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A Publication of the Mekong Wetlands Biodiversity Conservation and Sustainable Use Programme

# Siamese Crocodile in Lao PDR



Preliminary Status Review of the Siamese Crocodile (*Crocodylus siamensis* SCHNEIDER, 1801) (Reptilia: Crocodylia) in Lao PDR

A JOINT UNDP - IUCN - MRC GEF-FUNDED PROGRAMME

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Programme Management Unit  
082/02 Fa Ngum Road, Vientiane, Lao PDR  
Tel: +856 (0)21 240 904, Fax: +856 (0)21 216 127  
Email: [info@mekongwetlands.org](mailto:info@mekongwetlands.org)  
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Preliminary Status Review of the Siamese  
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## Acronyms and Abbreviations

Asl	above sea level
DAFO	District Agriculture and Forestry Office
DOF	Department of Forestry
DFRC	Division of Forests, Resources and Conservation
GOL	Government of Lao PDR
GPS	Global Positioning System
IUCN	The World Conservation Union
Lao PDR	Lao People's Democratic Republic
LARReC	Living Aquatic Resources Research Centre
MAF	Ministry of Agriculture and Forestry
MWBP	Mekong Wetlands Biodiversity Conservation and Sustainable Use Programme
NAFRI	National Agriculture and Forestry Research Institute
NPA	National Protected Area
NTFP	Non-Timber Forest Product
PAFO	Provincial Agriculture and Forestry Office
PPA	Proposed National Biodiversity Conservation Area
PPA	Provincial Protected Area
WCS	Wildlife Conservation Society – Lao Programme

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### ບົດຄັດຫຍໍ້ (SUMMARY)

ບົດລາຍງານນີ້ ເປັນບົດລາຍງານ ຜົນໄດ້ຮັບທີ່ສໍາຄັນ ໃນການສໍາຫລວດ ແຂ້ນ້ໍາຈິດ (Siamese crocodile) ຂອງໂຄງການ ຮ່ວມມື ລະຫວ່າງ ສູນຄົ້ນຄ້ວາການປະມົງ (LARReC), ກະຊວງກະສິກໍາ ແລະ ປ່າໄມ້, ອົງການອະນຸລັກສັດປ່າ ປະຈຳ ສປປ ລາວ (WCS) ແລະອົງການຄຸ້ມຄອງ ແລະນໍາໄຊ້ ຊີວະນາໆພັນ ພື້ນທີ່ດິນທາມເຂດແມ່ນໍ້າ ຂອງຕອນລຸ່ມ (Mekong Wetlands Biodiversity Conservation and Sustainable Use Programme) (MWBP). ໃນຊ່ວງເດືອນ ມີນາ ຫາ ເດືອນມິຖຸນາ ປີ 2005 ແຂ້ນ້ໍາຈິດ ເປັນສັດຊະນິດນຶ່ງທີ່ໃກ້ຈະສູນພັນ. ຊຶ່ງເປັນຊະນິດທີ່ຫາຍາກທີ່ສຸດ ແລະຢູ່ໃນຫຼາຍແຫ່ງ ຂອງຊຶ່ງເຂດອາຊີຕາເວັນອອກສຽງໃຕ້ ກໍ່ໄດ້ສູນພັນໄປແລ້ວ. ສປປ ລາວ ຍັງບໍ່ທັນມີຂໍ້ມູນ ກ່ຽວກັບແຂ້ນ້ໍາຈິດນີ້ປານໃດ ການສໍາຫລວດຫຼວດຄັ້ງທໍາອິດ ແມ່ນຊ່ວງປີ 2003-2004 ໂດຍ ສູນຄົ້ນຄ້ວາການປະມົງ ແລະອົງການອະນຸລັກສັດປ່າ ປະຈຳ ສປປ ລາວ ຊຶ່ງຜົນ ຂອງການສໍາຫຼວດ ຄັ້ງນີ້ໄດ້ຢັ້ງຢືນວ່າ ຢູ່ ສປປ ລາວ ຍັງມີ ແຂ້ນ້ໍາຈິດ ອາໃສ່ຢູ່. ການສໍາຫຼວດຄັ້ງຕໍ່ມາ ແມ່ນໄດ້ຮັບການຈັດຕັ້ງປະຕິບັດ ຢູ່ໃນປີ 2005 ຊຶ່ງງົບປະມານ ຂອງການສໍາຫຼວດ ແມ່ນໄດ້ຮັບຈາກ ອົງການຄຸ້ມຄອງ ແລະນໍາໄຊ້ ຊີວະນາໆພັນ ພື້ນທີ່ດິນທາມ ເຂດແມ່ນໍ້າ ຂອງຕອນລຸ່ມ, ເຊິ່ງເປັນຜູ້ສະ ໜັບສະໜູນ ການອະນຸລັກ ແຂ້ນ້ໍາຈິດ ຢູ່ ສປປ ລາວ, ກໍາປູເຈຍ, ຫວຽດນາມ ແລະ ໄທ. ບົດລາຍງານ ດັ່ງກ່າວ ໄດ້ນໍາສະເໜີຜົນ ແລະຂໍ້ມູນທີ່ສາມາດນໍາໄຊ້ໄດ້ ຂອງການສໍາຫຼວດ ແຂ້ນ້ໍາຈິດ ໃນປີ 2005, ເພື່ອເປັນຂໍ້ມູນພື້ນຖານ ໃນການວາງແຜນ ການອະນຸລັກແຂ້ນ້ໍາຈິດ ຂອງສປປ ລາວ.

1. **ການສໍາຫຼວດ ໃນປີ 2005.** ໃນລະຫວ່າງ ເດືອນມີນາ ຫາ ເດືອນ ມິຖຸນາ, ປີ 2005 ການສໍາຫລວດພາກສະໜາມໄດ້ຮັບການ ຈັດຕັ້ງປະຕິບັດ ຢູ່ບຶງ, ໜອງ ແລະແມ່ນໍ້າທັງໝົດ 25 ແຫ່ງ, ຢູ່ໃນ 3 ແຂວງ ໃນພາກໃຕ້ຂອງ ສປປ ລາວ. ວິທີການສໍາຫລວດໄດ້ເຮັດຫລາຍວິທີ ໂດຍການຍ່າງແບບເປັນແລວ, ການສໍາຫລວດໃຊ້ໂຄມເຍືອງຕອນກາງຄືນເພື່ອນັບ ຈໍາ ນວນແຂ້ທີ່ເຫັນ, ສໍາພາດຊາວບ້ານເພື່ອເກັບກໍາຂໍ້ມູນ ແລະທີ່ຢູ່ອາໄສ ຂອງແຂ້, ປະເມີນເສດຖະກິດສັງຄົມ. ລວມທັງ ການຮວບຮວມ ບັນດາເອກະ ສານ ກ່ຽວກັບແຂ້ນ້ໍາຈິດ ຂອງ ສປປ ລາວ ເຂົ້າໃນຕາຕະລາງ ຈໍານວນ 122 ຕາຕະລາງ, ໂດຍຂໍ້ມູນ ຂອງເອກະສານທັງໝົດ ແມ່ນອີງໃສ່ ການສໍາຫຼວດ ໃນປີ 2003-2005 ແລະເອກະສານອື່ນໆ. ຂໍ້ມູນເຫຼົ່ານີ້ ສາມາດຫາໄດ້ ຢູ່ທີ່ອົງການອະນຸລັກສັດປ່າ ປະຈຳ ສປປລາວ.
2. **ການກະຈາຍ:** ຂໍ້ມູນການກະຈາຍຂອງ ແຂ້ ໄດ້ບັນທຶກໄວ້ (ໃນ ປີ1860s-2005) ຂໍ້ມູນນີ້ ໄດ້ຈາກການບັນທຶກຈາກແມ່ນໍ້າ 25 ແຫ່ງຢູ່ໃນ 9 ແຂວງ ທາງພາກໃຕ້, ພາກກາງແລະ ທາງທິດຕາເວັນຕົກ ຂອງ ສປປ ລາວ ກວມເອົາເນື້ອທີ່ 465 ກມ<sup>2</sup> ຈາກການບັນທຶກເຫັນວ່າ ມີລະດັບຄວາມສູງໜ້ອຍກວ່າ <400 ແມັດ ທຽບໃສ່ລະດັບນໍ້າທະເລ ແລະເກືອບທັງໝົດ (n=199, 98%) ແມ່ນຢູ່ໃນພື້ນທີ່ຮາບພຽງ ຂອງແມ່ນໍ້າຂອງ ເຊິ່ງປົກຄຸມພື້ນທີ່ດິນທາມເຂດຕໍ່າ ໃນສປປ ລາວ. ປະຫວັດຄວາມເປັນມາ ກ່ຽວກັບການກະຈາຍຂອງ ແຂ້ ແມ່ນມີ (ປີ <1979 ຄົ້ນຫຼັງ) ຊຶ່ງໄດ້ມີການຂະຫຍາຍອອກຢ່າງກ້ວາງຂວາງແຕ່ ທາງພາກໃຕ້ ຈົນເຖິງປາກຊັນ (ຮູບທີ່ 3) ຊຶ່ງເລາະລຽບຕາມແມ່ນໍ້າຂອງ ແລະ ສາຂາ ຂອງແມ່ນໍ້າຂອງ ເຊິ່ງບໍ່ໄດ້ມີການບັນທຶກກ່ຽວກັບແຂ້ ຢູ່ທາງພາກເໜືອ ຫລື ພາກຕາເວັນອອກສ່ຽງເໜືອ ຂອງ ສປປ ລາວ ເຊິ່ງເປັນເຂດພູ ສູງ. ຈາກການບັນທຶກ ໃນປີ (>1980) ແລະພາຍຫຼັງ (n= 104) ໄດ້ຈາກແມ່ນໍ້າ 18 ແຫ່ງ ຢູ່ໃນ 8 ແຂວງ. ຈາກການສໍາຫຼວດ ໃນປີ 2005 ສະແດງໃຫ້ເຫັນວ່າແຂ້ມີການລຸດລົງ: ຂໍ້ມູນຈາກ 24 ແຫ່ງມີລາຍງານກ່ຽວກັບແຂ້ ໃນເມື່ອກ່ອນ, ແຕ່ ຈາກການບອກເລົ່າ ຂອງຊາວບ້ານມີພຽງແຕ່ 15 ແຫ່ງທີ່ລາຍງານວ່າຍັງມີແຂ້ຢູ່ ໃນປະຈຸບັນ (ເຊິ່ງລຸດລົງ 38%), ຜ່ານ ການສໍາຫຼວດ ທີ່ຍັງຢືນໄດ້ມີພຽງ 6 ແຫ່ງທີ່ສາມາດຍັງຢືນໄດ້ວ່າມີແຂ້ ແລະມີພຽງ 2 ແຫ່ງທີ່ມີແຂ້ໄຂ່. ພື້ນທີ່ດິນທາມເຂດລຸ່ມ ຂອງແມ່ນໍ້າຂອງແມ່ນຖືກລົບກວນຢ່າງໜັກ ແລະຜົນຂອງ ານສໍາຫຼວດອາດບອກໄດ້ເຖິງການລຸດລົງ ຂອງແຂ້ ໃນອາດິດ ຢູ່ໃນຫຼາຍແຫ່ງ.

3. **ການບັນທຶກຂໍ້ມູນ ແຂ້ວນ້ຳຈືດ:** ເປັນໂຕຊີ້ບອກ ເຖິງການກະຈາຍ ຂອງແຂ້ ໃນສປປ ລາວ ໃນປະຈຸບັນ. ເຊິ່ງ ພົບເຫັນຢູ່ແມ່ ນ້ຳ 7 ແຫ່ງ ທາງພາກໄຕ້ ຂອງສປປ ລາວຄື: ເຊປຽນ, ເຊຄຳພໍ ແລະເຊກອງ, ແຂວງອັດຕະ ປື; ເຊໂດນ, ແຂວງສາລະວັນ ແລະ ເຊບັ້ງໄຟ, ເຊບັ້ງທຽງ ແລະເຊຈຳພອນ. ແຂວງສະຫວັນນະເຂດ (ຮູບທີ່ 3). ການສຳຫຼວດໃນຕໍ່ໜ້າ ກ່ຽວກັບປະຊາ ກອນແຂ້ ຢູ່ຕາມແມ່ນ້ຳແຫ່ງອື່ນໆທີ່ຍັງເຫຼືອ ຢູ່ທາງພາກໄຕ້ ຂອງສປປ ລາວ ອາດຈະຕ້ອງ ໄດ້ບັນທຶກເປັນ ລາຍລັກອັກ ສອນໄວ້ໃນເອກະສານ.
4. **ສະຖານະພາບ ແລະຄວາມອຸດົມສົມບູນ:** ໃນປັດຈຸບັນ ຂໍ້ມູນກ່ຽວກັບແຂ້ ຢູ່ໃນ ສປປ ລາວ ຍັງບໍ່ທັນຄົບ ຖ້ວນ ພໍທີ່ຈະປະ ເມີນຈຳນວນແຂ້ ທັງໝົດໄດ້ເທື່ອ. ແຕ່ຈາກຂໍ້ມູນທີ່ມີຢູ່ ເປັນໂຕຊີ້ບອກວ່າ ຄວາມອຸດົມ ສົມບູນ ຂອງແຂ້ ໄດ້ຫລຸດລົງຢ່າງ ໜ້າເປັນຫ່ວງ. ຈາກການລາຍງານເຫັນວ່າ ໃນຊ່ວງປີ 1800s ຈຳນວນ ປະຊາກອນແຂ້ຍັງມີຫຼາຍ, ແຕ່ປັດຈຸບັນແຂ້ເປັນ ສັດທີ່ຫາຍາກ ຫລື ຢູ່ຫຼາຍໆບ່ອນກໍອາດຈະສູນພັນໄປ ແລ້ວ. ຈາກການບັນທຶກຈຳນວນແຂ້ ໃນປີ 2005 ທີ່ພົບເຫັນຢູ່ບຶງ 5 ແຫ່ງ ເຫັນວ່າມີແຂ້ພຽງແຕ່ປະມານ 16 ໂຕ. ໂດຍອີງໃສ່ຂໍ້ມູນເລົ່ານີ້ ແລະການສຶກສາ ຂອງແຂ້ຊະນິດອື່ນໆ, ມີຄວາມ ເປັນໄປໄດ້ວ່າ ຢູ່ໃນບຶງ 5 ແຫ່ງນີ້ຈະມີແຂ້ຢູ່ປະມານ 115-372 ໂຕ, ເຊິ່ງແຂ້ທັງໝົດອາດຈະບໍ່ໄດ້ມີການປະສົມພັນ ແລະ ບໍ່ໄດ້ໄຂ່. ຈຳນວນທີ່ປະເມີນນີ້ແມ່ນເກີນ ຈາກການລາຍງານ ຂອງຊາວບ້ານ. ຈາກພື້ນທີ່ດິນທາມ 9 ແຫ່ງ ຂອງຈຳ ນວນ 24 ແຫ່ງ ຂອງການສຳຫຼວດ ໃນປີ 2005 ປະຊາຊົນທ້ອງຖິ່ນ ເວົ້າວ່າຊຸມປີ 1970s ຈຳນວນແຂ້ ແມ່ນ ຍັງມີຫຼາຍ.
5. **ຖິ່ນທີ່ຢູ່ອາໄສ:** ຄວາມເປັນມາ ຂອງແຂ້ ຢູ່ສປປ ລາວ ແມ່ນມີຢູ່ຕາມແມ່ນ້ຳ, ບຶງ ແລະໜອງຕ່າງໆ ລວມ ທັງບ່ອນທີ່ບົກ ແຫ້ງ ແລະບ່ອນທີ່ມີນ້ຳຕະຫຼອດປີ. ຂໍ້ມູນກ່ຽວກັບແຂ້ ໄດ້ຮັບການຮວບຮວມ ຈາກ 51 ເຂດ ຂອງສປປ ລາວ, ເຊິ່ງປະ ກອບດ້ວຍ: ແມ່ນນ້ຳ ແລະຫ້ວຍທີ່ໄຫຼຕະຫຼອດ 29 ແຫ່ງ ແລະບຶງ, ໜອງ ແລະ ກຸດທີ່ນ້ຳບໍ່ໄຫຼ 22 ແຫ່ງ. ຈາກຈຳນວນ 22 ແຫ່ງທີ່ເປັນບຶງ, ໜອງ ແລະກຸດ ທີ່ນ້ຳບໍ່ໄຫຼ ຂໍ້ມູນກ່ຽວກັບແຂ້ ທີ່ໄດ້ຈາກການລາຍງານແມ່ນມາຈາກໜອງ ແລະບຶງປົກ ຫຸ້ມດ້ວຍພືດນາໆຊະນິດ (n=14) ຫຼື ບຶງທີ່ເປີດ ແປນ (n=7) ຫຼື ບຶງບ່ອນທີ່ມີນ້ຳບາງລະດູ (n=1). ຈຳນວນ 6 ຄົນ ໃນຈຳ ນວນ 31 ຄົນ ທີ່ຖືກສຳພາດ ໃນ ປີ 2005 ລາຍງານວ່າ ໃນລະດູແລ້ງແຂ້ຈະຍ້າຍໄປຢູ່ບ່ອນທີ່ມີນ້ຳຕະຫຼອດປີ ແລະໃນລະດູຝົນ ພວກມັນກໍ ຍ້າຍໄປມາລະຫວ່າງບ່ອນທີ່ມີນ້ຳຕະຫຼອດ ແລະບ່ອນທີ່ນ້ຳບາງລະດູ.
6. **ການປະສົມພັນ:** ຮັງແຂ້ ຈຳນວນ 5 ຮັງ ແລະອີກ 3 ຮັງທີ່ໄດ້ມີການພັກໄຂ່ ຈາກ 6 ເຂດ ຢູ່ທາງພາກໃຕ້ ຂອງ ສປປ ລາວ ໄດ້ຮັບການບັນທຶກ ໃນ ປີ 2005. ມີພຽງ 2 ແຫ່ງເທົ່ານັ້ນ ໃນຈຳນວນ 6 ແຫ່ງທີ່ຍັງຢືນໄດ້ ວ່າປະສົບຄວາມສຳເລັດ ໃນການຝັກໄຂ່, ເຊິ່ງເປັນທີ່ຢູ່ອາໄສ ສອງແຫ່ງທີ່ມີຄວາມແຕກຕ່າງກັນຄື: ຮັງທີ 1 ແມ່ນຢູ່ໃນກຸດ ທີ່ເປັນປ່າຕົບໜາມີພືດນ້ຳ ແລະ ຫຍ້າພູຕາມໜ້ານ້ຳ, ຄວາມເລິກຂອງນ້ຳ 3-4 ແມັດ ຫ່າງ ຈາກບ່ອນນ້ຳທີ່ໄຫລຕະຫລອດປີ 200 ແມັດ. ຮັງຂອງມັນສ່ວນຫລາຍຈະໄດ້ຮັບແດດໂດຍກົງ. ແລະຮັງທີ 2 ພົບເຫັນຢູ່ໃກ້ກັບແຄມໜອງຢູ່ໃນປ່າໄມ້ (ມີເຮືອນຍອດປົກຄຸມ 20-30 ແມັດ) ໄກຈາກບ່ອນທີ່ນ້ຳໄຫລ ຕະຫລອດປີ 200 ແມັດ ແລະສ່ວນຫລາຍຈະໄດ້ຮັບເງົາຂອງຕົ້ນໄມ້ບັງໝົດມື້. ສ່ວນຮັງອື່ນໆ ໄດ້ມີການ ບັນທຶກຈາກບ່ອນທີ່ມີພືດນ້ຳພູຕາມໜ້ານ້ຳ ແລະ ໄດ້ຮັບການລາຍງານ ກ່ຽວກັບຮັງແຂ້ອີກຮັງໜຶ່ງ ທີ່ຢູ່ແຄມ ກຸດ. ຮັງໄຂ່ທັງໝົດນີ້ ແມ່ນພົບຢູ່ໃນກຸດ ແລະໜອງບໍ່ແມ່ນແມ່ນ້ຳ.

