 1999: Annex 5). Gibbon calls were heard from Phou Alang on 7 March 1996; from an escarpment 2 km north of the middle Houay Phalaphang valley on 9 March 1996, from south-west or south-east of the observer; from 3-4 km to the south of Ban Donkoum on the lower slopes of Phou Ngou on 7 March 1996. This last record was not of duetting calls and may have been a lone male. No other gibbon calls were heard despite extensive fieldwork in the middle stretches of the Houay Phalaphang and a five-day trail-mapping survey in the upper headwaters. Guides insisted that gibbons were occasionally heard on Phou Kham-Gnai, in the Houay Dua catchment, but in the northern third of the NPA people felt that gibbons were absent. The NPA supports an extremely small population, probably reflecting heavy hunting and relatively poor-quality semi-evergreen forest in parts of the NPA; the table mountains in the south and centre are the main refuges for primates. Their total area is not very large and they are isolated from one another, so they are unlikely to support viable long-term populations unless protection is improved over a wider area (Evans *et al.* 1996a). Boonratana (1998a) heard none in the NPA in December 1997, but had less than a week afield. P. Phiapalath (*in litt.* 2008) received reports in mid 2008 that the NPA's gibbon population had declined following hunting, some of it related to road-building, inside the NPA.

Laongam production forest, in Muang Laongam, M. Khongxedon, M. Vapi and M. Salavan, Salavan province

Locator: c.o. 15°37´N, 106°06´E

Level of evidence: reported

Last positive information: [2002]

Notes. Gibbons were reported formerly to have occurred during village interviews in June 2002 (Robichaud *et al.* 2002), but further interviews in 2005 (at only one village) did not elicit any claim of presence (Poulsen *et al.* 2005).

Xe Kong Pine Forest, Xekong province (former potential NPA)

Locator: c.o. 15°30′N, 106°45′E

Level of evidence: reported

Last positive information: [1992]

Notes. Gibbons were reported by provincial forestry officials in March 1992 (Salter 1992b).

Dakchung plateau, Xekong province

Locator: c.o. 15°30′N, 107°20′E

Level of evidence: reported

Last positive information: [1994]

Notes. Gibbons were reported during December 1993–January 1994 from five villages: Ban Dakdan, Ban Rak, Ban Dakbol, Ban Tangiung (extirpated) and Ban Praungai (Bergmans 1995); however, brief field survey in 1996 and 1998 (Timmins & Vongkhamheng 1996a, Showler *et al.* 1998a) did not find any gibbons on the plateau or receive any further reports. Much of the plateau remained unsurveyed, however. The Xe Kong Pine Forest former potential NPA (which see) may overlap with the plateau.

Phou Theung proposed national protected area and surroundings, Xekong province

Locator: 15°25-54′N, 106°29-51′E

Level of evidence: confirmed

Last positive information: 2006

Notes. Villagers reported gibbons to occur during a February 1994 visit to seven villages (Berkmüller *et al.* 1995a). During field surveys in mixed deciduous–semi-evergreen forest during 16–21 March and in deciduous dipterocarp forest on 19–22 March 2006, singing gibbons were heard thrice, in the Phou Theung (15°30′, 106°39′E) and Phou Samsao areas (c.15°37′N, 106°43′E). All seven villages in the Phou Theung sub-Forest Management Area reported gibbons in their area. Ban Songkhon villagers mentioned Phou Chalang as a main area. Ban Pakkhayong, Ban Pakpoun, Ban Nangyong and Ban Satu villagers mentioned Phou Theung. Ban Gnoktong villagers mentioned Phou Theung and Phou Kathae. Ban Tapouak villagers mentioned Phou Theung and Phou Sanyot (Poulsen *et al.* 2006).

Thateng, Salavan province (former potential NPA)

Locator: c.o. 15°26′N, 106°23′E

Level of evidence: reported

Last positive information: [1989]

Notes. Gibbons were reported in two out of three village interviews held during November 1989 (Salter 1989b, Duckworth *et al.* 1999: Annex 5).

Silivangveun production forest, in M. Xanasomboun and M. Bachiang, Champasak province

Locator: c.o. 15°24´N, 105°58´E

Level of evidence: reported

Last positive information: [2002]

Notes. Gibbons were reported formerly to have occurred during interviews in 2002 (Robichaud *et al.* 2002), but further interviews in 2005 (at only two villages) did not elicit any claim of presence (Poulsen *et al.* 2005).