- 7. **ຄວາມເຊື່ອຖື :** ການສຳພາດໃນ ປີ 2005 ສ່ວນຫລາຍບໍ່ໄດ້ພິຈາລະນາເຖິງໄພຂົ່ມຂູ່ກັບ ແຂ້ ຂອງໝູ່ບ້ານ ແລະບ່ອນຫາປາ ແລະບໍ່ໄດ້ຍືນເຖິງຜົນກະທົບຕໍ່ກັບຊາວບ້ານ ຜ່ານການສຳພາດ 31 ຄົນ (42%) ແມ່ນ ເຊື່ອຖືວ່າ ແຂ້ ມີຄຸນຄ່າທາງຮີດຄອງປະເພນີ ຕໍ່ຊາວບ້ານເລົ່ານີ້ (ຢູ່3 ແຂວງ ພາກໃຕ້ ຂອງສປປ ລາວ) ແຂ້ ເປັນທີ່ເຄົາລົບນັບຖື ແລະເປັນສິ່ງທີ່ເຊື່ອຖື ຂອງໝູ່ບ້ານ. ຜ່ານການສຳພາດ ໃນ ປີ 2005.ພື້ນທີ່ 6 ແຫ່ງ ຂອງ ພື້ນທີ່ດິນທາມ 25 ແຫ່ງ ປະຊາຊົນທ້ອງຖິ່ນໄດ້ມີລະ ບຽບໃນການປົກປັກຮັກສາ ແລະຄຸ້ມຄອງແຂ້ ທີ່ ເຂົາເຈົ້າມີຄວາມເຊື່ອຖື ເຊັ່ນການຫ້າມລ່າ. ໃນປະຈຸບັນຄວາມເຊື່ອຖື ກ່ຽວກັບແຂ້ ແມ່ນມີຢູ່ພຽງບາງບ່ອນ ເຊິ່ງມັນສະແດງອອກຢູ່ບ່ອນວ່າ ຈຳນວນແຂ້ໃນປະຈຸບັນ. ຢູ່ຕາມບຶງ, ໜອງ ແລະ ກຸດບາງແຫ່ງບ່ອນທີ່ມີ ແຂ້ອາໄສ ປະຊາຊົນບໍ່ໄດ້ໃຫ້ຄວາມເຊື່ອຖື ກ່ຽວກັບແຂ້ເລີ້ນີ້. ຜູ້ຖືກສຳພາດ 4 ຄົນ ໃນຈຳນວນ 31 ຄົນ ລາຍງານວ່າຍັງມີແຂ້ 2 ໂຕ ເຊິ່ງສັງເກດຈາກຮອຍຕີນ ທີ່ແຕກຕ່າງກັນ (ຮູບຮອຍຕີນຄ້າຍຄືກັບຮອຍຕີນ ເປັດ ຫຼື ຮອຍຕີນເຮັຍ ຊື່ພາສາອັງກິດແມ່ນ: monitor lizard *varanus*) ຈາກການລາຍງານ ຂອງ 2 ແຂວງ ເຫັນວ່າແຂ້ທັງ 2 ໂຕ ອາໄສຢູ່ພື້ນທີ່ ທີ່ມີລັກສະນະຄືກັນ.
  
- 8. **ໄພຂົ່ມຂູ່:** ປັດໃຈຫຼັກທີ່ເຮັດ ຈຳນວນແຂ້ ໃນທົ່ວໂລກລຸດລົງ ແມ່ນການລ່າເພື່ອເປັນສິນຄ້າ ແລະການສູນ ເສຍທີ່ຢູ່ອາໄສ ຢູ່ໃນປີ 2005 ບໍ່ໄດ້ມີການບັນໄດງ ກ່ຽວກັບການລ່າແຂ້ເພື່ອເປັນສິນຄ້າ. ປະຊາຊົນ 4 ບ້ານ ຈາກຈຳນວນ 17 ບ້ານ ລາຍງານວ່າ ມີການລ່າແຂ້ ໃນລະຫວ່າງປີ 1950-1970, ແລະປະຊາຊົນ ຈາກບ້ານໜຶ່ງ ລາຍງານວ່າ ໃນລະຫວ່າງ ປີ 1961-75 ເຊິ່ງເປັນສິ່ງຄາມຕ້ານ ຈັກກະພັດລ່າເມືອງຂຶ້ນ ໃນ ພາກພື້ນອິນດູຈີນ, ແຂ້ສ່ວນໃຫຍ່ ຖືກລ່າຢ່າງໜັກໜ່ວງ ເພື່ອເອົາຊີ້ນມາເປັນອາ ແລະເອົາໜັງຂອງມັນໄປ ຂາຍ ເພື່ອຫາລາຍໄດ້. ການປະເມີນຈຳນວນແຂ້ທີ່ຖືກລ່າ ຢູ່ອາດີດທີ່ ຜ່ານມາ ອາດຈະຕໍ່າ ເພາະວ່າຜູ້ຖືກ ສຳພາດບາງຄົນ ບໍ່ໃຫ້ການຮ່ວມມື ໃນການປົກສາຫາລືກ່ຽວກັບເລື່ອງນີ້. ໂດຍອີງ ຕາມບັນດາເອກະສານ ຕ່າງໆ ການລ່າແຂ້ແບບຜິດກົດໝາຍແມ່ນໄດ້ເກີດຂຶ້ນຢ່ງແຕ່ຫຼາຍ ຢູ່ບັນດາແຂວງພາກໃຕ້ ຂອງສປປ ລາວ ຈົນມາເຖິງຕົ້ນປີ 1990, ແຂເປັນ ແລະໜັງຂອງມັນຖືກຂາຍໄປໄທ ແລະກຳປູເຈຍ, ນອກນັ້ນຍັງນຳແຂ້ ຈາກກຳປູເຈຍ ຜ່ານບັນດາແຂວງພາກໃຕ້ ຂອງສປປ ລາວ ໄປຂາຍໃຫ້ໄທ. ແຂ້ເກືອບທັງໝົດ ແມ່ນຖືກ ຂາຍໄປໄທ. ຄວາມ ຕ້ອງການແຂ້ເປັນທີ່ຢ່າງຢ່າງຕໍ່ເນື່ອງໃນພາກພື້ນອິນດູຈີນ ອາດຈະກໍ່ໃຫ້ເກີດການ ຊື້- ຂາຍແຂ້ ຢູ່ສປປ ລາວ.
  
- 9. **ການລົບກວນ:** ການກະຈາຍຂອງແຂ້ ໃນສປປ ລາວແມ່ນຢູ່ບ່ອນທີ່ປະຊາຊົນຕັ້ງບ້ານ. ການລົບກວນທີ່ມີ ຕໍ່ແຂ້ ປະ ກອບດ້ວຍ 7 ບັນຫາຄື: ການລ່າ, ການເຮັດຮ່ອງລະບາຍນ້ຳ, ຈູດປ່າ, ລ້ຽງສັດ, ຫາປາ, ເກັບຜັກ. ຈາກການສຳພາດບຶງ, ໜອງ ແລະສາຍນ້ຳຕ່າງໆ ຈຳນວນ 24 ໃນປີ 2005 ເພື່ອສົມທຽບຕົວເລກການລົບ ກວນບ່ອນຢູ່ ຂອງແຂ້. ບຶງ, ໜອງ ແລະສາຍນ້ຳຕ່າງໆ 19 ແຫ່ງແມ່ນ  $\geq 50\%$  ເຊິ່ງອາດຈະເປັນຕົວເລກ ສູງ ສຸດ ທີ່ບົ່ງບອກເຖິງ ການລົບກວນບ່ອນຢູ່ຂອງແຂ້. ມີພຽງ 4 ບ່ອນເທົ່ານັ້ນທີ່ມີລາຍງານ ກ່ຽວກັບຮັງແຂ້, ສ່ວນຈຳນວນທີ່ເຫຼືອແມ່ນຖືກລົບກວນ ແລະມີ 2 ບ່ອນຈາກຈຳ ນວນ ທີ່ຖືກລົບກວນທັງ 4 ບ່ອນທີ່ຍັງຍືນ ໄດ້ວ່າ ມີແຂ້ໄຂ່ (2005). ພື້ນທີ່ເລົ່ານີ້ເກືອບວ່າຄ້າຍຄືກັບແຫ່ງອື່ນໆ, ແຕ່ສິ່ງທີ່ແຕກຕ່າງແມ່ນມີພືດ ນ້ຳປົກ ຄຸມປະມານ 60-100% ຢູ່ບໍລິເວນອ້ອມແອ້ມ ແລະຢູ່ໃນບຶງ, ໜອງ ແລະແມ່ນ້ຳເລົ່ານັ້ນ ສົມ ທຽບກັບ 24 ແຫ່ງທີ່ມີພືດນ້ຳປົກຄຸມພຽງແຕ່ 20%. ເຫັນວ່າເຖິງຈະມີ ການລົບກວນບ່ອນຢູ່ ຂອງແຂ້ ແຕ່ພວກມັນ ຍັງ ອາໄສ ຢູ່ຕາມຫ້ວ, ໜອງ, ບຶງ ແລະແມ່ນ້ຳຈຳນວນໜຶ່ງ ຖ້າຫາກວ່າພື້ນທີ່ເລົ່ານັ້ນຫາກຍັງມີພືດ ນ້ຳປົກຄຸມ ຢູ່. ອາດຈະ ເປັນໄປໄດ້ ຖ້າຫາກຍັງມີພືດນ້ຳຢູ່.

10. **ການອະນຸລັກ:** ການອະນຸລັກແຂ້ ຢູ່ສປປ ລາວ ຈະຕ້ອງເອົາໃຈໃສ່ 3 ປັດໃຈຫຼັກຄື: ການອະນຸລັກແບບມີສ່ວນຮ່ວມ ຂອງຊຸມຊົນ ທີ່ຢູ່ນອກປ່າສະຫງວນແຫ່ງຊາດ, ຄຸ້ມຄອງບຶງ, ໜອງ ແລະແມ່ນ້ຳປ່ອນທີ່ມີ ແລະບໍ່ມີນ້ຳຕະຫຼອດປີ; ປ້ອງ ກັນເຂດທີ່ຍັງຄົງຄົງຢືນແນ່ນອນວ່າມີແຂ້ວາງໄຂ່. 40 ຈາກ 51 ປ່ອນທີ່ມີການບັນທຶກ ກ່ຽວກັບແຂ້ (78%) ແມ່ນຢູ່ນອກເຂດປ່າ ສະຫງວນ ແຫ່ງຊາດ ແລະຢູ່ປ່ອນທີ່ໄກກັບບ້ານປະຊາຊົນ. ການອະນຸລັກຢູ່ສປປ ລາວຈະປະສົບຜົນສໍາເລັດໄດ້ ໃນໄລ ຍະຍາວຈະຕ້ອງໄດ້ຮັບການຈັດຕັ້ງປະຕິບັດ ແບບປະສົມປະສານ ແລະມີສ່ວນຮ່ວມຄື: ການອະນຸລັກແຂ້ ແລະການນໍາ ໄຊ້ພື້ນທີ່ທີ່ແຂ້ອາໃສໄປພ້ອມໆກັນ. ຢູ່ບາງປ່ອນ ຄວາມເຊື່ອຖື ກໍ່ເປັນອີກທາງໜຶ່ງ ທີ່ຈະເຮັດໃຫ້ການອະນຸລັກ ແຂ້ປະສົບຜົນສໍາເລັດ.
11. **ແຂ້ລ້ຽງ:** ຢູ່ສປປ ລາວ ມີພຽງສວນສັດບ້ານເກີນແຫ່ງດຽວທີ່ມີແຂ້ລ້ຽງ (ສວນສັດດັ່ງກ່າວຕັ້ງຢູ່ ບ້ານ ເກີນ, ແຂວງ ວຽງຈັນ). ເຊິ່ງມີຫຼາຍ 300 ໂຕ ແລະບາງໂຕເປັນລູກຊອດ ເຊິ່ງເກີດຈາກການປະສົມພັນ ກັບຊະນິດອື່ນ. ເນື່ອງຈາກວ່າສປປ ລາວ ບໍ່ມີຟາມລ້ຽງ ແຂ້ ດັ່ງນັ້ນການປະສົມຂ້າມສາຍພັນ ຂອງແຂ້ທໍາມະຊາດ ກັບແຂ້ທີ່ລັກອອກຈາກຄອກ ຈຶ່ງບໍ່ມີຄວາມສ່ຽງ ສູງ. ການປ່ອຍແຂ້ລ້ຽງກໍ່ເປັນອີກວິທີໜຶ່ງ ໃນການອະນຸລັກແຂ້ ແລະໃນອານາຄົດຫາກແຂ້ ໃນທໍາມະຊາດຫາກດັບສູນ ຈໍານວນແຂ້ທີ່ມີຢູ່ ໃນສວນສັດກໍ່ສາມາດນໍາໄປປ່ອຍໄດ້ ແຕ່ຕ້ອງໃຫ້ພື້ນໃຈວ່າມັນບໍ່ແມ່ນລູກຊອດ ແລະບໍ່ແມ່ນແຂ້ທີ່ ນໍາມາຈາກປະເທດອື່ນ.

### ຂໍ້ສະເໜີ (RECOMMENDATIONS)

ບັນຂໍ້ແນະນຳຕ່າງໆຂ້າງລຸ່ມນີ້ ເປັນຄວາມຕັ້ງໃຈ ທີ່ຈະຊ່ວຍໃນການອະນຸລັກແຂ້ *Crocodylus siamensis* ຢູ່ໃນສປປ ລາວ:

1. ວຽກງານປູກຈິດສຳນຶກ: ສືບຕໍ່ກິດຈະກຳປູກຈິດສຳນຶກ ໃນການອະນຸລັກ ແຂ້ ໃນຂອບເຂດທົ່ວປະເທດ ໂດຍຄວນຈັດກອງ ປະຊຸມສຳມະນາຂັ້ນສູນກາງ ຫຼື ຂັ້ນແຂວງ ໃຫ້ກັບພາກສ່ວນທີ່ກ່ຽວຂ້ອງທີ່ສຳຄັນ (ລັດ ແລະທົວໜ່ວຍທຸລະກິດ ກຸ່ມກັບອຸດ ສະຫະກິດ) ໃນການມີສ່ວນຮ່ວມ ໃນການຈັດສັນບົງ, ໜອງ ແລະກຸດຕ່າງໆ. ກອງປະຊຸມສຳມະນາດັ່ງກ່າວ ຄວນເນັ້ນໃສ່ ແຂວງ ອັດຕະປື, ສາລະວັນ ແລະສະຫວັນນະເຂດ ໂດຍສະເພາະແມ່ນບັນດາສາຍນ້ຳທັງ 7 ແຫ່ງຄື: ເຊປຽນ, ເຊຄຳພໍ ແລະເຊກອງ (ແຂວງ ອັດຕະປື), ເຊໂດນ (ແຂວງ ສາລະວັນ) ແລະເຊບັ້ງໄຟ, ເຊບັ້ງທຽງ ແລະເຊຈຳພອນ (ແຂວງ ສະ ຫວັນນະເຂດ). ສູນຄົ້ນຄ້ວາການປະມົງ (LARReC) ແລະກົມປ່າໄມ້ (DoF) ອາດຈັດກອງປະຊຸມສຳມະນາດັ່ງກ່າວ ໂດຍອີງໃສ່ບັນດາຈຸດປະສົງຂ້າງລຸ່ມນີ້:
  - ປູກຈິດສຳນຶກ ໃຫ້ກັບອົງການທີ່ກ່ຽວຂ້ອງ ໂດຍສະເພາະແມ່ນ ບັນດາສາຍນ້ຳທີ່ສຳຄັນທັງ 7 ແຫ່ງໃນການອະນຸລັກແຂ້.
  - ກຳນົດຂັ້ນຕອນ ເພື່ອຮວບຮວມເອົາ ແຜນການອະນຸລັກແຂ້ ແລະບັນດາສາຍນ້ຳທີ່ສຳຄັນທັງ 7 ແຫ່ງເຂົ້າໃນວາລະການ ແຜນຂອງສູນກາງ ແລະຂອງແຂວງ. ຂໍ້ມູນເລົ່ານີ້ຈະຊ່ວຍອົງການຈັດຕັ້ງຕ່າງໆ ຂອງລັດຖະບານ ໃນການກຳນົດທ່າແຮງ ກ່ຽວກັບແຂ້ ໃນປະຈຸບັນ ເພື່ອເປັນປ່ອນອີງ ໃນການພິຈາລະນາບັນດາໂຄງການພັດທະນາອື່ນໆ ຢູ່ໃນບັນດາພື້ນທີ່ດິນ ທາມຕ່າງໆ.
  - ກຳນົດພາລະບົດບາດ ແລະຄວາມຮັບຜິດຊອບ ຂອງແຕ່ລະອົງການ ເພື່ອຄຸ້ມຄອງພື້ນທີ່ດິນທາມທີ່ເປັນປ່ອນຢູ່ຂອງແຂ້.
  - ກຳນົດສິ່ງທີ່ຊາວບ້ານຈະໄດ້ຮັບຜົນປະໂຫຍດ ຈາກການຮັກສາ ແຂ້ເຊິ່ງເປັນຊະນິດພັນທີ່ຖືກໄພຂົ່ມຂູ່ໃນປະຈຸບັນ ຕົວຢ່າງ: ໂຄງການອະນຸລັດແຂ້ ແລະສັດຊະນິດອື່ນ ຂອງພື້ນທີ່ດິນທາມ ໃນແມ່ນ້ຳຂອງ ຕອນລຸ່ມເຊັ່ນ:
    - ໃຫ້ນັກທ່ອງທ່ຽວມາເບິ່ງແຂ້ ຢູ່ຕາມບົງ, ໜອງ ແລະແມ່ນ້ຳ ປ່ອນທີ່ມີຄວາມເປັນໄປໄດ້ ດ້ວຍຮູບແບບການທ່ອງທ່ຽວ ແບບອະນຸລັກ.
    - ກຳນົດເຂດປ້ອງກັນ ເຊິ່ງເປັນປ່ອນຢູ່ຂອງແຂ້ ແລະສັດທີ່ໄກ່ສູນພັນຊະນິດອື່ນໆ ເຊິ່ງອາດຈະເປັນປ່ອນທີ່ປາອອກແມ່ ແຜ່ລູກ ແລະປະຊາຊົນກໍ່ຈະມີປາກົນຫຼາຍຂຶ້ນ.
  - ກະກຽມເອກະສານ ຂໍ້ມູນຄວາມຈິງ ກ່ຽວກັບແຂ້ ເຊິ່ງເອກະສານດັ່ງປະກອບດ້ວຍຂໍ້ມູນກ່ຽວ ກັບສະຖານະພາບ, ໄພຂົ່ມຂູ່, ຄວາມສຳຄັນ ແລະກິດລະບຽບກ່ຽວກັບແຂ້ ຢູ່ສປປ ລາວ (ຕົວຢ່າງ: ອີງໃສ່ຂໍ້ມູນ ໃນບົດລາຍງານສະບັບນີ້). ສິ່ງເອກະ ສານ ຂໍ້ມູນຄວາມຈິງ ກ່ຽວກັບແຂ້ ໃຫ້ພາກສ່ວນ ກະສິກຳ ແລະປ່າໄມ້ ທຸກຂັ້ນ, ປ່າສະຫງວນແຫ່ງຊາດ, ອົງການວາງ ແຜນທີ່ດິນ, ອົງອະນຸລັກ ແລະອົງການພັດທະນາຕ່າງໆ ທີ່ບໍ່ແມ່ນອົງການຈັດຕັ້ງລັດ (NGOs) ແລະສະຖາບັນການສຶກ ສາອື່ນໆ ໃນສປປ ລາວ.