Muang Lamam, Xekong province

Locator: c.o. 15°20´N, 106°50´E

Level of evidence: reported

Last positive information: [2008]

Notes. P. Phiapalath (*in litt.* 2008) received village reports from Ban Pakpoun and Ban Kayong in October 2007. Villagers report that gibbons persist (E. Meusch *in litt.* 2008). However, during several days bird-watching within 26 January–6 February 2005, J. N. Dymond (*in litt.* 2008) heard none, although he did not enter much of the forest in the district. Much of this district lies in Phou Theung proposed NPA (which see), and it perhaps overlaps with the Xe Kong Pine Forest former potential NPA (which see).

Muang Paksong, Champasak province

Locator: c.o. 15°10´N, 106°15´E

Level of evidence: reported

Last positive information: [2007]

Notes. Villagers reported in August 1998 that a few gibbons persist around the Houay Xai at P.K. 72 (J.-P. Pedrono verbally 2008), in this area where they were abundant in the late 1950s (sect. 2.2). The only place in the district (outside those parts in Dong Hua Sao NPA) still supporting gibbons known to Khamhou Moukdala (verbally 2008) is on the Sayphou Louang near the Houay Ho, on the border of Champasak and Attapu provinces. Much of this district lies in Dong Hua Sao NPA, Bolaven Northeast proposed NPA or Bolaven Southwest proposed NPA (which see).

Bolaven Northeast (= Phou Kateup) proposed national protected area

Locator: 15°00–24´N, 106°23–49´E

Level of evidence: confirmed

Last positive information: 1995

Notes. Gibbons were reported from all villages where presence was checked in 1988–1990 (Duckworth *et al.* 1999: Annex 5; sites mapped in Salter *et al.* 1990). The southern parts of this area, and adjacent parts of the plateau, were surveyed in March–April 1995 (WCS 1995a, Evans *et al.* 2000). Two groups were heard to the east from Ban Taot (800 m) on one of the four mornings there, and one group was heard on the one morning in the eastern part of the Nong Lom forest block, c.2 km north-west of the Xe Nam Noy damsite (800 m). Three parties were heard in one morning from mixed deciduous forest bordering semi-evergreen forest in the middle Xe Namnoy valley (300–400 m), and party was heard calling from hills at the mouth of the Xe Namnoy in April (160–180 m). WCS (1995a) predicted that these remnant groups were likely to be lost in the following few years due to hunting, with little possibility of recolonisation, due to the barriers of cleared habitat. In the 1995 surveys, none was

heard in the plateau forests south of the Xe Pian headwaters, but they were predicted (then) to occur in parts of this area. Remote plateau forests south of Ban Latsaluay were not visited but were adjudged likely to support gibbons. Numbers on the plateau itself were low, reflecting the fragmented and degraded forest.

Dong Hua Sao National Protected Area (1993)

Locator: 14°50′–15°11′N, 105°55′–106°18′E

Level of evidence: confirmed

Last positive information: 1999

Notes. Respondents in ten of 11 villages questioned during 1989–1993 reported gibbons from their area (Duckworth *et al.* 1999: Annex 5). During a May–July 1993 field survey, gibbons were recorded only in pristine or lightly-disturbed evergreen or semi-evergreen forests. They were found in slope forest around Ban Nongkhe and Ban Houayton and on the plateau at Phou Phongkham/Nalong. The only lowlands records were at Quan Mou where they were heard on both mornings spent there. In all four areas, 3–4 groups were heard each morning. No gibbons were recorded from most of the lowland logged forest or in one area of apparently suitable plateau forest. Villagers reported gibbons from other areas of near-intact forest, to the north-west of Ban Nongkhe and around Phou Tabeng (Duckworth *et al.* 1995). Tape-recordings from this survey identify the animals as *Nomascus sp. incertae sedis* (T. Geissmann *in litt.* 2008). In a January–March 1996 re-survey of the lowlands, population were again thought to be centred on the escarpment slopes, but the occupied area was more extensive than previously thought in the area between Ban Nongkhe and Ban Houayphoung, and a number of outlying groups were found scattered across the logged lowlands. In detail, up to three parties were heard per morning in the Houay Sout valley, but there were apparently fewer around the Houay Bangliang itself (Houay Bangliang sector). In the Houay Takit sector, three parties were heard on the escarpment slopes of Phou Pong (sometimes audible from the logged lowlands as far away as Nong Ngu). In the Middle Houay Namphak typically one party (occasionally two) could be heard during a morning from any limited area, including the vicinity of Ban Nongkhe. All parties were in the unlogged slope forests north of Houay Namphak or the hilly unlogged forest on both sides of Houay Nyat. Around Ban Houayphoung, up to three parties were audible in lightly logged forest within 2 km of the village to the north and north-west. One lone male was heard in heavily degraded forest south of Nong Hou on the sole morning spent there. Gibbons were predicted to be absent from these two areas by Timmins *et al.* (1993a) on the grounds that the forest had been logged. Around Ban Nongpop (Ban Somsup), one party was heard well to the west of the village itself (where none was recorded in 1993) and one party was seen and another heard in semi-evergreen forest close to Quan Mou, where they were present in 1993 (Evans *et al.* 1996b). Boonratana (1998a) heard gibbons in two of his three surveys areas of the NPA in November–December 1997, each with about a week afield. Gibbons were widely recorded by patrols across the NPA in 1996–1999, but in by no means all sectors each year, and a week's direct wildlife survey in September 1999 had no direct encounters with any primates (Boonratana 1999). Three mornings round Ban Nongpop in December 2007 recorded no gibbon song; since the 1990s surveys Quan Mou and various other areas had been converted to cultivation (Duckworth 2008), but there are still reports from around Phou Tabeng (Khamhou Moukdala verbally 2008). Somphong Bounphasy and I. G. Baird *in litt.* 2008) related that small groups remain around Ban Houayton and Ban Nongayk (Khet Phoutabeng).

Bolaven Southwest (= Phou Louang) proposed national protected area

Locator: 14°42′–15°06′N, 106°21–39′E

Level of evidence: confirmed

Last positive information: 1995

Notes. Gibbons were reported from all villages where presence was checked in 1988–1990 (Duckworth *et al.* 1999: Annex 5; sites mapped in Salter *et al.* 1990). During a rapid reconnaissance in April 1995, they were found in all three areas where early morning visits were made to semi-evergreen forests: the general area of Ban Houayko (song heard from about ten separate locations, with up to three parties audible in one morning from a single point; 320–340 m); the escarpment between Ban Houayko and Ban Houaychot (two parties seen and a third heard; 350–750 m); and the waterfall near Nong Gnai (two parties heard on one morning; 300 m) (Evans *et al.* 2000).

Xe Khampho proposed national protected area

Locator: 14°35′–15°00′N, 106°11–35′E

Level of evidence: reported

Last positive information: [c.1995]

Notes. Gibbons were reported from all villages where presence was checked in 1988–1990 (Duckworth *et al.* 1999: Annex 5; sites mapped in Salter *et al.* 1990), and during some of 19 village interviews (Berkmüller *et al.* 1995a), but no mention was made of them by Cox *et al.* (1991, 1992) who focussed their work in deciduous dipterocarp forest and other open habitats unsuitable for gibbons.

Muang Pathoumphon, Champasak province

Locator: c.o. 14°45′N, 106°10′E

Level of evidence: confirmed

Last positive information: [2005]

Notes. Gibbons were reported from all villages where presence was checked in 1988–1990 (Duckworth *et al.* 1999: Annex 5; sites mapped in Salter *et al.* 1990). In the early 1990s, gibbons probably persisted in suitable habitat throughout the area, being audible, for example, from Ban Thangbeng (= Ban Lak 48) on route 13 (B. Phanthavong verbally 2008). Gibbons were reported present at 13 and extirpated in 12 of 32 villages interviewed in and around the district's production forest in 2005 (Poulsen *et al.* 2005). A short survey of part of the area (forming the ADB–Biodiversity Corridor Conservation Initiative pilot site; partly overlapping with the production forest area) in December 2007–January 2008, which involved visiting the best remaining forest patches, found no gibbons: populations seem very low, if indeed any gibbons remain in the corridor pilot area (Duckworth 2008). Much of this district lies in Dong Hua Sao or Xe Pian NPAs or in Xe Khampho proposed NPA.

Muang Sanamxai, Attapu province

Locator: c.o. 14°50′N, 106°30′E

Level of evidence: reported

Last positive information: [2007]

Notes. Gibbons were reported from all villages where presence was checked in 1988–1990 (Duckworth *et al.* 1999: Annex 5; sites mapped in Salter *et al.* 1990). Villagers report that gibbons persist (E. Meusch *in litt.* 2008); many were reported to Boonlop Sidala (verbally 2008) to live on Sayphou Louang, in the Muang Sanamxai–Muang

Samakhixai area. Somphong Bounphasy and I. G. Baird (*in litt.* 2008) related that small groups remain around Ban Kaxe, Ban Don and Ban Pakbo). Much of this district lies in Xe Pian NPA or Bolaven Southwest proposed NPA.