2. ສ້າງຄວາມສາມາດທາງດ້ານວິຊາການ ໃຫ້ກັບພະນັກງານປ່າໄມ້. ພະນັກງານປ່າໄມ້ ທີ່ເຮັດວຽກພາກສະໜາມຫຼາຍທ່ານ ອາດຈະເຂົ້າໃຈເຖິງຄວາມສໍາຄັນ ໃນການອະນຸລັກແຂ້. ແຕ່ວ່າຂໍ້ມູນດັ່ງນີ້ອາດຊ່ວຍ ໃນການຄຸ້ມຄອງແຂ້:
- ກະກຽມແບບຟອມບັນທຶກພາກສະໜາມ ໃຫ້ພະແນກກະສິກໍາ ແລະປ່າໄມ້ ເພື່ອໃຊ້ເຂົ້າໃນລາຍງານ ເຖິງແຂ້ທີ່ພົບເຫັນ. ແບບຟອມ ດັ່ງກ່າວຄວນຈະປອບດ້ວຍ ສະຖານທີ່ ທີ່ພົບເຫັນ (ແມ່ນ້ຳ, ເມືອງ, ບ້ານ ທີ່ຢູ່ໄກທີ່ສຸດ), ວັນທີ, ເດືອນ, ປີ, ປະເພດຖິ່ນທີ່ ຢູ່ອາໃສ ແລະປະເພດທີ່ພົບເຫັນ: ເຫັນຢູ່ຕາມທໍາມະຊາດ, ຊັ້ນສ່ວນທີ່ຄົນເກັບໄວ້, ຮັງ ແລະໄຂ່)
  - ສົ່ງແບບຟອມດັ່ງກ່າວໃຫ້ກັບ ພະແນກ ແລະຫ້ອງການ ກະສິກໍາ ແລະປ່າໄມ້. ໂດຍສະເພາະແມ່ນ ແຂວງອັດຕະປື, ຈໍາປາສັກ, ສາລະວັນ ແລະສະຫວັນນະເຂດ.
  - ພະແນກ ແລະຫ້ອງການ ກະສິກໍາ ແລະປ່າໄມ້ ຄວນເອົາວຽກງານກວດກາຕິດຕາມແຂ້ ເຂົ້າໃນຕາຕະລາງກວດກາຕິດຕາມ (ຕົວຢ່າງ: ຖ້າມີການລາຍງາຍຂອງຊາວບ້ານວ່າເຫັນແຂ້ຢູ່ຕາມທໍາມະຊາດ ແລະແຂ້ທີ່ຖືກຄົນຈັບ). ພະນັກງານປ່າ ໄມ້ຍັງສາມາດປຸກຈິດສໍານິກໃຫ້ກັບຊາວບ້ານ ດ້ວຍຮູບແບບເປັນກັນເອງ ເວລາລົງໄປປະຕິບັດວຽກງານພາກສະໜາມ. ແບບຟອມການສໍາຫຼວດຕອນກາງຄືນ ແມ່ນໄດ້ຄັດຕິດມານໍາເອກະສານສະບັບນີ້ (ເບິ່ງ Appendix 1)
3. ການອະນຸລັກ ແຂ້ ແບບມີສ່ວນຮ່ວມຂອງຊຸມຊົນ: ສິ່ງທີ່ສໍາຄັນ ໃນການອະນຸລັກແຂ້ ຢູ່ສປປ ລາວ ແມ່ນການ ອະນຸລັກ ແບບມີສ່ວນຮ່ວມ ຂອງຊຸມຊົນ ເພື່ອປັບປຸງ ການຄຸ້ມຄອງ ພື້ນທີ່ດິນທາມ ທີ່ຢູ່ນອກເຂດປ່າສະຫງວນ ສອງແຫ່ງຄື: ບຶງ ພູໂລ້ນ (ເຊປຽນ, ແຂວງ ອັດຕະປື) ແລະກຸດໝາກແຜ້ວ (ເຊຈໍາ ພອນ, ແຂວງສະຫວັນນະເຂດ) ພື້ນທີ່ສອງແຫ່ງນີ້ຄວນ ຈະໄດ້ຮັບການພິຈາລະນາຢ່າງຮີດດ່ວນເພື່ອຈຸດປະສົງ ໃນການອະນຸລັກແຂ້ (ເບິ່ງ Figure 3). ອີງຕາມຂໍ້ມູນທີ່ ບຶງພູ ໂລ້ນ ແລະກຸດໝາກແຜ້ວ ເປັນເຂດທີ່ດີທີ່ສຸດ ສໍາລັບການອະນຸລັກ ແຂ້ ຢູ່ສປປ ລາວ ໃນປະຈຸບັນ.

### (ກ) ບຶງພູໂລ້ນ

- ຈັດກອງປະຊຸມກັບບັນດາບ້ານທີ່ຢູ່ໄກໂຄງເຊັ່ນ: ບ້ານບິນດົງ, ບ້ານສະໝອງໃຕ້, ບ້ານຫີນລາດ ແລະ ບ້ານໃໝ່ (ບັນ ດາບ້ານເລົ່ານີ້ເຄື່ອນໄຫວກິດຈະກຳຕ່າງໆຢູ່ບຶງດັ່ງກ່າວ) ໃຫ້ໄວເທົ່າທີ່ຈະເປັນໄປໄດ້ ເພື່ອປຶກສາຫາລື ກ່ຽວກັບການ ອະນຸລັກແຂ້ ແລະການນໍາໃຊ້ຂັບພະຍາກອນທໍາມະຊາດ.
- ໃນກອງປະຊຸມຈະຕ້ອງມີການ ປຶກສາຫາລື ແລະຕົກລົງກັນວ່າ ຈະປັບປຸງເຂດທີ່ບໍ່ສາມາດຈູດປ່າ ເພື່ອປ້ອງກັນໄຟທີ່ ຈະໄໝ້ຮັງ ແລະໄຂ່ຂອງແຂ້.
- ຈັດກອງປະຊຸມ ກັບພາກສ່ວນທີ່ກ່ຽວຂ້ອງ ໂດຍສະເພາະແມ່ນບໍລິສັດ ຕິດຕັ້ງຕະຂ່າຍໄຟຟ້າ ທີ່ຖັດຈາກບຶງແຂ້ ໃນປະຈຸບັນ (2005). ພັດທະນາ ການວັດແທກ ການຈັດສັນສິ່ງແວດລ້ອມ ເພື່ອໃຫ້ເກີດຜົນກະທົບຕໍ່ບຶງ ແລະແຂ້ໜ້ອຍ ທີ່ສຸດເທົ່າທີ່ຈະເປັນໄປໄດ້.

**(ຂ) ກຸດໝາກແຜ້ວ**

- ຈັດກອງປະຊຸມກັບບ້ານ ຕານສຸມ ແລະບ້ານເລົ່ານາດ ໃຫ້ໄວເທົ່າທີ່ຈະໄວໄດ້ ເພື່ອປຶກສາຫາລື ກ່ຽວກັບການອະນຸ ລັກແຂ້ ແລະການນຳໄຊ້ຊັບພະຍາກອນທຳມະຊາດ. ຈຸດປະສົງຫຼັກ ຂອງກອງ ປະຊຸມ ຄວນປະກອບດ້ວຍ
- ຮ່ວມມືກັບ ພະແນກ ແລະ ຫ້ອງການກະສິກຳ ແລະປ່າໄມ້ ໃນການແບ່ງດິນແບ່ງປ່າ ໃຫ້ກັບບ້ານ ຕານສຸມ ແລະ ບ້ານ ເລົ່ານາດ ເພື່ອກຳເຂດນຳໄຊ້ ຂອງບ້ານຢ່າງແນ່ນອນ.
- ປັບປຸງລະບຽບການສະເພາະ ໃນການນຳໄຊ້ຊັບພະຍາກອນທຳມະຊາດຂອງຊຸມຊົນ. ລະບຽບການ ດັ່ງກ່າວ ຄວນ ປະກອບດ້ວຍ ການຫ້າມຄົນເຂົ້າໄປລົບກວນປ່ອນທີ່ແຂ້ເຮັດ ຢູ່ກຸດໝາກແຜ້ວ.
- ພິຈາລະນາເອົາກຸດໝາກແຜ້ວເປັນ ປ່າສະຫງວນເມືອງ ຫຼື ແຂວງ.
- ກຳນົດທ່າແຮງສຳລັບ ການທ່ອງທ່ຽວທຳມະຊາດ ຫຼື ວິທີການອື່ນໆ ເພື່ອໃຫ້ປະຊາຊົນມີລາຍໄດ້ ຈາກ ການອະນຸລັກ ແຂ້ ຢູ່ກຸດໝາກແຜ້ວ.
- ໃນອານາຄົດຄວນມີການສຳຫຼວດແຂ້ ຢູ່ຕາມບຶງ, ໜອງ ແລະກຸດຕ່າງໆ ຢູ່ເຊຈຳພອນ ເພື່ອຂຽນ ເປັນເອກະສານ ກ່ຽວກັບສະຖານະພາບ ຂອງແຂ້. ເພາະບຶງ, ໜອງ ແລະກຸດຕ່າງໆເລົ່ານັ້ນອາດ ເປັນເຂດທີ່ສຳຄັນ ຕໍ່ການອະນຸລັກ ແຂ້ໄດ້.

4. ການສຳຫຼວດ ຄັ້ງຕໍ່ໄປ. ການສຳຫຼວດ ກ່ຽວກັບສະຖານະພາບ ຂອງແຂ້ຄັ້ງໄໝ່ ຈະຕ້ອງໄດ້ຮັບການຈັດຕັ້ງ ຢ່າງ ຮີບດ່ວນ ຢູ່ຫຼາຍໆເຂດ ຂອງສປປ ລາວ, ເຊິ່ງອາດຈະເປັນປ່ອນຢູ່ ຂອງແຂ້ທີ່ສຳຄັນໃນລະດັບໂລກ. ເຂດທີ່ຄວນ ໄດ້ຮັບການສຳ ຫຼວດແມ່ນໃຫ້ເບິ່ງຕາຕະລາງຂ້າງລຸ່ມ: (ຕາຕະລາງທີ 19 ໃນຂໍ້ທີ 8.4). ປ່ອນທີ່ ສຳຄັນທີ່ສຸດແມ່ນ ເຊຈຳພອນ ແຂວງ ສະຫວັນນະເຂດ.

**ເຂດບູລິມະສິດ ໃນການສຳຫຼວດເຖິງສະຖານະພາບ ຂອງແຂ້ຄັ້ງຕໍ່ໄປ ຢູ່ສປປ ລາວ**

ແຂວງ	ເມືອງ	ແມ່ນ້ຳ	ການບັນ ທຶກ	ເຂດສຳຫຼວດ ແລະເຫດຜົນ	ບູລິມະ ສິດ
ອັດຕະປື	ຫາດຊາຍຟອ ງ	ເຊປຽນ ເຊຄຳພໍ	4	ບຶງໜຶ່ງຍົມ ແລະຫ້ວຍສອຍມອງ ຍັ້ງຍືນ ວ່າມີການ ອອກແມ່ ແຜ່ລູກ ຂອງແຂ້ (2005); ຊາວບ້ານລາຍ ງານ (1990s)	ສູງ
ອັດຕະປື	ສານໄຊ	ເຊກອງ-ເຊ ຂະໝານ	2	ປ່າສະຫງວນແຫ່ງຊາດ ດົງອາມພາມ ແລະນ້ຳຍິງ. ຊາວບ້ານ ລາຍງານ (1996); ຍັ້ງຍືນໄດ້ວ່າ ມີແຂ້ຢູ່ ເຊກອງ ແລະອຸດທິ ຍານແຫ່ງຊາດ ວິລະເຈ (ກຳປູ ເຈຍ); ແຂ້ຈຳນວນນີ້ແມ່ນ ທຽວ ໄປ-ມາລະຫວ່າງ ລາວ-ກຳປູເຈຍ.	ສູງ
ຈຳປາສັກ	ໂຂງ	ນ້ຳຂອງ	1	ສີພັນດອນ. ປະຊາຊົນທ້ອງຖິ່ນລາຍ ງານ (1990s); ເປັນ ປ່ອນຢູ່ອາ ຂອງແຂ້ ຄວາມໜ້າແໜ້ນ ຂອງແຂ້ ໃນອາດີດ	ປານກາງ

ຈຳປາສັກ	ປະທຸມພອນ	ຫ້ວຍຕວາຍ	1	ປ່າສະຫງວນແຫ່ງຊາດດົງຫົວສາວ. ປະຊາຊົນທ້ອງຖິ່ນລາຍ ງານ (1990s) ຄວາມໝາແໜ້ນ ຂອງແຂ້ໃນ ອາດີດ	ປານກາງ
ຈຳປາສັກ	ຊະນະສິມບູນ	ນ້ຳຂອງ	1	ປ່າສະຫງວນແຫ່ງຊາດ ພູຊຽງທອງ. ປະຊາຊົນທ້ອງຖິ່ນລາຍ ງານ (1990s) ຄວາມໝາແໜ້ນ ຂອງແຂ້ໃນ ອາດີດ	ປານກາງ
ຈຳປາສັກ	ສຸກຸມມາ	ຫ້ວຍຄຳມ່ວນ	1	ຫ້ວຍຄຳມ່ວນ, ຫ້ວຍກະລາ ແລະບໍລິ ເວນໄກ້ກັບສາ ຂາ ຂອງແມ່ນ້ຳ ຂອງ ປະຊາຊົນທ້ອງຖິ່ນລາຍງານ (1990s) ຄວາມໝາແໜ້ນ ຂອງແຂ້ໃນອາດີດ	ປານກາງ
ສາລະວັນ	ຄົງເຊໂດນ	ເຊໂດນ	3	ຫ້ວຍທວງ ແລະບໍລິເວນໄກ້ຄຽງ. ປະຊາ ຊົນທ້ອງຖິ່ນ ລາຍ ງານ (2004); ສະຖານະພາບໃນການວາງໄຂ່ ຍັງບໍ່ຈະແຈ້ງ.	ປານກາງ
ສາລະວັນ	ລະຄອນເພັງ	ເຊບັງນວນ	4	ປ່າສະຫງວນແຫ່ງຊາດ ເຊບັງນວນ. ປະຊາຊົນທ້ອງຖິ່ນລາຍ ງານ (1993-94)	ປານກາງ
ສະຫວັນນະເຂດ	ຈຳພອນ	ເຊບັງໄຟ	2	ໜອງຫຼວງ. ປະຊາຊົນທ້ອງຖິ່ນລາຍ ງານ (1990s, 2003); ມີການຢັ້ງຢືນ ວ່າມີແຂ້ໄຂ່ ຢູ່ໄກ້ກັບ ເຊຈຳ ພອນ.	ສູງ
ສະຫວັນນະເຂດ	ອາດສະພອນ ຈຳພອນ	ເຊຈຳພອນ	2	ບຶງບ່ອນທີ່ຈອດກັບ ເຊຊ້າງຊ້ອຍ; ຢູ່ຍອດນ້ຳໄກ້ຈະ ຮອດ ບ້ານນາທິມ. ມີ ບ່ອນໜຶ່ງທີ່ສາມາດ ຢັ້ງຢືນໄດ້ ວ່າ ມີແຂ້ ໄຂ່ (2005); ພົບເຫັນແຂ້ນ້ອຍ (1998); ບົດລາຍງານອື່ນໆ ໃນປີ 2004.	ສູງທີ່ສຸດ
ສະຫວັນນະເຂດ	ຈຳພອນ	ເຊຊ້າງຊ້ອຍ	2	ບຶງບ່ອນທີ່ຈອດກັບເຊຈຳພອນ; ປະຊາຊົນທ້ອງຖິ່ນ ລາຍງານ (2003); ໄກ້ກັບບ່ອນທີ່ຢັ້ງຢືນໄດ້ວ່າແຂ້ ໄຂ່ (2005).	ສູງ

5. ປ່າສະຫງວນແຂວງ. ໃນປະຈຸບັນຍັງບໍ່ທັນໄດ້ມີການທົບທວນ ກ່ຽວກັບແຂ້ ໃນເຂດປ່າສະຫງວນແຂວງ ຂອງສປປ ລາວ. ຄວນມີ ການທົບທວນກ່ຽວປ່າສະຫງວນແຂວງ ອັດຕະປື, ຈຳປາສັກ, ສາລະວັນ, ສະຫວັນນະເຂດ ແລະເຊກອງ ເພື່ອປະເມີນວ່າມີການ ການບັນທຶກ ກ່ຽວກັບແຂ້ ທີ່ໄດ້ຮັບການຮວບຮວມ ໃນການທົບທວນໃນຄັ້ງນີ້ (n=122) ແມ່ນມາ ຈາກປ່າສະຫງວນແຂວງຫຼືບໍ່. ສິ່ງເລົ່ານີ້ຊະຊ່ວຍ ໃນການຈັດບູລິມະສິດ ໃນການອະນຸລັກແຂ້.

6. ແຜນທີ່ກ່ຽວກັບ ພື້ນທີ່ດິນທາມ. ສປປ ລາວ ຍັງບໍ່ທັນໄດ້ເຮັດແຜນທີ່ ກ່ຽວກັບພື້ນທີ່ດິນທາມສະເພາະເທື່ອ. ແຜນທີ່ພື້ນ ທີ່ດິນທາມ ຈະຊ່ວຍກຳນົດ ພາກສ່ວນດິນທາມ ທີ່ຢູ່ໃນ ແລະນອກເຂດປ່າສະຫງວນແຫ່ງຊາດ.

ຂໍ້ມູນພື້ນທີ່ດິນທາມ ທີ່ມີສະແດງໃຫ້ເຫັນແລ້ວວ່າ ພື້ນທີ່ດິນທາມເລົ່ານັ້ນ ຢູ່ນອກເຂດປ່າສະຫງວນ: ເຊິ່ງມີຄວາມສໍາຄັນ ໃນການອະນຸລັກ ແຂ້ ແບບມີສ່ວນຮ່ວມ ຂອງຊາວບ້ານ.