Muang Samakhixai, Attapu province

Locator: c.o. 14°50′N, 106°50′E

Level of evidence: reported

Last positive information: [2007]

Notes. Gibbons were reported from all villages where presence was checked in 1988–1990 (Duckworth *et al.* 1999: Annex 5; sites mapped in Salter *et al.* 1990). P. Phiapalath (*in litt.* 2008) received village reports from Ban Mixay and Ban Lak-52 in October 2007. Villagers in various areas also reported to E. Meusch *in litt.* (2008) that gibbons persist. Many were reported to Boonlop Sidala (verbally 2008) to live on Sayphou Louang, in the Muang Sanamxai–Muang Samakhixai area.

Phou Khathong proposed national protected area

Locator: 14°54′–15°19′N, 106°47′–107°14′E

Level of evidence: confirmed

Last positive information: 2006 [2008]

Notes. Gibbons were reported from all villages where presence was checked in 1988–1990 (Duckworth *et al.* 1999: Annex 5; sites mapped in Salter *et al.* 1990). Berkmüller *et al.* (1995a) listed gibbons for this area, presumably from a February 1994 reconnaissance of ten villages. Gibbons were recorded directly within the proposed NPA in early 1997 (Davidson *et al.* 1997), but it is difficult to tease out the records specific for this area from those of Dong Ampham NPA (which see). As expected, this 1997 survey did not record any gibbons on the Attapu plain sector, which is predominantly deciduous dipterocarp forest. In about March 2006, a fresh skin was photographed in Ban Namhieng, Muang Xaisetha (15°10′N, 106°49′E); the village is on the east bank of the Xe Kong, and extends east toward the Phou Kathong area. The gibbon reportedly came from the foot-hills of Phou Kathong, where many gibbons, occasionally taken for meat, are reported to persist (E. Meusch & R. Mollot *in litt.* 2008). P. Phiapalath (*in litt.* 2008) received reports in mid 2008 that the area's gibbon population was much declined.

Dong Ampham National Protected Area (1993)

Locator: 14°38′–15°18′N, 107°08–39′E

Level of evidence: confirmed

Last positive information: 2007

Notes. Respondents in both villages questioned in March 1992 reported gibbons from their area (Salter 1992b, Duckworth *et al.* 1999: Annex 5). During 1996 field assessments for the Xe Kaman dam, gibbons were widely and commonly heard (M., S. and A. Watson *in litt.* 2000). In January and April–May 1997, gibbons were locally numerous but shy. In more detail, they were widespread and relatively common in the Xe Kaman Lowlands sector, being heard regularly around the Xe Kaman dam site, along the Houay Po, Houay Sinkin, above Ban Don Khen-Nyai and along the Nam Kamah in both January and May. All were singing from tracts of mature secondary or old-growth evergreen forests. Only one was seen in this sector, at the dam site. In the Xe Xou Lowlands sector, up to three groups were heard daily along the Houay Jeneeit, singing from distant mixed deciduous forested hills and ridges. In the Central-

northern Hills sector, as with the Xe Kaman Lowlands, gibbons were still widespread and not uncommon in the Central-northern Hills. Groups were heard calling up to at least 950 m, just south of Nong Fa. Animals were observed on two occasions in this zone, both in January. A family of gibbons was watched, at 615 m, in evergreen forest on the west-facing hill slope above Ban Don Khen-Nyai. Two gibbons were seen briefly as they fled from a fruiting fig at 985 m on the same slope. Although none was heard in the Western Foothills sector, local reports indicate they most certainly occur, although perhaps at lower densities than in the Xe Kaman Lowlands and the Central-northern Hills. The individual seen at the dam site had warm buffy cheeks. The family of gibbons watched above Ban Don Khen-Nyai were seen well, and appeared morphologically distinctly different: cheek patches on a male and a dark infant were conspicuously white with no buffy tones, extending in a point to the level of a line connecting the top of the ear to the eye. Gibbons were stated to be regularly hunted: in many villages their meat reportedly ranked second only to that of Douc in order of preference. Bones and infants are sold to Vietnam (Davidson *et al.* 1997). Tape-recordings from this survey identify the animals as *Nomascus sp. incertae sedis* (T. Geissmann *in litt.* 2008) and it is unlikely that two forms are present, notwithstanding the reported variation in cheek-patch colour. J.-F. Reumaux (verbally 2008) visited the area around the Xe Kaman dam site in February 2008 and heard more than ten groups indicating that the population remains at last locally strong. P. Phiapalath (*in litt.* 2008) received reports in mid 2008 that the NPA's gibbon population had greatly declined.

Nam Ghong Provincial Protected Area (former potential NPA), Muang Phouvong, Attapu province

Locator: c.o.14°30′N, 107°00′E

Level of evidence: confirmed

Last positive information: 1998 [2007]

Notes. Gibbons were reported from all villages where presence was checked in 1988–1990 (Duckworth *et al.* 1999: Annex 5; sites mapped in Salter *et al.* 1990). Calls were heard twice, at 14°34′N, 106°58′E, just north of Ban Makteo (Phianong), and at 14°38′N, 107°06′E, some way north of Ban Hoytan (Schaller 1997). Although this paucity of records would suggest scarcity of gibbons, a deeper penetration of forest in a short February–March 1998 survey found that they were widespread (detected over the entire survey area), locally common, and easily seen even though hunting seemed heavy (Fernando in prep., R. J. Tizard *in litt.* 1998). Gibbons were widely reported in this area in October 2007 (P. Phiapalath *in litt.* 2008).

Xe Pian National Protected Area (1993)

Locator: 13°55′–14°47′N, 105°54′–106°29′E

Level of evidence: confirmed

Last positive information: 2008

Notes. Respondents in all 11 villages questioned during 1989–1993 reported gibbons from their area (Salter 1989a, Duckworth *et al.* 1999: Annex 5). None was noted in two brief cattle surveys of the sectors predominantly supporting deciduous dipterocarp forest, the Xe Kong plains and Dong Kalo, in 1991–1992 (Cox *et al.* 1991, 1992a). There were intensive surveys at several sites in the NPA in November 1992–March 1993, and May 1993 (Duckworth *et al.* 1994, 1995). These found gibbons throughout the Main Block sector of semi-evergreen forest, persisting in peripheral areas on hilltops, where forest was less degraded. In sectors dominated by deciduous dipterocarp forest, a few were heard in riverine semi-evergreen forest of Dong Kalo,

but none was found or reported on the Xe Kong Plains. In total, they seemed to occur at high density across 1500 km² of the NPA. At two sites within the Main Block, co-ordinated counts of singing gibbons were carried out in December 1992 and February 1993 by 5–8 stationary observers at 400 m intervals along forest trails from pre-dawn to a fixed time (08h00 at Houay Kua and 10h00 at Houay Tapkua, based on local singing patterns); each observer typically heard 5–6 (on one day, 9–10) calling bouts per morning in the Houay Kua area in December, and 3–5 in the Houay Tapkua area in February. A revisit to the Houay Kua site in May 1993 found that calling levels had increased dramatically compared with December: it was difficult to distinguish individual calling bouts or, except for close groups, to estimate their bearing. Gibbons were seen fairly regularly and easily: they usually fled quite quickly, but only for a short distance. Crude calculations gave a range of 400–6720 gibbon groups within the Xe Pian NPA, but although this is highly speculative (sect. 1.6.2.1), it was clear that Xe Pian NPA then supported a vast population of gibbons. Tape-recordings identify the animals as *Nomascus sp. incertae sedis* (T. Geissmann in Duckworth *et al.* 1995). Steinmetz (1997a) found that villagers reported that gibbons occurred commonly in all areas of semi-evergreen forest, especially hills and ridges, with historically a higher density than presently, received a moderate level of cultural protection, and although not a preferred food were hunted for food occurring on an opportunistic basis. No significant meat trade was reported, but a pet trade was reported from central parts of the NPA (but not from southern parts) for the late 1980s–early 1990s, but diminishing by the mid 1990s to a low level. During a field survey in early 1997 (Steinmetz 1997b), gibbons were heard every day in semi-evergreen forest from each camp except Camp 1 (confluence of Xe Pian and Xe Khampho, Xe Kong plains sector where only two days were spent), i.e. at Camp 2 (Houay Kua, Main Block sector, semi-evergreen forest; 1–7 February 1997); Camp 3 (11 km south-west of Camp 2, Main Block sector, in tall semi-evergreen forest along the Houay Jieng Hieng; 8–13 February 1997); Camp 4 (Houay Kaliang, Dong Kalo sector; 15–20 February 1997); and Camp 5 (also along the Houay Kaliang, Dong Kalo sector, 11 km east of Camp 4; 27 March–1 April 1997). At Camps 4 and 5 they were heard only in SEF on the ridge which runs east-west along the course of the Houay Kaliang, not in the deciduous forest of the plains. They were heard calling less than the 4–8 bouts per day of Duckworth *et al.* (1995), but given methodological differences it cannot be inferred that this indicates a decline since 1992–1993. In 2000, Stephen Ling (*in litt.* 2008) found that gibbons were still widespread and common in the central Main Block, but perhaps somewhat decreased because they were heard from forest camps only "most if not all" mornings, and often "a couple" of different animals; there were a couple of close sightings, and partial remains of hunted gibbons were sometimes found. However, by 2000–2001, they were clearly much less numerous than in 1992–1993; during a number of wide-ranging survey visits to all the NPA's habitats totalling about 50 days afield, gibbons were heard only in the main block from south of Ban Taong, and much less than daily even when staying overnight in the forest (M. K. Poulsen *in litt.* 2008). J. Johnston (*in litt.* 2008) heard gibbons while camping about 10 km south of Ban Taong in about March 2000. A skin was seen in a hunters' camp along the Houay Kua in 2006; many hunting camps were found along the Main Block's streams at this time, and on a four-day walk through the Main Block in 2005 or 2006 gibbon calls were heard in the morning on two days and gibbons themselves were seen on one day; the records were distributed throughout the survey walk in the main block (Anon. 2006, K. Khounboline verbally 2008). Villagers of Ban Taong reported in 2004 that they heard gibbons 'all the time' around their village, but during a 7-day visit to the village check this, gibbons were heard on only one morning, when they called from several spots within 2 km of the village. A single group was again heard there in January 2009 (P. Eshoo verbally 2008–2009). In 2006, on a three-day walk from Ban Taong through forest, three