7. ການປ່ອຍ ແລະການຄຸ້ມຄອງແຂ້ລ້ຽງ. ຢູ່ສປປ ລາວ ໃນປະຈຸບັນ ບໍ່ຂໍ້ແນະນຳໃຫ້ປ່ອຍແຂ້ລ້ຽງ. ຄວນຈະນຳໄຊ້ຄວາມຮູ້ທາງດ້ານວິຊາການ ແລະງົບປະມານເຂົ້າ ໃນການປົກປັກຮັກສາແຂ້ທີ່ຍັງເຫຼືອ ຕາມທຳມະຊາດ. ກ່ອນຈະ ມີການປ່ອຍ. ຄວນມີການປຶກສາຫາລືກັນກັບຜູ້ຮັບຜິດຊອບ ສວນສັດບ້ານເກີນ ເພື່ອບໍ່ໃຫ້ປ່ອຍແຂ້ລ້ຽງ ແລະປ້ອງກັນການລັກອອກ ຈາກຄອກ ຂອງແຂ້ລ້ຽງ ເຊິ່ງມັນອາດຈະໄປປະສົມພັນ ຂ້າມສາຍພັນ ກັບແຂ້ຊະນິດອື່ນ. ອາດຈະໃຫ້ສວນສັດມີສ່ວນ ຮ່ວມ ໃນການອະນຸລັກແຂ້ ໂດຍນຳໄຊ້ກິດຈະບູກຈິດສຳນຶກ ໃຫ້ກັບຜູ້ທີ່ມາເບິ່ງສັດ ຢູ່ ສວນສັດບ້ານເກີນ.
8. ການມີສ່ວນຮ່ວມ ໃນການອະນຸລັກແຂ້ໃນພາກພື້ນ. ຄວນມີການແລກປ່ຽນຂໍ້ມູນທີ່ກ່ຽວຂ້ອງ ກັບແຂ້ກັບບັນດາ ປະເທດ ຕ່າງໆເຊັ່ນ: ລາວ-ກຳປູເຈຍ-ຫວຽດນາມ-ໄທ-ອິນໂດເນເຊຍ ເພື່ອແລກປ່ຽນປະສົບການ ແລະຄວາມຮູ້ ກ່ຽວກັບການອະ ນຸລັກແຂ້. ເຊິ່ງແລກປ່ຽນຂໍ້ມູນດັ່ງກ່າວ ທາງອົງການຄຸ້ມຄອງ ແລະນຳໄຊ້ ຊີວະນາໆພັນ ພື້ນທີ່ດິນ ທາມ ເຂດແມ່ນ້ຳ ຂອງຕອນລຸ່ມ (Mekong Wet lands Biodiversity Program) (MWBP) ກຳລັງກຳນົດຢູ່.

## Summary

This report is a key output of the “2005 Lao Siamese Crocodile Survey”, a cooperative project conducted from March-June 2005 by the Living Aquatic Resources Research Centre (LARReC, Ministry of Agriculture and Forestry), Wildlife Conservation Society – Lao Programme (WCS) and Mekong Wetlands Biodiversity Conservation and Sustainable Use Programme (MWBP)<sup>1</sup>. *Crocodylus siamensis* (the Siamese Crocodile) is a Critically Endangered species, which is very rare or locally extinct in many parts of its historic range in south-east Asia. In the Lao People’s Democratic Republic (Lao PDR), very little is known of the species. The first targeted *C. siamensis* surveys were conducted from 2003-04 by LARReC/WCS, which confirmed the continued occurrence of wild *C. siamensis* in Lao PDR. Follow-up surveys were conducted in 2005 with funding from the MWBP, which is supporting *C. siamensis* conservation efforts in Lao PDR, Cambodia, Viet Nam and Thailand. This report presents 2005 survey findings and other available information on *C. siamensis*, and is intended as a preliminary review to assist urgently-needed crocodile conservation actions in Lao PDR.

- 1. Surveys in 2005.** Field surveys from March-June 2005 were conducted at 25 wetlands (lakes, ponds, rivers), in three provinces in southern Lao PDR. Survey methods included day transects (searching for crocodile signs), spotlight counts, community interviews, and habitat and socio-economic assessments. A database of 122 national crocodile records was compiled, based on 2003-05 surveys and other reports, with data on habitat, reliability and location of records. This database is housed at the WCS-Lao Programme.
- 2. Distribution.** National *C. siamensis* records (1860s-2005) were from 25 river systems in nine provinces of south, central and west Lao PDR, over an area of 465 km<sup>2</sup> (minimum area encompassed by all records). All records are <400 m elevation and most (n=119, 98%) are within the “Mekong Plain” physiographic unit, which encompasses lowland wetlands in Lao PDR. The historic distribution of *C. siamensis* (defined here as  $\leq 1979$ ) extended from the extreme south to at least Pakxan (Figure 3), along the Mekong River and inland tributaries. There are no records from the extreme north or north-east of Lao PDR, which is mountainous. Current ( $\geq 1980$ ) records (n=104) are from 18 river systems in eight provinces. Surveys in 2005 suggest a severe range decline has occurred: of 24 surveyed wetlands where crocodiles were reported to have occurred, communities stated crocodiles now only occurred in 15 sites (a decline of 38%), yet surveys only confirmed crocodile occurrence in six sites and successful breeding in two sites. Most lowland wetlands in Lao PDR are highly disturbed, and survey results may reflect local declines in many other sites of historic occurrence.
- 3. National crocodile records** indicate the current “core” distribution of *C. siamensis* in Lao PDR appears to be within seven river systems in southern Lao PDR: Xe Pian, Xe Kampho and Xe Kong river systems (Attapeu Province); Xe Don river system (Saravan Province); and, Xe Bangfai, Xe Banghiang and Xe Champhone river systems

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<sup>1</sup> The Mekong Wetlands Biodiversity Conservation and Sustainable Use Programme (MWBP) is a joint programme of the four riparian governments of the Lower Mekong Basin – Cambodia, Lao PDR, Thailand and Viet Nam – managed by the United Nations Development Programme (UNDP), The World Conservation Union (IUCN) and the Mekong River Commission (MRC).

(Savannakhet Province) (Figure 3). Further surveys may document remnant crocodile populations in other river systems in southern Lao PDR.

4. **Status and abundance.** There is currently insufficient data to estimate the total *C. siamensis* population in Lao PDR, but available data indicate a severe national decline in abundance. The species was reported to be “common” in the 1800s, but is now rare or locally extinct in many sites. In 2005, a minimum estimate of 16+ crocodiles was recorded at five wetlands. Based on studies of other crocodile species, this suggested a total non-hatchling population of 115-372 crocodiles in these sites, although comparison with local reports suggests these are overestimates. At nine of 24 wetlands in 2005, local communities stated crocodiles were “much more” abundant before the 1970s.
5. **Habitat.** In Lao PDR, *C. siamensis* historically occurred in a wide range of permanent and seasonal wetlands, including rivers, lakes and ponds. Crocodile records were compiled from 51 sites in Lao PDR: 29 flowing waterbodies (perennial rivers and streams) and 22 non-flowing waterbodies (lakes, ponds, marshes). Within non-flowing waterbodies, crocodiles were reported from permanent freshwater ponds and lakes with vegetated water surfaces (n=14) or with open water surfaces (n=7), or seasonal freshwater marsh (n=1). Six of 31 interviewees in 2005 reported that in the dry season, crocodiles reside within permanent waterbodies, and in the wet season, disperse between permanent and seasonal waterbodies.
6. **Breeding.** Five nest and three hatchling records were compiled in 2005, from six sites in southern Lao PDR. Successful breeding in 2005 was confirmed in only two of six sites, which were in notably different habitats. One was located on a thick, exposed floating mat of grasses, over water 3-4 m deep, 200 m from a seasonal river. The nest received direct sunlight most of the day. The second nest was located near the bank of a pond, within forest (canopy 20-30 m) 200 m from a perennial river, and was shaded most of the day. Of three other nest records, two were reported from floating vegetation mats over the water, and one was reported from the bank of a lake. All nest sites were at lakes or ponds, not rivers.
7. **Community cultural beliefs.** Most interviewees in 2005 did not consider crocodiles a threat to humans or village fish resources, and none had heard of any attacks on humans. Thirteen of 31 interviewees (42%) attributed some cultural value to crocodiles, and in these communities (in three provinces in southern Lao PDR), crocodiles were respected as part of the forest “spirits” believed to occur near the village. Six of 25 wetlands surveyed in 2005 were subject to local resource regulations due partly to these crocodile-related beliefs, and crocodile hunting was prohibited. Presence of crocodile-related cultural beliefs was found to sometimes, but not always, indicate the presence of crocodiles. In some wetlands where crocodiles occurred, communities did not appear to attribute any cultural significance to them. Four of 31 interviewees stated that two crocodile forms exist, which differ only in their foot shape (shaped like the feet of a duck or monitor lizard *Varanus* sp. respectively). Both forms were said to occur in the same habitats and were reported from two provinces.
8. **Threats.** Historic commercial hunting and habitat loss are key factors attributed to global declines of *C. siamensis*. No evidence of any commercial hunting or trade in crocodiles was recorded in 2005. Four of 17 communities reported crocodile hunting occurred from

the 1950s-70s, and one community stated hunting was most intensive during the period of Indochinese Conflict (1961-75), when crocodiles were hunted for meat and skin to supplement diet and income. The extent of historic hunting may have been under-recorded as some interviewees were reluctant to discuss this subject. Based on other literature, the illegal crocodile trade in Lao PDR appears to have been widespread in southern provinces until at least the early 1990s, with sale of live crocodiles or skins to Thailand or Cambodia, or transport of crocodiles from Cambodia to Thailand via southern Lao PDR. Most reported trade was to Thailand. Ongoing regional demand for live crocodiles may encourage capture/sale of crocodiles in Lao PDR.

9. **Disturbance Index.** The distribution of *C. siamensis* overlaps with the most densely settled regions of Lao PDR. The extent of seven disturbance variables (historic hunting, clearance, drainage, burning, livestock grazing, fishing and weed invasion) recorded at 24 wetlands in 2005 were compared in a "Disturbance Index". Nineteen wetlands had index scores of  $\geq 50\%$  of the maximum possible score, indicating most sites were exposed to relatively high disturbance. In the only four sites where nesting was reported, some or all disturbance variables were present, and the only two confirmed breeding sites in 2005 were the most highly disturbed of these four sites. These sites appeared to be similar to most other sites, except for the presence of high remnant vegetation cover (60-100%) around or within the wetland, compared with mean 20% cover at 24 sites. This suggests that crocodile recruitment may persist in the presence of some disturbance, as long as vegetation cover is retained around or within the wetland.
10. **Conservation.** Conservation of *C. siamensis* in Lao PDR will largely involve three key factors: community-based conservation approaches outside of the national protected areas system (NPA); landscape-level management of a range of permanent and seasonal wetlands (rivers, lakes and ponds); and, protection of confirmed breeding sites. Forty of 51 sites with crocodile records (78%) are outside the NPA system and are located in community lands. The long-term success of *C. siamensis* conservation in Lao PDR will involve integration of crocodile conservation with community wetland use. In some sites, existence of crocodile-related cultural values may increase the chances of conservation success.
11. **Captive populations.** Captive *C. siamensis* are only known to occur in one institution in Lao PDR, the Ban Kuen Zoo (in Vientiane Province). More than 300 crocodiles are housed at the zoo and some may be hybrids with other *Crocodylus* species. The absence of other crocodile institutions in Lao PDR reduces the risk of hybridisation of wild crocodiles with escaped hybrids. Reintroduction is a potential conservation tool for *C. siamensis* and the zoo stock could potentially be used for any future reintroduction efforts.

## Recommendations

The following recommendations are intended to assist conservation of *Crocodylus siamensis* in Lao PDR.

1. **Raising awareness.** To continue raising national awareness for crocodile conservation, it is recommended that a national workshop and/or provincial workshops be implemented for all key agencies (government and private industry) involved in wetland management. These workshops should focus on the provinces of Attapeu, Saravan and Savannakhet, and in particular seven key river systems: the Xe Pian, Xe Kampho and Xe Kong river systems (Attapeu Province), Xe Don river system (Saravan Province), and, Xe Bangfai, Xe Banghiang and Xe Champhone river systems (Savannakhet Province). Workshops could be conducted by LARReC and DOF, with the following objectives.
  - Raise institutional awareness about crocodiles among relevant agencies, and especially, the location and importance of these seven river systems for crocodile conservation.
  - Identify procedures to incorporate crocodile conservation and important wetland sites into national and provincial planning agendas. This may assist government agencies to identify the potential presence of crocodiles when development projects are being considered in wetland areas.
  - Identify the role and responsibility of each agency for managing wetlands that support crocodiles.
  - Identify potential benefits for local communities that result from the protection of threatened wetland species e.g. crocodiles and the other flagship species of the MWBP. For example:
    - development of crocodile-based ecotourism in some wetlands;
    - protection of some wetland habitats for crocodiles and other threatened species may help to protect and increase local fish populations e.g. because of increased protection of fish breeding sites.
  - Prepare a small fact sheet about *C. siamensis*. This could include information on the status, threats, importance and national legislation about crocodiles in Lao PDR (e.g. based on information in this report). Distribute the fact sheet to all forestry agencies, National Protected Areas, other land planning agencies, conservation and development NGOs, and academic institutions in Lao PDR.
2. **Raising technical capacity of forestry staff.** Many forestry field staff may be unaware of the conservation importance of crocodiles. The following could assist with local crocodile management:
  - Prepare a field recording form for provincial forestry offices to report *C. siamensis* sightings. This sheet should include: location of sighting (river, district, nearest village); date, habitat, type of sighting (wild or captive specimen, nest, eggs).
  - Distribute this form (described above) to PAFO/DAFO in Attapeu, Champasak, Saravan and Savannakhet Provinces.

- PAFO/DAFO agencies could include crocodile monitoring in routine field patrols (e.g. by reporting any local sightings or captive crocodiles). Staff could also conduct informal discussions in villages to raise local awareness about crocodile conservation. A sample spotlight survey form (Lao language) is also given in Appendix 1.

**3. Community-based crocodile conservation.** In Lao PDR, the most important factor for crocodile conservation is the development of community-based projects for wetland management, outside of the protected areas system. Two sites are recommended for immediate community-based crocodile conservation efforts: the Beung Pulone wetland complex (Xe Pian river system, Attapeu Province); and, the Kout Mark Peo wetland complex (Xe Champhone river system, Savannakhet Province) (Figure 3). These are the highest-priority sites for *C. siamensis* conservation currently known in Lao PDR. The following steps are recommended. Recommendations for additional sites are summarised in Table 18 (Section 8.3).

**(A) Pulone lake wetlands complex:**

- Conduct meetings with the communities of Pindong, Samong-Thai, Hinlath and Ban Mai (which utilised these wetlands) as soon as possible, in order to discuss crocodile conservation and local resource use.
- Through community consultation and agreement, develop no-burn zones to halt fire damage of the wetlands and potential destruction of crocodile nesting sites.
- Hold meetings with relevant agencies involved in current (2005) construction of an electricity transmission line next to one wetland (Beung Ke). Develop environmental management measures to minimise environmental impacts to the wetland and crocodiles.

**(B) Kout Mark Peo wetlands:**

- Conduct meetings with Tansoum and Laonath villages as soon as possible, to discuss crocodile conservation and local resource use. A key aim of meetings should be to obtain community agreement for an immediate halt (if only temporary) of clearance and burning of the remaining forest around Kout Mark Peo lake. This will be critical for long-term conservation of crocodile nesting habitat in this lake.
- Conduct cooperative land zoning and allocation between PAFO, DAFO, Tansoum and Laonath villages, to clearly identify community lands around these wetlands.
- Develop site-specific community regulations for local resource use. This could include prohibited-access zones in the centre of Kout Mark Peo lake, to protect crocodile nesting habitat.
- Consider designation of Kout Mark Peo lake as a community and provincial protected area.
- Assess the potential for ecotourism or other methods for local communities to benefit from conservation of the Kout Mark Peo wetlands.
- Conduct further surveys to document crocodile status in nearby wetlands of the Champhone river, which may also be important for crocodile conservation.

**4. Further surveys.** New status surveys are urgently required in other sites in Lao PDR, which may support globally important crocodile populations. Recommended survey sites

are listed below (from Table 19, Section 8.4). The highest priority site for further surveys is the Xe Champhone river system (Savannakhet Province).

5. **Provincial Protected Areas (PPAs).** The current review did not assess the representation of *C. siamensis* in the PPA system of Lao PDR. A review of PPAs in Attapeu, Champasak, Saravan, Savannakhet and Sekong Provinces should be conducted, to assess whether any of the national crocodile records compiled in this review (n=122) are located in PPAs. This will assist in developing national conservation priorities for *C. siamensis*.

#### Locations and Priorities for Further Status Surveys of *Crocodylus siamensis* in Lao PDR

Province	District(S)	River System	Records	Survey Site and Justification	Survey Priority
Attapeu	Hadxaifong, Sanamxay	Xe Pian-Xe Kampho rivers	4	Bung Nong Ngom and Houay Soymong wetlands. Confirmed breeding in region (2005); local reports (1990s)	High
Attapeu	Sanxai	Xe Kong-Xe Kaman	2	Dong Amphan NPA and Nam Ghong PPA. Local reports (1996); crocs confirmed in Xe Kong river and Virachey NP (Cambodia); potential transborder populations	High
Champasak	Khong	Mekong River	1	Seephandon wetlands. Local reports (1990s); extensive wetland habitats; crocs historically abundant	Medium
Champasak	Phathoom-phone	Houay Thouay	1	Dong Hua Sao NPA. Local reports (1990s); crocs historically abundant	Medium
Champasak	Sanasomboon	Mekong River	1	Phou Xiang Thong NPA. Local reports (1990s); crocs historically abundant	Medium
Champasak	Sukuma	Houay Khammouane	1	Houay Khammouane, Houay Khala and nearby tributaries. Local reports (1990s); crocs historically abundant	Medium
Saravan	Khong Xe Don	Xe Don	3	Thouang stream and nearby wetlands. Local reports (2004); breeding status unclear	Medium
Saravan	Xe Bang Nouan, Lakhonepheng	Xe Bang Nouan	4	Xe Bang Nouan NPA. Local reports (1993-4)	Medium
Savannakhet	Champhone	Xe Banghiang	2	Nong Louang wetlands. Local reports (1990s, 2003); near confirmed breeding sites in Xe Champhone river system	High
Savannakhet	Atsaphone, Champhone	Xe Champhone	2	Wetlands near confluence with Xe Xangxoy; upper reaches near Nathom village. Confirmed breeding in one area (2005); juvenile seen (1998); other reports (2004)	Highest
Savannakhet	Champhone	Xe Xangxoy	2	Wetlands near confluence with Xe Champhone. Local reports (2003); near 2005 confirmed breeding site	High

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6. **National wetland mapping.** No detailed mapping of the wetlands of Lao PDR has yet been conducted. A national wetland mapping project would help to identify the proportion of wetlands within and outside the national protected areas system. Existing wetland inventories already show that most wetlands are outside protected areas: this supports the importance of community-based efforts for crocodile conservation outside protected areas.
  7. **Reintroduction and management of captive populations.** Reintroduction of crocodiles is not recommended in Lao PDR at this time. Current technical and financial resources should be used to protect the remaining *C. siamensis* populations in Lao PDR, before reintroduction is considered. Discussions should be held with the Ban Kuen Zoo to prevent any release or escape of captive crocodiles, which may be hybrids with other crocodile species. It may also be beneficial to involve the zoo in national crocodile conservation efforts e.g. develop public awareness activities about crocodiles at the zoo.
  8. **Involvement in regional conservation efforts.** Information exchange should be encouraged between relevant agencies in Lao PDR with agencies in Cambodia, Viet Nam, Thailand and Indonesia, to share experiences and knowledge in conservation of *C. siamensis*. Potential approaches for information exchange of regional crocodile conservation are currently being assessed by MWBP.