different groups were heard from Bak Hong Mek (where a night was spent), which lies about 10 km slightly S of W of Ban Taong. A few weeks later Khaisy Vongphoumy (verbally 2008) repeated the route and found a dead gibbon at Bak Hong Mek, which he believed to have been killed by villagers from Ban Nongping. He heard none, even though this walk took place in good weather in March, so calling should have been high. On 12 June 2008 he heard them from the guest house in Ban Taong, which is right on the edge of the village (P. Eshoo verbally 2008). Somphong Bounphasy and I. G. Baird *in litt.* 2008) related that there are still many gibbons around the Ban Pindong part of the NPA (Muang Sanamxai, Attapu province), with smaller numbers left around Ban Taong and Ban Tavang (Muang Pathoumphon) and Ban Phonsaat (Muang Sanamxai). Somphan Keohanam reported (per I. G. Baird *in litt.* 2008) that recent information shows major declines in the NPA's gibbon population. Vietnamese wildlife traders are active in the area (C. Vongkhamheng *in litt.* 2008).

Don Khon, Siphandon, Champasak province

Locator: c.o. 13°56´N, 105°56´E

Level of evidence: extinct, if ever present

Last positive information: [1970s]

Notes. The Siphandon area is a remarkable complex of braids in the Mekong mainstream, at the very southern tip of Lao PDR (e.g. Daconto 1998). This contains many (literally, 4000, = 'si phan') islands, of which one of the largest, at 6 km², is Don Khon. Cunningham (1998: 121) reported that "villagers say that...gibbons .... and 'tigers' were extirpated from the island somewhat earlier [i.e. more than 20 years ago]. Villagers say that large areas of the island's forests were cleared by the French Cambodian refugees during the 1970s". Gibbons, presumed to be Pileated through their position west of the Mekong, were still audible in the mid 1990s from Don Khon calling from the Cambodian forests (Cunningham 1998). Specifically, Evans (1996) recorded that one was distantly heard from Ban Hangkhon calling in Cambodia on 2 May 1996 and a party was heard duetting for 15 minutes on 4 May 1996 from a vantage point 1 km upstream of the village. The party was on the taller of the two hills facing Ban Hangkhon on the south bank, but could not be seen; then unfamiliar with the sounds of Pileated Gibbon, he specifically noted the major differences in song-type from the pale-cheeked gibbons in Xe Pian and other parts of South Lao PDR. What remains unclear, and probably will forever, is the species identity of gibbons on Don Khon and any other of the Siphandon islands, if any truly did support gibbons. The site is placed under Section B (Nomascus not Hylobates) because birds endemic to east of the Mekong (e.g. Grey-faced Tit Babbler *Macronous kelleyi* occur on the islands (P. Davidson in Duckworth *et al.* 1999), but this does not mean that Nomascus rather than Hylobates would have occurred.

APPENDIX 2. CAPTIVE GIBBON RECORDS FROM LAO PDR[1]

Site	Date	Species	Type of location	Age	Other notes	Source
1980s						
Vientiane town	May 1988	No information	In front of an office	Adult	Two animals in one cage	J. Murray *in litt.* 2008
Nam Phou, Vientiane town	from at least 1986 well into the 1990s	No information!	Vietnamese shop	Adult (in 1993)	Date of disappearance of this well-known animal unknown	D. Van Gansberghe *in litt.* 2008, C. Inthavong verbally 2008
1990s						
Louangphabang	1991	Pale-cheeked gibbon	Restaurant; not Hotel Phousi	No information	Reportedly from Phongsali	J.-P. Pedrono verbally 2008
Hotel Phousi, Louangphabang	early 1993	Pale-cheeked gibbon	Upmarket hotel	Full-grown		E. Nemeth *in litt.* 1993, Bergmans 1995
Louangphabang town	mid 1996	White-handed Gibbon	No information	No information		R. J. Timmins in Duckworth *et al.* 1999
Louangphabang town	October 1998	Unknown	Le Saladier restaurant	No information	Gone by March 1999; reportedly sold to foreigners	J.-F. Reumaux per T. Geissmann *in litt.*
Xaignabouli town	1998	White-handed Gibbon	Petrol station	Young		R. Boonratana; Duckworth *et al.* 1999: Plate 13
Ben Keun Zoo	28 March 1999	White-handed Gibbon	Zoo	Adult	Reportedly in zoo for 3–4 yrs	T. Geissmann *in litt.* 2008
Ben Keun Zoo	28 March 1999	White-cheeked gibbon	Zoo	Juvenile (black)	Reportedly in zoo for two yrs	T. Geissmann *in litt.* 2008
Ben Keun Zoo	28 March 1999	White-cheeked gibbon	Zoo	Juvenile (black)	Reportedly in zoo for two yrs	T. Geissmann *in litt.* 2008
Wat Simouang, Vientiane town	27 & 29 March 1999	White-handed Gibbon	Wat	Adult	Reportedly in wat for five yrs	T. Geissmann *in litt.* 2008
Wat Simouang, Vientiane town	27 & 29 March 1999	Yellow-cheeked-type gibbon	Wat	Adult	Reportedly in wat for five yrs	T. Geissmann *in litt.* 2008

Site	Date	Species	Type of location	Age	Other notes	Source
Wat Simouang, Vientiane town	27 & 29 March 1999	White-cheeked-type gibbon	Wat	Adult	Reportedly in wat for five yrs	T. Geissmann *in litt.* 2008
Vientiane town	1990–1991	No information	House of an American of UNDP[2]	Adult		Many recorders
Sokpalouang, Vientiane town	*c*.1995	No information	Private house[2]	No information		T. D. Evans *in litt.* 2008
Ban Dongmen, Vientiane town	29 March 1999	White-cheeked-type gibbon	Private house perhaps Chinese	Adult	Reportedly acquired unweaned 5 yrs previously	T. Geissmann *in litt.* 2008
Ban Lak-20	1998–1999	Pale-cheeked gibbon	Shop	Infant		Robichaud & Stuart 1999; Duckworth *et al.* 1999: Plate 13
Ban Siangkin, Nakai–Nam Theun NPA	1994	Pale-cheeked gibbon	Remote village house	Juvenile	Offered for sale to the surveyor	R. J. Timmins *in litt.* 1995
Pakxe outskirts	23 November 1992	Pale-cheeked gibbon	Upmarket fish-garden restaurant	Immatures, one nearly full gown	Two	J.W.D.
Pakxe	mid–late 1990s	No information	On the shoulder of a walking man	No information		T. D. Evans *in litt.* 2008
Ban Khon-neua, Don Khon	1997	No information	Village	No information		P. Cunningham *in litt.* 2008
2000s						
Louang-Namtha town	2002	Pale-cheeked gibbon	Wealthy private house	No information	Reportedly not obtained from local forest	A. Johnson verbally 2008
The Gibbon Experience (resort), Bokeo	2005	Black Crested Gibbon	Ecotourism resort	Quite young	Seized from a trader in Ban Houayxay market	J.-F. Reumaux *in litt.* 2008
Vangviang	2000	No information	Private houses, in small cages	Young	Two animals; different owners	M. Sly *in litt.* 2008