# 1. Introduction

This report is a key output of the “2005 Lao Siamese Crocodile Survey”, a cooperative project conducted from March-June 2005 by the Living Aquatic Resources Research Centre (LARReC, Ministry of Agriculture and Forestry), Wildlife Conservation Society – Lao Programme (WCS) and Mekong Wetlands Biodiversity Conservation and Sustainable Use Programme (MWBP)<sup>2</sup>. It is intended as a preliminary review of the national status of *Crocodylus siamensis* (the Siamese Crocodile) in the Lao People’s Democratic Republic, and is based on 2005 survey findings, preliminary crocodile surveys from 2003-04, and a compilation of other national records. There is little available data on *C. siamensis* in Lao PDR, and prior to 2003 there had been no systematic national surveys of the species. Conservation of wetland habitats and species is an increasing priority in Lao PDR (MAF 2005), and it is hoped this report will serve as a baseline for planning and implementation of urgently-needed conservation actions for *C. siamensis*.

## 1.1 Siamese Crocodile

*Crocodylus siamensis* is a freshwater, mound-nesting crocodylian that was historically widely distributed in south-east Asia, including Thailand, Cambodia, Viet Nam, Lao PDR, Indonesia, Malaysia and possibly Brunei (de Rooij 1915; Ho Thu Cuc 1994; MOSTE 1992; Platt and Ngo Van Tri 2000; Ramono and Raharjo 1994; Ratanakorn 1994; Ross 1998; Ross *et al.* 1998; Smith 1930). The species historically occurred in a wide range of wetland habitats, including permanent and seasonal swamps, open ponds and lakes, and rivers, and appears to have been relatively abundant (previous references). Currently, *C. siamensis* is ranked as “Critically Endangered” by The World Conservation Union (IUCN) (IUCN 2004; Thorbjarnarson 1992) and in the early 1990s was thought to be nearly extinct in the wild (based on IUCN criteria “A1 ac”, severe decline in population and a reduced distribution, IUCN 1994, 2001). It is one of nine Critically Endangered reptile species in the Indochinese region (CEPF 2004), and conservation of wild *C. siamensis* populations is considered an urgent priority by IUCN Crocodile Specialist Group (Ross 1998). Key threats identified in the decline of global populations are intensive, unsustainable hunting for the leather trade (the species is commercially valued for its belly skin) and habitat loss (Ross 1998; Stuart *et al.* 2000). The size of most remnant populations is unknown, but most are clearly fragmented or close to local extinction (e.g. Platt and Ngo Van Tri 2000; Stuart *et al.* 2002). The largest remnant populations are thought to be in Cambodia (Daltry 2000; Daltry and Momberg 2000).

In Lao PDR, *C. siamensis* is classified as “At Risk”, the highest national threat ranking, on the basis of extreme paucity of field and trade records, and widespread local reports of decline and disappearance (Stuart 1999). Until recently, almost nothing was known of the status, distribution and ecology of *C. siamensis* in Lao PDR. Early reviews (based largely on information from local communities) indicated that a widespread and severe decline in *C. siamensis* populations had occurred, due to habitat loss and commercial trade in crocodiles, and that remnant populations were highly vulnerable to local extinction (Salter 1993; Stuart 1999; Stuart and Platt 2000). From 2003-04, the first targeted crocodile surveys in Lao PDR

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<sup>2</sup> The Mekong Wetlands Biodiversity Conservation and Sustainable Use Programme (MWBP) is a joint programme of the four riparian governments of the Lower Mekong Basin – Cambodia, Lao PDR, Thailand and Viet Nam – managed by the United Nations Development Programme (UNDP), The World Conservation Union (IUCN) and the Mekong River Commission (MRC).

were undertaken (Phothitay and Sompanith 2003, 2004; Thorbjarnarson 2003). These confirmed the persistence of small breeding populations in some sites in southern Lao PDR, and reinforced the urgency for ongoing crocodile survey and conservation efforts (Thorbjarnarson *et al.* 2004).

## 1.2 Project Background

Cooperative planning for a crocodile conservation project was initiated by LARReC, WCS and the Lao National University in 2001. Crocodile surveys by LARReC/WCS from 2003-04 (Thorbjarnarson *et al.* 2004) included interviews with local communities in areas where crocodiles had been reported, habitat assessments and some field searches for crocodile signs (day searches for trails, dung etc and spotlight surveys). Few crocodiles were seen in the wild, but reports of nesting and small numbers of crocodiles were obtained from Attapeu, Saravan and Savannakhet Provinces. These results confirmed the urgent need for follow-up surveys to identify priority sites and conservation measures for the species. In 2004, discussions were held between LARReC, WCS, IUCN Crocodile Specialist Group and MWBP to plan and initiate follow-up surveys. In 2005, the “Lao Siamese Crocodile Survey” was conducted from March-June, by LARReC (within NAFRI, of the Ministry of Agriculture and Forestry), WCS and MWBP. Principal funding for the project was from the MWBP. *Crocodylus siamensis* is one of four “flagship” species of the MWBP, which is currently supporting *C. siamensis* conservation efforts in Lao PDR, Cambodia, Thailand and Viet Nam.

## 1.3 Objectives

The objectives of the 2005 project were to:

1. Conduct follow-up surveys in priority sites identified during LARReC/WCS surveys in 2003-04.
2. Conduct surveys in previously unsurveyed sites where crocodiles (especially nesting) were reported.
3. Compile and review available information on *C. siamensis* in Lao PDR.
4. Identify sites of national conservation priority for *C. siamensis* and provide recommendations for follow-up conservation activities in these sites.

The remainder of this report is divided into the following sections:

- Section 2 (methods);
- Section 3 (legislative status and protection in Lao PDR);
- Sections 4-7 (ecology, distribution, community perceptions and threats);
- Section 8 (conservation); and,
- Section 9 (references).

2005 field data, sample survey forms, field itineraries and summaries of project meetings are in Appendices 1-8. A map of 2005 survey sites is shown in Section 2.1. Specific 2005 survey locations and other site names mentioned in the report are shown in Appendix 2, and geographic coordinates for 2005 survey sites and villages are located in Appendices 4 and 6. Acronyms and abbreviations used in this report are listed under the table of contents.

## 2. Methods

### 2.1 Study Areas

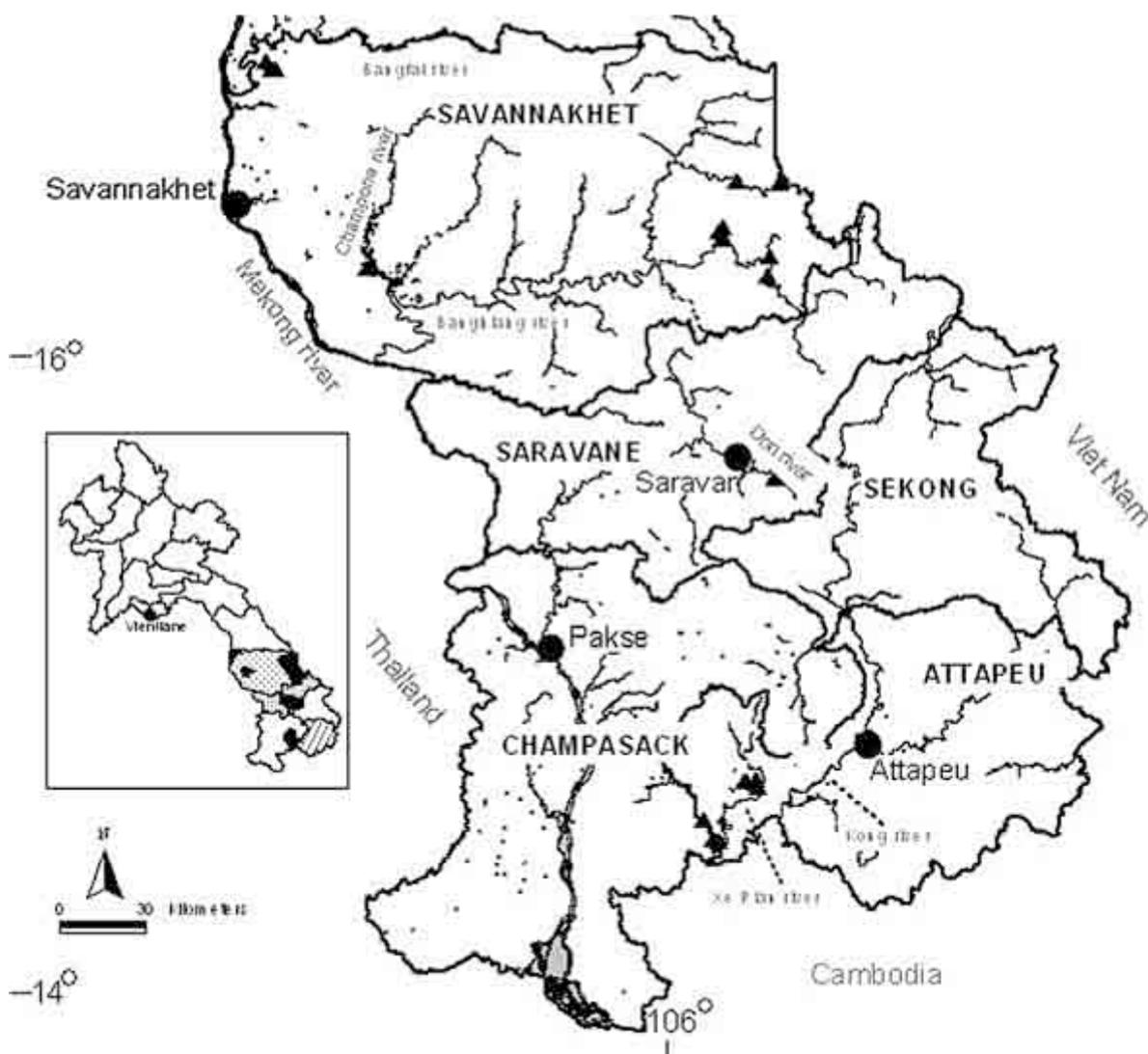
Lao PDR is located in the centre of the Indochinese Peninsula. The climate is tropical monsoonal, with a pronounced wet- (May-October) and dry-season (November-April). Mean annual rainfall ranges from 1,500-3,500 mm between regions, and the mean minimum daily temperature is 20°C, ranging from 0-40°C in various regions and seasons (Duckworth *et al.* 1999; ICEM 2003). Lao PDR is one of four Lower Mekong Basin countries (with Viet Nam, Cambodia and Thailand), and its hydrology is dominated by the Mekong River, which extends for 1,700 km along much of the country's west border. Fourteen major tributaries of the Mekong occur in Lao PDR, as well as hundreds of associated waterways and wetland complexes. Rivers are freshwater and non-tidal, but subject to seasonal fluctuation and flooding. Biologically, Lao PDR is one of the richest countries on the planet, and is a key component of the 'Indo-Burma Hotspot' (one of 25 'hotspots' which cover 1.4% of the Earth's surface yet >60% of terrestrial species diversity, Brooks *et al.* 2002). Lao PDR is located within the 'Indochinese' subdivision of the Indomalayan zoogeographic realm (MacKinnon and MacKinnon 1986). The country is divided into 18 administrative units, and in 2000 had a population of 5.4 million (mean density 22 people/km<sup>2</sup>, the lowest in Asia), with an annual growth rate of 2.4% (ICEM 2003). It is one of the poorest countries in the world: in a Human Development Index that ranks 177 countries in a combined measure of per capita income, literacy and life expectancy, it is ranked 135<sup>th</sup>, with a GDP per capita (in 2002) of US\$1,720 (UNDP 2004).

Most wetlands are confined to a single physiographic unit, the "Mekong Plain", which encompasses the south-west regions of Lao PDR and is generally  $\leq 200$  m elevation, in comparison with most (80%) of Lao PDR, which is hilly or mountainous and 500-2,000 m elevation (Duckworth *et al.* 1999). The plain is a narrow strip of flat, fertile land which supports the country's most important agricultural lands and highest human population (density 5,500 people/1,000 ha cultivated land) (ICEM 2003). Savannakhet and Champasak Provinces contain the highest human populations (500-750,000 people) and densities (20-70 persons/km<sup>2</sup>) in the plain (Hook *et al.* 2003). Most of Lao PDR's population is dependant on these wetlands for income generation, and aquatic animals (e.g. fish, frogs, lizards, snails, shrimp) provide 70-90% of animal protein in local diets (Claridge 1996). The most intensively used wetlands are in low-lying, seasonally inundated areas. Most natural wetlands have been lost or partially modified to rain-fed and irrigated paddy fields and reservoirs.

Crocodile surveys from 2003-05 (Phothitay and Somphanith 2003, 2004; Thorbjarnarson 2003; current report) were conducted in five river systems in the Mekong Plain: the Xe Pian (Attapeu Province), Xe Don (Saravan Province) and Xe Bangfai, Xe Banghiang and Xe Champhone (Savannakhet Province) (Figure 1). Survey sites included standing waterbodies (permanent oxbow lakes, seasonal and permanent ponds, marshes, grasslands), and meandering and fast-flowing perennial rivers and streams. Most wetlands were in relatively degraded rural landscapes, including dry dipterocarp and evergreen forest, and burnt, cleared rice fields. Much of south-east Lao PDR is located in the "Southeastern Indochina Dry Evergreen Forests" ecoregion (Wikramanayake *et al.* 2002) and historically supported dry dipterocarp forest. Some survey sites were characterised by widely spaced deciduous trees and an open understory of grasses and forbes, but most sites showed evidence of logging.

Remnant cover comprised a mosaic of bamboo shrubland, dipterocarp trees, secondary forest, burnt and cleared areas, and rice fields. Most survey sites were subject to varying degrees of drainage, burning, clearance, weed invasion, livestock grazing, fishing or collection of NTFPs. Most sites were accessible by a combination of road, boat or walking, one-two days travel from large provincial towns.

**Figure 1:** River Systems Surveyed for Crocodiles from 2003-05 in Lao PDR



Triangles – 2005 survey sites. Circles – provincial towns. Inset map of Lao PDR shows provinces (shaded) and districts (black) of 2005 surveys

## 2.2 Field Surveys in 2005

### 2.2.1 Selection of Survey Sites

A preliminary review of crocodile records was undertaken at project inception (March 2005). Site selection was mainly based upon the results of preliminary surveys between 1999 and 2004 (Stuart and Platt 2000; Thorbjarnarson *et al.* 2004). In 2005, priority was given to crocodile records/sites with clear description, dates and reliability of crocodile sightings, and to sites with nesting records. This approach was clearly biased toward sites with a higher

likelihood of supporting crocodiles, and no systematic sampling across a range of habitats was taken, in order to maximise survey time and effort.

## 2.2.2 Summary of Survey Effort

From March-June 2005, four field surveys were conducted in Attapeu, Saravan and Savannakhet Provinces of southern Lao PDR. Twenty-five wetlands (17 standing waterbodies and eight rivers or streams) were visited and crocodile status and habitats documented. Thirteen day transects (16.2 person-hours and 5.8 ha wetlands searched) and ten spotlight surveys (14.5 person-hours and 30 km of rivers) were conducted. Thirty-one interviews with local communities from 21 villages, one district forestry office and one border police post were conducted. Socio-economic conditions and resource use of 17 villages near survey wetlands were recorded. 2005 survey forms are in Appendix 1 and results in Appendices 2-7. Crocodile survey effort is summarised in Table 1 and includes 2003-04 surveys. From 2003-05 a total of 27 wetlands were surveyed.

**Table 1:** Larrec/WCS Crocodile Surveys in Lao PDR from 2003-2005

No.	Province	District	Wetland	Survey Effort				Year of Survey			Source
				Spotlight Surveys	Transect Searches	Village Interviews	Habitat Assessment	'03*	'04*	'05	
1	Attapeu	Sanamxay	Beung Ke lake	x	x	x	x	x		x	1,2,4
2	Attapeu	Sanamxay	Beung Pulone lake	x	x	x	x			x	1
3	Attapeu	Sanamxay	Nong Hoi pond		x	x	x			x	1
4	Attapeu	Sanamxay	Nong Ke pond (Xe Pian NPA)		x	x	x			x	1
5	Attapeu	Sanamxay	Nong Kham Miem lake		x	x	x			x	1
6	Attapeu	Sanamxay	Nong Khoung Hape pond		x	x	x			x	1
7	Attapeu	Sanamxay	Nong Palu lake (Xe Pian NPA)		x	x	x			x	1
8	Attapeu	Sanamxay	Xe Kampho river (Xe Pian NPA)			x	x			x	1
9	Attapeu	Sanamxay	Xe Pian river (Xe Pian NPA)	x		x	x			x	1
10	Saravan	Khong Xe Don	Thouang stream			x	x		x		3
11	Saravan	Saravan	Nong Boua pond			x	x		x	x	1,3
12	Saravan	Saravan	Xe Don river	x		x	x		x	x	1,3
13	Savannakhet	Champhone	Cheo lake	x		x	x	x		x	1, 2
14	Savannakhet	Champhone	Kout Mark Peo lake	x	x	x	x	x		x	1,2,4

15	Savannakhet	Champhone	Kout Noy pond			x	x	x		x	1, 2
16	Savannakhet	Champhone	Kout Phinoy lake			x	x	x		x	1,2,4
17	Savannakhet	Champhone	Kout Tao pond			x	x	x		x	1, 2
18	Savannakhet	Champhone	Kout Xe Hack lake			x	x	x		x	1,2,4
19	Savannakhet	Nong	Houay Saping stream			x	x			x	1
20	Savannakhet	Nong	Xe Lanong river (upper reaches)			x	x			x	1
21	Savannakhet	Nong	Xe Lou river			x	x			x	1
22	Savannakhet	Nong	Xe Samouan river			x	x			x	1
23	Savannakhet	Sepon	Xe Pon river			x	x			x	1
24	Savannakhet	Sonbouli	Done Yanong wetlands			x	x	x			2
25	Savannakhet	Xaibouli	Beung Hor wetland			x	x	x		x	1,2
26	Savannakhet	Xaibouli	Beung Saiyan wetland			x	x	x		x	1,2,4
27	Savannakhet	Xaibouli	Boua Thong wetland	X		x	x	x		x	1,2,4

\*mainly community interviews: 1-surveys March-June 2005; 2-Phothitay and Somphanith (2003); 3-Phothitay and Somphanith (2004); 4-Thorbjarnarson (2003)

All 2005 survey teams included representatives from LARReC, Provincial and District Agricultural and Forestry Offices (PAFO, DAFO) and WCS. The following personnel accompanied field surveys in 2005:

*10-18 March (Savannakhet Province):* Mr. Chanthone Phothitay (LARReC); Mr. Somchan Phanthanlangsy (PAFO); Mr. Boundouan Monepadith (DAFO Xaibouli District); Mr. Chompeth (DAFO Champhone District); Mark R. Bezuijen and Mr. Bounthavy Phommachanh (WCS).