Site	Date	Species	Type of location	Age	Other notes	Source
Vangviang	2005	Pale-cheeked gibbon	Private house, in a small cage	Young	Different owner from above ones	M. Sly *in litt.* 2008
Ben Keun Zoo	2004	White-cheeked gibbon sp.	Zoo	Well-grown	One on public display	M. Sly *in litt.* 2008
Wat Thampulosi, Vientiane	22 August 2008	*N. gabriellae* or *N.* sp. *incertae sedis*	Wat	Full-grown	Two, free-ranging[3]	J.W.D. (sect. 2.5.2.2)
Vientiane town	2007	Black Crested Gibbon	Noodle restaurant	Young	Reportedly from Nam Ha NPA, bought by a labourer of the ADB 3 road.	T. E. Hansel *in litt.* 2008
Wat Simouang, Vientiane town	2001	Pale-cheeked gibbon	Wat	Adult	Reputedly bred	M. Sly *in litt.* 2008
Wat Simouang, Vientiane town	2001	Pale-cheeked gibbon	Wat	Young	Two (one reputedly born there, later died; one reputedly from Muang Fuang); filmed, footage in GAPE's awareness video	M. Sly *in litt.* 2008
Wat Simouang, Vientiane town	14 August 2008	Pale-cheeked gibbon	Wat	Full-grown	1♂, 1♀	J.W.D.
Near That Louang, Vientiane town	2004–2005	No information	No information	Presumed at least well-grown	Audible from the marsh	J.W.D.
Ban Namtek (M. Bolikhan, Bolikhamxay; 18°30´N, 104°08´E)	January 2007	Pale-cheeked gibbon	Village house	No information	Captured locally. Disappeared within a few months	C. Hallam *in litt.* 2008
A zoo east of Thakhek	About 2004	Pale-cheeked gibbon	Zoo	No information	One animal	A. Johnson verbally 2008
Ban Vangngang,	Early 2009	Southern White-	Village house	Young	Destined for	A. Mellor per C. Hallam *in litt.*

Site	Date	Species	Type of location	Age	Other notes	Source
Savannakhet		cheeked Gibbon?	(short-term)		Vietnamese trader	2008
Ban Napong, Salavan	2004 to date	Pale-cheeked gibbon	Shop	No information	One animal in 2004, two from 2005	J. Johnston *in litt.* 2008
Muang Kaleum town, Xekong	July 2008–January 2009	Crested gibbon	Middle-affluence private house; not for sale	Very young on arrival	Reported local origin	E. Meusch *in litt.* 2008
Pha Suam fall, Muang Bachiang, Champasak	2006–2008	*N. gabriellae* or *N.* sp. *incertae sedis*	Restaurant; Thai owner	Young (in 2006)	Reportedly taken from poachers. Footage in GAPE's awareness video	M. Sly, G. C. Coffmann & J. Johnston, severally, *in litt.* 2008
Pakxe town	*c*.2005	Pale-cheeked gibbon	Shop	Very young	Purchased, as infant, in town market	J. Johnston *in litt.* 2008
Pakxe town	*c*.2008	No information	Private house, Englishman	Young at purchase	Different from above animal; sentimental purchase	J. Johnston *in litt.* 2008
13 km south of Pakxe	*c*.2001	No information	Restaurant	No information		M. K. Poulsen *in litt.* 2008
Don Khon, Champasak	December 2007	No information	With children in a village with many guest-houses	No information	Unclear if same as animal below	J. Johnston *in litt.* 2008
Don Khon, Champasak	December 2008	[Pale-cheeked gibbon]	Sala Phae / Sala Done Khone hotel	No information	Reportedly obtained from people who planned to eat it	An anonymous tourist *in litt.* 2008

Sites are listed, within decades, from north to south. This is surely a highly incomplete list.

[1] This listing is nothing like a full one of even the animals that were detected during the 1990s surveys; information on these is highly dispersed.

[2] Although there is no direct linkage, these might refer to one animal; reflecting the high administrative demands of international transport, expatriates often leave their 'pets' behind on moving from a country (M. I. Evans verbally 1984).

[3] See text for more detail.