*31 March-10 April (Attapeu Province):* Mr. Chanthone Phothitay (LARReC); Mr. Sisavath (PAFO); Mr. Bandith (DAFO Sanamxay District); Mark R. Bezuijen and Mr. Bounthavy Phommachanh (WCS).

*4-10 May (Savannakhet Province):* Mr. Chanthone Phothitay (LARReC); Mr. Sisangvon (PAFO); Mr. Somphane (DAFO Nong District); Mark R. Bezuijen and Mr. Bounthavy Phommachanh (WCS).

*26 May-6 June (Saravan and Attapeu Provinces):* Mr. Somboun Chanyra (LARReC); Mr. Phountasine (PAFO Saravan) and Mr. Kholakhan (DAFO Saravan); Mr. Pungun (PAFO Attapeu) and Mr. Bandith (DAFO Sanamxay); Mark R. Bezuijen and Mr. Bounthavy Phommachanh (WCS).

### 2.2.3 Crocodile Survey Methods

Similar to *C. siamensis* surveys in Cambodia and Viet Nam (Daltry *et al.* 2003; Platt and Ngo Van Tri 2000; Simpson and Han 2004; Stuart *et al.* 2002), varying habitat and logistical conditions prevented the adoption of a single method to quantify crocodile abundance. Because of low density or wariness of crocodiles at most sites, surveys were unable to confirm crocodile presence/absence in most sites where crocodiles were reported to occur. A combination of day transects and spotlight surveys were used to detect crocodile

presence and when possible, estimate the minimum number of crocodiles present. Neither method measures absolute abundance, but may provide an index of relative density (number crocodiles or crocodile signs per kilometre), which allows changes in population size and structure to be quantified over time (Bayliss 1987; Messel *et al.* 1981). It was often not possible to conduct both methods at a site, e.g. in seasonally dry or vegetated lakes, spotlight surveys were not possible. Detectability of crocodiles varied widely between habitats (varying visibility and possibly, varying dung decay rates between dry and wet sites). Surveys were undertaken by a range of skilled and unskilled personnel, but potential observer error was considered minimal because search areas were small, team numbers high, and because local villagers accompanying surveys usually found signs first, on the basis of where they had previously seen signs.

*Day transects.* Searches for crocodile dung, trails and tracks were conducted around wetland margins and over surface aquatic vegetation in eight sites. Transect search length (kilometres) and area (hectares) was measured by recording the length and width of the search area with a Garmin *eTrex Vista* GPS. Transect width varied with team size (up to five people). For seasonally dry waterbodies, a maximum search width of five metres was considered effective for five people, as this gave a small search area of one m/person. After marking a five-metre search width with quadrat tape, the team would then search the wetland's perimeter for crocodile signs. A similar approach was used within vegetated lakes (e.g. on thick floating mats). At one site (Pulone lake, Attapeu Province), crocodile dung was encountered in small raised outcrops of bare land in the wetland. To quantify search areas of these microhabitats, the length and width of at least five search areas was measured to derive a mean area estimate. Search effort (total person-hours) was recorded. Locations of crocodile signs were recorded with GPS, and dung was collected for dietary analysis. Double-counting of signs was prevented by all signs being noted by a single recorder. Crocodile/sign density was calculated per kilometre from each transect.

At sites where crocodile faeces ("dung") were recorded, we used the method of Daltry *et al.* (2003) to estimate the minimum number of crocodiles present. Dung was measured and divided into different size classes, assumed to represent different-sized crocodiles. All dung within one size class was assumed to be from one individual, even if dung was collected in different parts of a wetland. To ensure a conservative estimate, we assumed that only samples more than two size classes apart belonged to different individuals.

*Spotlight surveys.* Spotlight surveys were conducted with hand-held torches in seven sites. Margins of lakes, ponds and one river were walked, and in one river surveys were made from a boat. Spotlight surveys were generally limited by vegetated water surfaces, absence of water (in seasonal wetlands), lack of boats, or logistic difficulties in surveying shallow, rocky rivers at night. Surveys began one-two hours after dark. Survey start/finish locations and crocodile sightings were recorded with a GPS. Crocodiles were identified to species or recorded as "eyeshine" if only the eye reflection was seen. Crocodile length was recorded in foot categories (1-2 ft, 2-3 ft etc), which provides a higher accuracy than metres (all other measurements in this report follow the metric system). Survey forms and results are in Appendices 1-2.

### 2.2.4 Interviews

Interviews were conducted at local communities close to wetlands surveyed. Efforts were made to interview at least one village elder (for historic information) and younger, active fishers. Most interviewees had lived in their village their entire life. Interviewees were first asked if they knew what a crocodile was, and to describe the appearance of a crocodile, because interviewees sometimes referred to large monitor lizards, or “*naga*” (spiritual serpent-like animals that apparently occur in rivers), with crocodiles. Interviews comprised a series of standardised questions including: crocodile presence, date (year/month) and specific locality of last sighting (if time permitted, the informant was asked to bring the team to the site); nesting; local crocodile names and any forms recognised; beliefs; uses (e.g. medicinal); and, commercial trade (historic/current). Results provided during group discussions (more than one informant) were treated as a single interview, because group answers were probably biased by presence of senior village members (younger residents might agree with older residents irrespective of their accuracy, out of respect). An interview form is in Appendix 1.

### 2.2.5 Nesting and Morphometrics

During surveys, the opportunity was taken to measure crocodiles and nests. Standardised measurements were recorded for nest dimensions and crocodile morphology, based on methods from Bezuijen *et al.* (1995) and Ross and Mayer (1983). Nest measurements included local information on nest history and quantification of nesting habitat. Biometric measurements were recorded from wild individuals, skulls and skins, and included total length, head length, body weight, scalation and a range of other body dimensions (see Appendix 4).

### 2.2.6 Wetland Habitats

A simple “dry-season wetland profile” was developed and recorded at all wetlands surveyed. Variables included: wetland dimensions; vegetation structure; bankside habitats within 50 m of the waterbody; and, human resource use. All waterbodies visited were defined as ‘wetlands’ under the Ramsar Convention on Wetlands: “areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six metres” ([www.ramsar.org](http://www.ramsar.org)). Wetlands were classified using the system of Claridge (1996) for Lao PDR: waterbodies were defined as lakes, ponds or rivers, with additional subdivisions indicating duration of water presence (seasonal/permanent) and degree of vegetation cover (open/vegetated). Standing waterbodies were defined as ‘lakes’ (>8 ha) or ‘ponds’ (<8 ha) (Claridge 1996). Variables and methods are in Appendix 1; results are in Appendix 6.

### 2.2.7 Socio-Economic Conditions Near Wetlands

General socio-economic conditions of villages closest to wetland survey sites were recorded. These were generally the village(s) which had community ownership of the wetland. Socio-economic information was obtained from interviews with the village head or deputy head, and included basic demographic data (number houses, families, village population), wetland resource use, existing infrastructure and any development (e.g. roads, dams) occurring in the region. These data provided background information on resource use and potential threats to crocodiles at nearby wetlands. A survey form is in Appendix 1; results are in Appendix 7.

## 2.3 National Records

Available crocodile records in Lao PDR were compiled from a range of published and unpublished literature. Type of record (wild sighting, captive specimen, remains), source (local report, direct sightings by scientists e.g. from 2003-05), date, locality (province, district, river system, site), wetland habitat and nearest village were compiled for each record. Records were defined as “historic” ( $\leq 1979$ ) or “current” (1980-2005) with 1979 selected as a cut-off point because local communities often stated that crocodiles occurred before, but not after, the period of Indochinese Conflict (1961-75), and that most commercial crocodile hunting was conducted from the 1950s-70s. Habitat loss was probably also high in the 1970s after the end of conflict, when many communities returned to villages and resumed agricultural activities. Hunting and habitat loss are generally considered to be the key factors responsible for the global decline of *C. siamensis*.

Records were assigned a “reliability ranking” using a modified method of Stuebing *et al.* (in prep.):

1 – confirmed records (direct sightings of wild crocodiles, nests or faeces during LARReC/WCS surveys from 2003-05; or, dead specimens with a clear locality description and collection); (=reliable)

2 – direct sightings of crocodile tracks/trails by LARReC/WCS surveys from 2003-05 (we considered tracks/trails to be less reliable than dung because these were sometimes poorly formed/unclear), or captive crocodiles/remains (e.g. skins, skulls) observed by these authors in a source area, with a specific collection locality and date provided by local people; or, crocodile sightings by a local resident interviewed by the authors, who correctly described the species and provided a locality and date; or, direct sightings by other field biologists with a correct description, locality and date; (=possible)

3 – second-hand records, specifically: captive specimens/remains outside a source area (e.g. a district town) where the owner was able to provide collection locality and date; or, local reports given to the authors or other scientists *within* a source area *and* with a specific locality and date provided (=unreliable).

Other records (third-hand information) were excluded. Georeferences (UTM) were derived by GPS for all rank “1” and many rank “2” records. For records in the general literature with no geographic coordinates, we assigned a georeference based on site descriptions and use of *Service Geographique D’Etat* topographic maps (scale 1:100,000 and 1:200,000). If a specific wetland locality was not provided, we assigned a georeference of the village where the record was obtained from. Twenty crocodile records presented in a map by Salter (1993) is the only early compilation of crocodile records for Lao PDR and is important, yet no coordinates and sometimes only general descriptions are given for each record. All of Salter’s (1993) records are local reports collected during other surveys and of varying reliability. To utilise these records, we derived broad georeferences (estimated to be  $\pm 10$  km accuracy) to Salter’s records, by comparing his map against topographic maps, locality names and location of protected areas. In many cases, Salter’s records could not be assigned to a specific lake, pond or river. All records without specific localities were assigned a “3” ranking.

Wetland habitats assigned to records were based on the national wetlands classification system of Claridge (1996). In this system, standing waterbodies are defined as “lakes” (>8 ha) or “ponds” (<8 ha), and “marshes/swamps” are a subdivision of lakes/ponds with different types of aquatic vegetation (Claridge 1996).

We also recorded “negative occurrence”, which were records where local communities had been specifically questioned about the presence of crocodiles and clearly stated they had never seen or heard of crocodiles in the region. Otherwise, lack of data about crocodiles was not inferred as crocodile absence.

A total of 135 records (Section 5) were entered into ArcView GIS 3.2 (©Environmental Systems Research Institute, Inc.), to estimate the extent of historic and current distribution of *C. siamensis* in Lao PDR. Records were examined for apparent “core” distributions and durability over time (to indicate local declines/extinctions), and were overlaid against the existing national protected areas system of Lao PDR, to assess representation of *C. siamensis* in protected areas. The database of records (raw data) is stored at the WCS Lao Programme. Analyses were limited by the low sample size and dominance of rank “3” (unreliable) records. To derive a minimum total number of sites where crocodiles were reported, multiple records from a single river were treated as separate sites if: river sections were separated by barriers e.g. waterfalls or dams; or, records were >30 km apart (an arbitrary distance) (Simpson and Han 2004).

## 2.4 Data Analysis and Limitations

Analysis of 2005 survey data was limited due to low numbers of crocodiles and absence of a single, standardised sampling method. To compare and rank the relative levels of disturbance recorded in wetlands, a simple “Disturbance Index” (DI) was developed using *SPSS for Windows* vers. 10.0.1 (©SPSS Inc.; Pallant 2001). Seven human-related impacts were used to assess relative disturbance of 24 wetlands where communities reported that crocodiles historically occurred (Appendix 6):

- weed invasion [percent of cover of one aquatic species (water hyacinth *Eichhornia* sp.) in wetland + percent of cover of one terrestrial shrub (*Mimosa pigra*) within 50 m of wetland];
- habitat clearance (percent of cover “cleared land”, “irrigated rice” and “rain-fed rice” within 50 m of wetland);
- burning (percent of cover burnt within 50 m of wetland in the previous two years);
- fishing (number of seasonal + permanent residences at wetland) (more appropriate indexes e.g. number of households fishing the wetland, were difficult to accurately record in rapid assessments);
- livestock (percent of cover trampled within 50 m of wetland);
- proximity to nearest village (straight-line distance in kilometres from nearest village); and,
- historic crocodile hunting ( $\leq 1979$ ) (information from local communities; no evidence of hunting was recorded in 2005).

Testing for normality (Table 2) indicated some data were not normally distributed, but we chose to use untransformed data and (after checking for possible errors) did not remove

outliers to maintain the range of natural values within the sample. Continuous variables (except "weed invasion") were collapsed into four standardised groups (i.e. twice as sensitive as "yes/no") utilising the minimum/maximum values in each group as cut-off points. "Weed invasion" was collapsed into three groups because of many "0" values at the 25 and 50 percentiles. Group ranges were calculated for the 25, 50 and 70 percentiles and each group was assigned a value between 1 and 4, with 4 indicating the highest disturbance (except for "weed invasion", where the lowest group was assigned a value of "1" and the higher two "3" and "4"). A value range of 1-4, rather than 0-3, was used because for three of six variables (burning, livestock, distance), a "0" value would include sites where a disturbance was in fact present. This resulted in all sites having a minimum value of "1" for all variables, even if a variable was absent. For the variable "distance", we inverted the score values to correspond with high scores implying high disturbance (thus a distance score of "4" implied the distance between a village and wetland was small). "Hunting" was assigned a value of 0 (no hunting) or 4 (the highest value) as hunting is considered to be one of the greatest threats to *C. siamensis*. Two other disturbance variables (logging, hybridisation of wild populations, Section 7) were excluded due to insufficient data.

**Table 2:** Normality Tests and Group Scores for Seven Collapsed Disturbance Variables Recorded at 24 Wetlands in 2005

Variable	Mean	5% Trimmed Mean*	Skew	Kurtosis	Histogram	Outliers	Signif**	Min, Max Cut-Off Values (Collapsed Variables)	No. Groups	Percentile	Assigned Scores (Data Range)
Weed (%)	14	12	1.7	3.1	+skew	1	.296	0, 80	3	33.3,66.67	1 (0-0); 3 (1-16.67); 4 (17+)
Clearance (%)	20	17	1.4	2.1	+skew	1	.214	0, 90	4	25, 50, 70	1 (0-0); 2 (1-15); 3 (16-30); 4 (31+)
Burning (%)	41	41	-0.1	-1.6	kurtosis	0	.187	0, 80	4	25, 50, 70	1 (0-12.5); 2 (12.6-45); 3 (46-70); 4 (71+)
Fishing (%)	36	25	3.0	10.5	+skew	1	.305	0, 300	4	25, 50, 70	1 (0-0); 2 (1-1.5); 3 (1.6-61.5); 4 (61.6+)
Livestock (%)	45	44	0.5	-1.4	normal	1	.212	0, 100	4	25, 50, 70	1 (0-10); 2 (11-40); 3 (41-99); 4 (100)
Village proximity (km)	1.9	1.7	1.1	1.6	kurtosis	1	.245	0, 8	4	25, 50, 70	4 (0-0.1); 3 (0.2-1.7); 2 (1.8-3.4); 1 (3.5+)
Hunting (y/n)											0-no hunting; 4-hunting

\*top and bottom 5% of cases removed and new mean value recalculated (Pallant 2001).

\*\*Kolmogorov-Smirnov Test for Normality of score distribution. No variables significant at  $\alpha=.05$  threshold, indicating normality (Pallant 2001)

Disturbance scores were compared against the status of crocodiles in each site (sites where crocodiles were reported to occur by local communities, sites where crocodiles were confirmed to occur in 2005 surveys, and sites where successful breeding was confirmed in 2005) (Section 7.6).

## 3. Legislative Status and Policy

### 3.1 National Legislation

*Crocodylus siamensis* is listed as a “Prohibited Category I” species and all hunting and trade is prohibited [Ministry of Agriculture and Forestry 1991, Instructions on the Execution of the Minister’s Council’s Decree No. 118/CCM, on the *Management and Protection of Aquatic Animals, Wildlife and on Hunting and Fishing* (5 October 1989)]. The listed conservation status of *C. siamensis* is “At Risk”, the highest national threat ranking for any species (Stuart 1999; Stuart and Platt 2000). In Lao PDR, all wildlife is the property of the State, and management and protection of wildlife species, wetlands and most forests is principally within the Division of Forest Resource Conservation in the Department of Forestry (DOF), within the Ministry of Agriculture and Forestry (MAF).

Other legislation that protects crocodiles or wetland habitats include (Duckworth *et al.* 1999):

- Minister’s Council’s Decree No. 185/CCM, in Relation to Prohibition of the Wildlife Trade (21 October 1986) (which prohibits export of all wildlife);
- Minister’s Council’s Decree No. 47/CCM, on the State Tax System (26 June 1989) (which lists various natural resources subject to resource tax rates);
- Prime Minister’s Decree No. 164 (29 October 1993) (which restricts wildlife hunting and other resource use in NPAs);
- Order 54/MAF and recommendations 377/MAF (1996) on customary rights and use of natural resources (which defines resource use rights of local communities);
- Decree 1074 of the MAF (11 September 1996) (which restricts wildlife trade and hunting and empowers PAFO with responsibilities to control hunting); and,
- President’s Declaration No. 125/PO on the Forestry Law (1996) (which addresses national wildlife ownership, management of hunting and restrictions on hunting prohibited species).

Field implementation of these laws is the responsibility of the Provincial Agriculture and Forestry Offices (PAFO), under the guidance of DOF. Environmental impact assessment, including those in wetlands, is coordinated by the Science, Technology and Environment Agency (STEA) in the Office of the Prime Minister. A draft Environmental Protection Law is currently being finalised, which will empower STEA to assist in the control of commercial exploitation of biodiversity. This may assist in management of any current illegal trade in *C. siamensis*. The *National Forestry Strategy 2005-2020* (MAF 2005) identifies a need for improved wildlife regulations concerning use of wetlands for fish raising and ecotourism, and this may also promote conservation of crocodile habitats. The principal national biodiversity research agency is LARReC, within the National Agriculture and Forestry Research Institute of DOF, which coordinated crocodile surveys from 2003-05.

### 3.2 International Policy

Lao PDR is a Contracting Party to two international conventions of relevance for national crocodile conservation. First, the *Convention on Biological Diversity*, which Lao PDR acceded to in 1996. Under this convention, a *National Biodiversity Strategy and Action Plan*

has been prepared by the Government of Lao PDR. This will provide a specific national legislative framework for addressing threatened species research, management and public awareness, and *C. siamensis* is listed as a key species for national conservation action. Second, the *Convention on International Trade in Endangered Species* (CITES). Lao PDR acceded to CITES in October 2004. *Crocodylus siamensis* is listed in Appendix I of CITES, which prohibits all international trade in the species unless subject to approved quotas and monitoring. The Lao PDR CITES Management Authority is the Division of Forest Resource Conservation within DOF, with technical assistance from STEA. National legislation and training of national staff in CITES protocols is currently being undertaken (2005) to ratify the agreement, and may assist in any cross-border illegal trade in crocodiles.

## 4. Available Data on Biology and Ecology in Lao PDR

### 4.1 Taxonomy

*Crocodylus siamensis* is the only crocodylian species confirmed to occur in Lao PDR (Stuart 1999; Stuart and Platt 2000). Four wild individuals examined by the 2005 survey team (Section 4.2) were identified as *C. siamensis* on the basis of morphology and scalation patterns. Few wild crocodiles have been examined in Lao PDR and it is possible that farm hybrids, exotic *Crocodylus* species or extralimital *C. porosus* may sometimes occur.

*Crocodylus porosus* (Saltwater Crocodile) occurs naturally in some regions of Thailand, Viet Nam and Cambodia, and *C. porosus*, *C. siamensis*, *C. rhombifer* (Cuban Crocodile) and hybridised forms of these species exist in some crocodile farms in these countries (Jelden *et al.* 2005; Ross 1998). In Lao PDR, only one institution, the Ban Kuen Zoo (Vientiane Municipality) is known to hold large numbers (>300 individuals) of *Crocodylus*. cursory examination indicates these are probably *C. siamensis*, but most apparently originate from Thai crocodile farms and the possibility of hybridised individuals cannot be ruled out (Phothitay *et al.* 2005; Thorbjarnarson 2003). The various *Crocodylus* species are similar in appearance, and hybridised individuals may only be identified through DNA testing.

### 4.2 Morphology and Biometrics

Four *C. siamensis* (two wild-caught live individuals, one dried specimen and one skin) were examined in 2005 (Table 3). All were wild specimens from wetlands in southern Lao PDR. All were identified as *C. siamensis* (and not other *Crocodylus* species) from a combination of distinctive morphological and scalation features (Ross *et al.* 1995, 1996, 1998; Ross and Mayer 1993) comprising: presence of large raised ridges along the margins of the cranial platform (although these may be poorly developed or absent in juveniles, and may also be present in other *Crocodylus* species); 29-33 (mean 31) transverse ventral (belly) scale rows; 49-53 (mean 50) transverse gular (throat) rows (the highest number in the genus *Crocodylus*); highly granular throat squamation compared with other *Crocodylus*; and, dorsal scalation characterised by four-seven (usually six) enlarged osteoderms (scales) across the midbody, less than 18 rows of precaudal scales, and a cervical shield of scales where the precaudal rows 20-23 would be. Methods of measurement are in Appendix 5.

**Table 3:** Biometric Measurements of Four Wild *Crocodylus Siamensis* in Southern Lao PDR, March-June 2005

Province	District	Site	Easting (Northing)	Status	Tail/snout complete?	TL (cm)	SVL (cm)	HL (cm)	HW (cm)	SE (cm)	SW (cm)	PP (cm)	MP (cm)	IO (cm)	Sex
Attapeu	Sanamxay	Beung Ke wetland	658618 (1625593)	Dried	Yes	42	19.6	7	nr	nr	nr	nr	nr	nr	?
Savannakhet	Champhone	Kout Mark Peo wetland	523597 (1807930)	Alive	Yes	41.7	20	6.8	3.3	3.9	1.4	2	2.2	0.4	?
Savannakhet	Champhone	Kout Mark Peo wetland	523597 (1807930)	Alive	Yes	32.4	15.8	5.6	2.7	2.3	0.9	1.8	2	0.3	?
Savannakhet	Nong	Xe Lanong river	650850 (1822202)	Skin	No	>200	nr	35.7	18.7	24.8	6.5	10	9.7	3.4	?

Belly Scales	Gular Scales	DCV	SCV	PC 1 - PC 5	PC 6	PC 7	PC 8	PC 9	PC 10	PC 11	PC 12	PC 13	PC 14	PC 15	PC 16	T: UF	T: UB	T: LF	T: LB	Belly Colour
34	>12*	19	21	4	6	6	5	6	5	5	6	6	5	4	4	4	14	4	11	Cream
33	>15*	19	18	4	6	6	6	4	6	6	4	4	5	5	4	4	14	4	11	Cream
28	>22	20	19	4	6	7	5	4	4	5	5	6	5	5	4	4	13	4	11	Cream
nr	nr	nr	nr	nr	nr	nr	nr	nr	nr	nr	nr	nr	nr	nr	nr	4	16	4	13	nr

Note: nr-not recorded (specimen in poor condition). TL- total length; SVL- snout-vent length; HL-head length; HW-head width; SE-snout-eye length; See Appendix 5 for other measurements. Weights not measured.

These four specimens had well-defined, raised margins along the cranial platform. This feature is apparently more common in mainland *C. siamensis* than in Indonesia, although this is based on small sample sizes (Ross *et al.* 1998). Total length of these four specimens ranged from 32.4 cm to >2 m (an incomplete dried skin). *Crocodylus siamensis* is reported to reach total lengths around 4 m, but more commonly attains lengths up to 3 m (Ross 1998). Two wild individuals measured in Savannakhet Province (total lengths 32.4 cm and 41.7 cm, Table 3) were caught together, and were part of a group of hatchling crocodiles observed by the team (Section 4.4). The sex of these individuals was unclear due to their small size. Both hatchlings appeared to be in excellent condition, with no external injuries or abnormalities. No other biometric measurements of wild *C. siamensis* are available from Lao PDR, although

>15 wild specimens have been measured in Cambodia (J. Daltry FFI pers. comm. June 2005).

## 4.3 Habitat

### 4.3.1 National Records

In Lao PDR *C. siamensis* has been reported from a wide range of wetland habitats, including non-flowing waterbodies (oxbow lakes, ponds, swamps in riverine forest, seasonally flooded grasslands, thickly vegetated swamps and permanent reservoirs) and large, slow flowing rivers and streams, with sandy, rock or mud substrate, up to 500 m elevation (Salter 1993; Stuart and Platt 2000; Thorbjarnarson *et al.* 2004; Wharton 1966). Bassenne (1912) noted that “on the sandy river-banks ... crocodiles stretched their long, scaly bodies ...”. Based on a total of 122 national *C. siamensis* records compiled for this review, *C. siamensis* occurs in at least six wetland habitats in Lao PDR (after Claridge 1996) (Table 4).

**Table 4:** Frequency of Crocodile Occurrence in Different Wetland Habitats in Lao PDR

Wetland Habitat (Claridge 1996)	Frequency of Records (per reliability rankings*)			Frequency of Sites (all rankings pooled)	
	1	2	3	Total	
Perennial river – perennial river channel	3	12	31	46	29
Permanent freshwater pond – vegetated water	1	9	6	16	4
Permanent freshwater pond – open water	0	2	0	2	2
Permanent freshwater lake – vegetated water	30	8	8	46	10
Permanent freshwater lake – open water	4	3	4	11	5
Seasonal freshwater marsh/swamp	0	0	1	1	1
Totals	38	34	50	122	51
<b>Total “flowing” (rivers, streams)</b>				<b>46</b>	<b>29</b>
<b>Total “non-flowing” (lakes, ponds, marshes)</b>				<b>76</b>	<b>22</b>

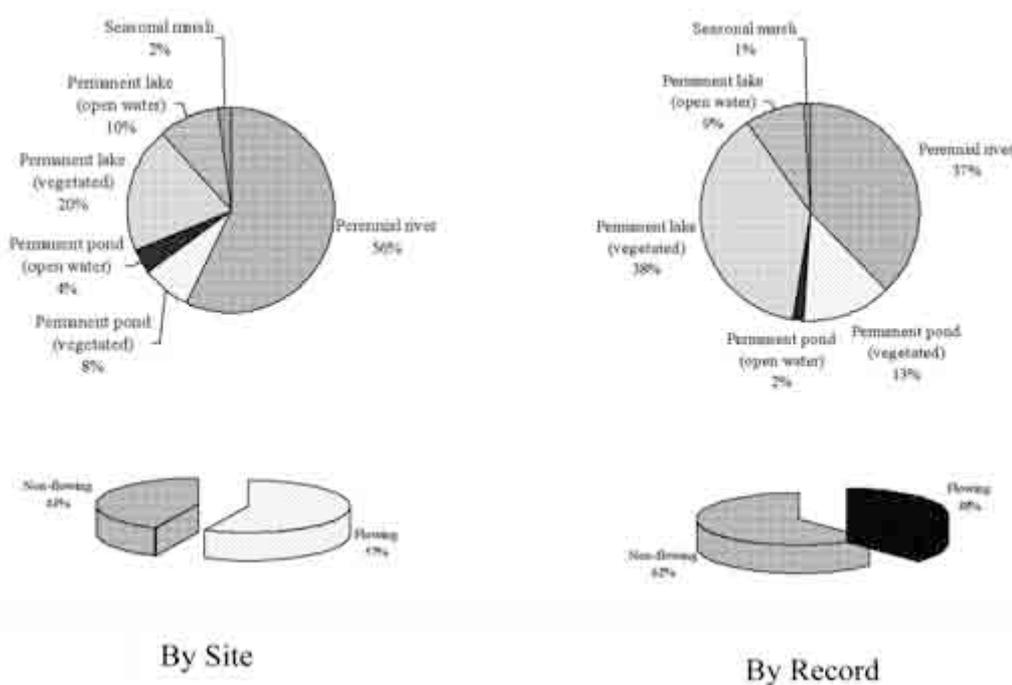
\*see Section 2.3

These data (Table 4, Figure 2) indicate the following:

- Based on habitat frequency per *site*, crocodile records in Lao PDR are evenly distributed between “flowing” waterbodies (n=29 sites) and “non-flowing” waterbodies (subcategories of lakes, ponds and marshes pooled) (n=22 sites). Within non-flowing waterbodies, most records are from vegetated (n=14 sites) compared with open (unvegetated) sites (n=7). These data indicate that in Lao PDR, *C. siamensis* occurs in a range of flowing (rivers, streams) and non-flowing (lakes, ponds, marshes) waterbodies, but within non-flowing waterbodies, may prefer thickly vegetated, rather than open, waterbodies.
- Habitat frequency per *records* suggests that crocodiles prefer non-flowing (n=76 records) to flowing (n=46) waterbodies. Analysis by the number of records is potentially

misleading, for two reasons. First, unequal sampling effort between flowing and non-flowing waterbodies possibly accounts for more records from non-flowing waterbodies. Non-flowing waterbodies were accorded a higher survey priority than rivers in 2005 (because the few available nest records were from lakes and ponds), and most confirmed (rank "1") records are from non-flowing waterbodies [22 of 38 rank "1" records (58%) are from a single site surveyed in 2005, Kout Mark Peo lake]. Second, the ranking process for records may have biased results. For example, records from perennial rivers increase as reliability decreases (Table 4). This is possibly because 22 of 31 "rank 3" records were compiled from published/unpublished literature, and assignment of habitat categories to these records was dependant upon descriptions provided. Authors may have named the nearest river if the specific site (e.g. lake or pond) was unknown.

**Figure 2:** Frequency of Crocodile Occurrence in Different Wetland Habitats in Lao PDR



- Thirteen reports of "negative occurrence" were compiled (sites where local communities were specifically questioned about the presence of crocodiles, and who clearly stated they had never seen or heard of crocodiles in the area). All were from perennial rivers. Seven of 13 negative records were in three rivers (Xe Lanong and Xe Pon rivers, Savannakhet Province, and Mekong River in Phou Xiang Thong NPA, Champasak Province) where nearby communities stated crocodiles did in fact occur (crocodile occurrence was confirmed in one of these rivers, Xe Lanong, in 2005). This indicates that local communities may not always be a reliable source to ascertain crocodile presence. For at least three of 13 records (two in Phoue Louay NPA and one at a waterfall in Phou Khao Kouay NPA), lack of occurrence is probably because of unsuitable habitat, as waterways were located in steep, hilly areas of swift flowing rivers.
- There appears to be some preference of crocodiles for permanent, non-flowing and vegetated waterbodies for nesting, although this is based on limited data (Section 4.4).

Elsewhere in its range, *C. siamensis* has been recorded in similar freshwater habitats, including oxbow lakes, slow-flowing rivers, streams and marshes in Cambodia (Simpson and Han 2004), swamps and slow flowing rivers in Thailand (Smith 1919, 1931), lakes, rivers, canals and marshes in Viet Nam (MOSTE 1992), and open lakes with thick floating vegetation mats, in forested areas, in Kalimantan (Indonesian Borneo) (Ross *et al.* 1998). In Cambodia, the species has not been found in flowing waterways with shallow water (<1.2 m) or in fast-flowing sections of rivers or streams (Simpson and Han 2004). In Thailand, sightings since the 1990s have been in swift-flowing rivers with sandbars and rapids, in hilly or mountainous areas (Kreetiyutanont 1993; Platt *et al.* 2002). Platt *et al.* (2002) speculate these are marginal habitats compared with historic centres of abundance in lowland swamps, and that crocodiles may have emigrated to such habitats in response to human disturbance.

#### 4.3.2 Wetlands Surveyed in 2005

Local communities reported that crocodiles historically or currently occurred in 24 of 25 wetlands surveyed in 2005. Seventeen (71%) of these wetlands were non-flowing waterbodies (lakes, ponds) and seven (29%) were perennial rivers. Twenty (83%) were permanently flooded and four were seasonal. Of the non-flowing waterbodies, 13 were permanent ponds and lakes (seven with *vegetated* water surfaces and six with *open* water surfaces), and four were *seasonal* marshes and ponds (three with *vegetated* water surfaces and one with an *open* water surface). These findings accord with national records (Section 4.3.2), indicating that within non-flowing waterbodies, *C. siamensis* appears to prefer vegetated rather than open waterbodies.

**Table 5:** Some Characteristics of Wetlands Reported to Support Crocodiles Surveyed in 2005

Water-body	Mean Size (ha)	Mean Depth (m)	Most Frequently Recorded Substrate	Mean %Unvegetated Surface of Waterbody	Mean %Cover Understory Layer Over Waterbody	Mean %Cover Canopy Layer Over Waterbody
Non-flowing	9±12 (0.24-39.6, n=16)	1.9±1.6 (0-5, n=16)	Mud	61±44 (0-100, n=16)	34±38 (0-100, n=16)	6±13 (0-50, n=16)
River	-	1.6±0.7 (0.7-2.7, n=6)	Rock	100	0	0

\*values are mean±standard deviation (range, n)

Standing waterbodies where crocodiles were reported varied widely in size, but both standing and flowing waterbodies were relatively shallow (<2 m, Table 5) at the time of surveys (March-June). Wetlands were visited in the peak of the dry season. The most frequently recorded substrate was "mud" in lakes and ponds, and "rock" in rivers. All rivers visited were relatively rocky, with long, slow-flowing sections with sandbars interspersed with shallow, swift-flowing rapids. Standing waterbodies had a range of open or partly vegetated water surfaces (floating or emergent, rooted aquatic vegetation). Some lakes and ponds had a low understory (0.3-1.5 m high, n=seven sites) and canopy (3-5 m high, n=4

sites) over the water surface (Appendix 6), usually associated with thick floating mats of sedges, reeds and grasses. The single site where crocodiles were reported not to occur was a small, rocky stream in a hilly area several kilometres from a river. Systematic sampling is required to test for any preferences of crocodiles for certain wetland habitats.

#### 4.4 Nesting and Dispersal

Eight nest and hatchling records in the Lao PDR were compiled (Table 6). All sites with nest records were visited in 2005, and five of eight records were obtained in the 2005 survey. Nesting records comprised: four nests with eggs (three were visited by LARReC/WCS survey teams in 2003-05), one general nesting report (no date specified), and three hatchlings.

**Table 6:** Crocodile Nest and Hatchling Records in Lao PDR, June 2005

Province	District	Site	Record	Reported Nesting Season (date of report)	Wetland Category*	Nest Habitat	Source
Attapeu	Sanamxay	Beung Ke	Nest with eggs	Late dry (Jun-86)	1	Floating mat	1
Attapeu	Sanamxay	Beung Ke	Hatchling (dead)	Early-mid dry (Feb)	1	Unknown	2
Attapeu	Sanamxay	Beung Pulone	Nest (no data)	Late dry (Jun-05)	2	Floating mat	1
Saravan	Saravan	Nongboua	Nest with eggs	Early-mid dry (Apr-04)	1	Bank (in forest)	1, 3
Savannakhet	Champhone	Kout Mark Peo	Nest with eggs	Early-mid dry (Feb-04)	2	Floating mat	1
Savannakhet	Champhone	Kout Mark Peo	Hatchling (~1 month old)	Early-mid dry (Mar-05)	2	Unknown	1
Savannakhet	Champhone	Kout Mark Peo	Hatchling (~1 month old)	Early-mid dry (Mar-05)	2	Unknown	1
Savannakhet	Champhone	Kout Mark Peo	Hatchlings	Early dry season (Oct/Nov-02)	2	Floating mat	4
Savannakhet	Xaibouli	Boua Thong	Nest with eggs	Late dry (Jun-03)	3	Bank (in forest)	4

**Note:** Wetland category (Claridge 1996): 1=Permanent freshwater pond - vegetated; 2=Permanent freshwater lake - vegetated; 3=Permanent freshwater lake - open water. Source: 1-2005 survey (March-June); 2-MWBP unpubl. data; 3- Phothisay and Somphanith (2004); 4- Thorbjarnarson (2003)

*Nesting season.* Eight nest and hatchling records are from the dry season (November-June) (Table 6). Nests with eggs were reported by local people to have been found in the mid-dry season (February n=1, April n=1) and late dry/early wet season (June n=3). Three wild

hatchlings (a dead specimen held by MWBP and two live individuals captured by the 2005 survey team) were found in the mid-dry season (February and March respectively), although three nests with eggs were reported from the late dry/early wet season (Table 3). Egg incubation period in captive *C. siamensis* is reported as 75-85 days (MOSTE 1992). These limited data suggest that in southern Lao PDR, *C. siamensis* nesting may occur from the late wet/early dry season (November-April) (explaining the presence of hatchlings in February-March) until June-July. Surveys in 2005 encountered a limited knowledge of crocodile nesting among most local communities in regions where crocodiles occurred: of 31 interviews with local communities in 2005, 84% (n=26) had never seen a nest and could not provide any information on nesting (Appendix 4).

Elsewhere in south-east Asia, limited available data suggest that wild *C. siamensis* nesting season varies between regions. In Cambodia, four documented wild nests were produced in the early wet season (April) (Simpson and Han 2004), although captive nesting generally occurs in the dry season (Jelden *et al.* 2005). In the Cardamom mountains of south-west Cambodia, local communities reported that nests are formed at the start of the wet season (April-May), and assuming an incubation period of 80-90 days this would result in hatchlings present in July/August (Daltry *et al.* 2003). In Viet Nam, nests are apparently constructed in the dry season (December-March) and eggs are laid in the early wet season (April) (MOSTE 1992). In Kalimantan (Indonesian Borneo), nesting was reported in the Borneo dry season (August-October) (Ross *et al.* 1998). In Thailand, captive *C. siamensis* construct nests in the wet season (Youngprapakorn *et al.* 1971).

*Nesting habitat.* Five nests in Lao PDR were all located at lakes or ponds (no reports from rivers or streams). Three were "floating-mat" nests (located on thick mats of floating vegetation in the wetland) and two were "bankside" nests, located in forest at the banks of the wetland (Table 6). These latter nests were located at an open water (unvegetated) lake and vegetated lake (covered with floating/emergent vegetation) respectively (Appendix 6).

Two of five reported nests were measured in 2005, and were within notably different microhabitats. One (in Kout Mark Peo pond) was located on a thick floating mat of grasses 1-1.5 m high, over 3-4 m of water, within a small (30 m diameter) area of swamp with no canopy cover. The pond was 200 m from a seasonal river. Percent shade over the nest was low and for most of the day the nest received direct sunlight (Table 7). The site was fringed by trees and shrubs 5-10 m high. In contrast, the second nest was located 15 m from the bank of a pond, within mature mixed deciduous forest (canopy 20-30 m), 200 m from a perennial river. This nest was shaded for most of the day (Table 7).

Elsewhere in south-east Asia, *C. siamensis* nests have been reported from a wide variety of non-flowing waterbodies (oxbow lakes, swamps, ponds) and slow-flowing rivers. Of four wild nests documented in Cambodia, three were next to an oxbow lake (on the banks) and one was within a swamp (on a floating vegetation mat) (Simpson and Han 2004). In East Kalimantan (Indonesian Borneo), nesting was reported by local people to occur on floating vegetation mats in open lakes and swamps (Ross *et al.* 1998).

*Nest dimensions and clutch size.* Two old (2004) nests were measured by the survey team in 2005 (Table 7). Nest dimensions presented are probably smaller than fresh nests (residents reported that both nests had subsided notably compared with the previous year).

**Table 7:** Two Old (2004) *Crocodylus Siamensis* Nests Measured in Lao PDR in 200

Province	District	Wetland	Date Measured	Habitat	Substrate	Nesting Year	Basal Diameter (cm)	Basal Width (cm)	Height (cm)	TNTE (cm)	TNBE (cm)
Savanna-khet	Champhone	Kout Mark Peo	12-Mar	Lake	Floating mat	2004	164	168	15	0	0
Saravan	Saravan	Nongboua	28-May	Pond	Bank	2004	120	120	30	14	34

Height Above Water (m)	Distance From Water (m)	Clutch Size	% Shade 0600-0900	% Shade 0900-1200	% Shade 1200-1500	% Shade 1500-1800
0.3	3	0*	20	0	0	0
1	15	13	100	100	10	60

**Note:** TNTE-distance from top of nest to the top egg; TNBE-distance from top of nest to the bottom egg.

\*the nest contained some small egg fragments but no intact or broken eggs; "% shade"- amount of time the nest is shaded from direct sunlight in each time category

One nest (in Kout Mark Peo pond) only contained eggshell fragments, and one nest (in Nong Boua pond) had a clutch size of 13 eggs. Mean dimensions of seven intact eggs in this clutch (mean±standard deviation, range, n) were: length  $87\pm 0.3$  mm (85-90, n=7); width  $49\pm 0.2$  mm (45-50, n=7).

In Cambodia, four wild clutches contained 16-25 eggs (Simpson and Han 2004) and in Viet Nam, reported clutch size was 15-26 eggs (MOSTE 1992). Captive *C. siamensis* in Thailand produce 20-50 per clutch (Youngprapakorn *et al.* 1994), and a nesting pair on a crocodile farm in Central Kalimantan apparently produced 30 eggs (owner pers. comm. to Ross *et al.* 1998). Five *C. siamensis* eggs measured in East Kalimantan had a mean length of 83 mm (range 80-88 mm) and mean width 52 mm (range 51-53 mm) (Ross *et al.* 1998).

*Successful breeding sites.* Nest reports in Lao PDR were compiled from five sites (Table 6). Successful breeding was confirmed in only two sites, Pulone and Kout Mark Peo lakes (Attapeu and Savannakhet Provinces respectively). A third nest record was from Beung Ke lake (Attapeu), of a single nest seen in the 1980s. In two other sites (Nong Boua and Boua Thong lakes, Saravan and Savannakhet Provinces respectively), communities reported that one-two resident crocodiles produced nests and eggs in some years, but that eggs do not hatch and it had been many years since hatchlings were seen (Baird 2001a,b; Phothitay and Somphanith 2003, 2004; Thorbjarnarson 2003; Appendix 4).

*Seasonal movements.* Limited information is available about seasonal dispersal of crocodiles in Lao PDR. During 2005 surveys, 25 of 31 interviewees (81%) were unaware of any seasonal movements of crocodiles. Six interviewees stated that crocodiles make annual seasonal movements between permanent and seasonal wetlands. Crocodiles were reported to disperse in the wet season, from permanent lakes/ponds to seasonal lakes/ponds and

nearby rivers (n=four interviewees), and from rivers to nearby lakes/ponds (n=two interviewees) (Appendix 4).

Local communities in the Xe Sap NPA (Saravan Province) also reported that in the wet season, crocodiles migrate from small permanent waterbodies to larger wetlands and rivers (Steinmetz *et al.* 1999). In general, it appears that crocodiles reside in permanent lakes, ponds or rivers during the dry season, but will disperse into seasonally flooded wetlands and river channels in the wet season. Reasons for dispersal are possibly related to foraging in seasonal habitats and searching for suitable nest sites. Interviewees in the Xe Pian and Xe Banghiang rivers (Attapeu and Savannakhet Provinces respectively, Figure 1) reported that crocodiles disperse over a wide area of river catchments in the wet season, then retreat to a relatively small number of permanent wetlands in the dry season.

## 4.5 Diet

Six crocodile faecal samples were collected during field surveys in 2005. Preliminary analyses of these samples showed they contained fish scales and mammal hairs. Crocodile faecal samples in Cambodia revealed presence of mammal, bird, reptile, fish and invertebrate remains, with fish and snakes the most frequently recorded prey items (Daltry *et al.* 2003). Dietary analyses based on faeces is limited to non-digestible portions of prey, and excludes soft-bodied prey items (e.g. frogs).

## 5. Distribution and Abundance

### 5.1 Historic Distribution and Abundance

One hundred and twenty-two crocodile records in Lao PDR were compiled, from 25 river systems or river sections (Figure 3). Only 18 records (15%) were “historic” (i.e.  $\leq 1979$ , Section 2.3), with all other records of crocodile sightings after 1980. This limited analysis of durability of records over time, which might indicate areas where crocodiles have persisted or declined. Seventy-two “current” ( $\geq 1980$ ) records (59%) were documented during crocodile surveys from 2003-05, indicating the general paucity of records prior to the inception of crocodile surveys. Three of 18 historic records were from 1860-1919 (anecdotal accounts by foreign explorers), 15 were from 1940-79, and there were no records from 1920-39 (Table 8). Increasing numbers of records in more recent decades is probably explained by the paucity of local people sufficiently old to recall first-hand sightings of crocodiles in earlier decades. In 2005, mean age of interviewees was 54 years (Section 6.1), indicating that first-hand historic reports were largely from the 1960s onward.

**Table 8:** Crocodile Records in Lao PDR Between 1860 and 2005

River System	Province	1860 - 1879	1880 - 1899	1900 - 1919	1920 - 1939	1940 - 1959	1960 - 1979	1980 - 1999	$\geq 2000$	Total
Xe Kaman	Attapeu							1		1
Xe Kong	Attapeu							1		1
Xe Pian	Attapeu						2	7	20	29
Xe Sou	Attapeu							1		1
Xe Kampho	Attapeu/ Champasak						1	3		4
Mekong*	Bholikhamxay			1						1
Nam Xan	Bholikhamxay							1		1
Houay Bangliang	Champasak							1		1
Houay Khammouane	Champasak							1		1
Houay Touay	Champasak							1		1
Nam Lepou	Champasak						1	1		2
Mekong*	Champasak	1	1					2		4
Xe Lamphao	Champasak					2				2
Nam Hinboun	Khammouane						1	1		2
Nam Ha	Luang Namtha							1		1
Xe Bang Nouan	Saravan							4		4

No records

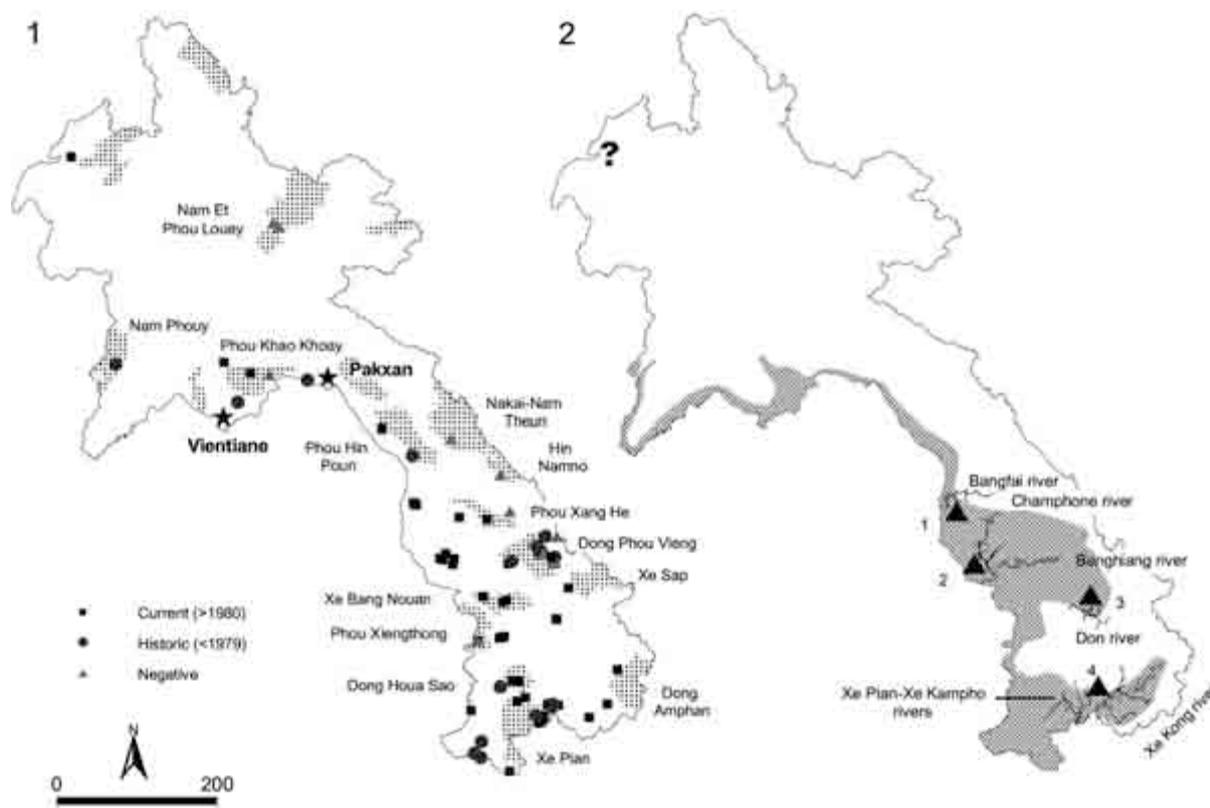
Xe Don	Saravan							10	10	
Xe Bangfai	Savannakhet							8	8	
Xe Banghiang	Savannakhet					1	3	1	5	
Xe Champhone	Savannakhet						2	29	31	
Xe Lanong	Savannakhet				3	1	1	1	6	
Xe Pon	Savannakhet					1			1	
Xe Xangxoy	Savannakhet							2	2	
Nam Ngum	Vientiane					1	1		2	
Nam Ngam	Xaignabouli					1			1	
	Total records	1	1	1		5	10	33	71	122

\*sections of the Mekong River treated as separate sites (see Section 2.3)

Based on 122 records, *C. siamensis* historically occurred in at least nine provinces of south, central and west Lao PDR, over an approximate area of 465 km<sup>2</sup> (Figure 4). This is a coarse overview only, based on the smallest area encompassed by all records. The species was apparently widespread in western Lao PDR, with reports from the Mekong River in Champasak Province (far south) to at least Bholikhamxay Province (central Lao PDR, Figure 3) (Bassenne 1912; Garnier 1996; Neis 1997; Wharton 1966). From Pakxan town (Bholikhamxay Province, Figure 3), Bassenne (1912) stated; "on the sandy river-banks, crocodiles stretched their long, scaly bodies ..."

One of the attractions of travelling up the Mekong was to shoot at these large saurians." Bassenne (1912) also observed crocodiles in Uttaradit Province of Thailand, at similar latitude to Vientiane (capital of Lao PDR). The most northerly national record of *C. siamensis* is an unconfirmed report of a crocodile shot in the Nam Ma river (Luang Namtha Province) in the 1990s (Figure 4). Crocodiles had apparently never been seen in the region before (Salter 1993). This record is 267 km north of the nearest record, and may be extralimital. Most records are from three provinces in the south of Lao PDR, Attapeu, Champasak, Saravan and Savannakhet (n=114, 93%). Most records (n=119, 98%) are located in the Mekong Plain physiographic region. Two records are from the Northern Highlands unit and one is from the Annamite Range, at the border of the Mekong Plain unit. All records of occurrence (historic and current) are located <400 m elevation. There are no *C. siamensis* records from the extreme north or north-east of Lao PDR, which is mountainous. A cluster of "current occurrence" and "negative occurrence" records from the eastern border of Savannakhet Province (i.e. in several closely-spaced communities, some stated crocodiles did occur and some stated crocodiles did not occur) probably indicates a genuine rarity of *C. siamensis* in this region, suggesting this region is at the eastern limits of *C. siamensis* range in Lao PDR. In the upper Xe Pon river in this region, one resident stated crocodiles had never been common, even before the Indochinese Conflict, and had not been seen for "decades". Ten of 13 "negative occurrence" records are located <400 m elevation and three are located >400 m elevation (from 600-1,000 m elevation).

**Figure 3:** Maps Showing (1) Crocodile Records in Lao PDR and The National Protected Areas System; (2) Minimum Area of *Crocodylus Siamensis* Distribution Encompassed by Records, and Location of Seven River Systems of High Conservation Priority for *C. Siamensis*.



Numbers 1-4 Are Locations of Four Nest Sites Reported in 2005 (1-Boua Thong pond; 2-Kout Mark Peo lake; 3-Nong Boua pond; 4-Beung Pulone and Ke lakes)

Historic accounts suggest *C. siamensis* was relatively common in some regions of Lao PDR in the late 1800s-early 1900s. In the 1880s, crocodiles were reported to be “very common in certain parts” of the Mekong River in Champasak Province close to Cambodia (Neis 1997: 16). Explorers to this region in the 1860s noted “..the waters of the river, less yellowish, allowed us to take several baths a day without having to fear the voracity of the alligators, which are more audacious in muddy waters” (Garnier 1996: 168). During cholera epidemics in the 1800s, infected human remains were placed in the Mekong to be consumed by crocodiles (Neis 1997). In the 1960s, crocodiles were apparently common in swamps along the Nam Lepou river (Champasak Province) along the border of Lao PDR and Cambodia: “every permanent waterhole..is repeatedly visited.. Crocodiles are captured in drying up stream beds within heavy gallery forest such as along the Tonle Repou” [Cambodian name for the Nam Lepou river] (Wharton 1966). Local residents interviewed in 2005 stated that until the 1950s-60s, crocodiles were “common” and “often seen” in the Xe Pian (Attapeu Province), Xe Champhone and Xe Banghianh rivers (Savannakhet Province) (Appendix 4). Crocodiles were seen along the Xe Banghianh river in the 1940s by David-Beaulieu (1949-1950), who noted “while rafting on this river in the dry season..one is able to meet different kinds of wildlife, such as crocodiles..” (pp.46-47).

Elsewhere in its range, the species was either considered “rare” globally (de Rooij 1915) or extremely common: Cheminaud (1939) stated that the large rivers of the Indochinese peninsula were “infested” by crocodiles, and noted there was an “upland” and “lowland” variety, similar in appearance, but he was unsure if these were the same. The abundant crocodiles he refers to may have been *C. porosus*. Cambodia possesses extensive wetlands and probably supported the largest global populations of these species (Jelden *et al.* 2005; Simpson and Han 2004), while Lao PDR may have supported relatively small global populations as wetland habitats are more limited (Thorbjarnarson *et al.* 2004). In Viet Nam, the species was thought to be historically “common” in wetlands in the south (Cao Van Sung and Jenkins 1998; Platt and Ngo Van Tri 2000).

## 5.2 Current Distribution

“Current” (i.e.  $\geq 1980$ ) national records of *C. siamensis* in Lao PDR (n=104 of 122, 85%) are from 18 river systems within eight provinces (Table 8). Comparison of historic and current records is limited because most records are “current”, reflecting increasing field data in the 1990s onward (crocodile reporting rate increases from 1.5 records/year to 12 records/year between the periods “1980-89” and “2000-05”) (Table 8). There are insufficient national records to calculate the area of current range of *C. siamensis* in Lao PDR, but available data clearly indicate that a large range contraction has occurred, compared with historic distribution. Most “current” and reliable (rank “1” and “2” records) are from only four southern provinces, Attapeu, Champasak, Saravan and Savannakhet, within seven of 18 river systems: Xe Pian, Xe Kampho and Xe Kong river systems (Attapeu Province); Xe Don river system (Saravan Province); and, Xe Bangfai, Xe Banghiang and Xe Champhone river systems (Savannakhet Province) (Figure 4).

In 2005, surveys of 24 wetlands where crocodiles historically occurred revealed that: local communities reported that crocodiles still occurred ( $\geq 1980$ ) in only 15 sites (a decline of 37%) (Appendix 4), but surveys confirmed occurrence in only six of 24 sites; and, nesting was reported in four sites, but successful breeding in 2005 was confirmed in just two sites. These declines may be representative of crocodile status in many other wetlands in Lao PDR where *C. siamensis* historically occurred.

## 5.3 Minimum Number of Crocodiles Seen in 2005

There is currently insufficient data to estimate the wild *C. siamensis* population of Lao PDR. In 2005, a minimum estimate of 16+ crocodiles was confirmed for five of 24 wetlands surveyed (below). Local communities reported that crocodiles still occurred in 15 of 24 sites (including the five sites where the team recorded crocodiles), indicating a decline in abundance or local extinctions in nine sites.

*Spotlight surveys.* Crocodiles were observed at three of six sites surveyed (Appendix 3). The most crocodiles recorded during spotlight surveys were in Kout Mark Peo lake (seven individuals, including five hatchlings and loud adult vocalisations heard in different locations in the wetland) (Table 9).

**Table 9: Spotlight Survey Results in Six Lao PDR Wetlands in 2005**

Province	District	Wetland	Date	Km	1-2*	2-3	7-8	9-10	ES	Calls^
Attapeu	Sanamxay	Beung Ke lake	5/4/05	0.46						
Attapeu	Sanamxay	Beung Pulone lake	7/4/05	0.1						
Attapeu	Sanamxay	Xe Pian river (Xe Pian NPA)	1/6/05	18						
Attapeu	Sanamxay	Xe Pian river (Xe Pian NPA)	3/6/05	5						
Attapeu	Sanamxay	Xe Pian river (Xe Pian NPA)	4/6/05	3.3						
Saravan	Saravan	Xe Don river	28/5/05	0.3			1		1	
Savannakhet	Champhone	Cheo dam	13/3/05	2						
Savannakhet	Champhone	Kout Mark Peo lake	13/3/05	0.01	3	1				
Savannakhet	Champhone	Kout Mark Peo lake	14/3/05	0.01	5					2 locations
Savannakhet	Champhone	Kout Mark Peo lake	15/3/05	0.01	1				2	1 location
Savannakhet	Xaibouli	Boua Thong lake	17/3/05	0.68				1		
		Minimum total								12

\*crocodile size classes (feet); ^loud "bellows" heard in different locations in wetland. ES-"eyeshine" (crocodile size not estimated)

Crocodiles were not recorded in four other sites but were confirmed to occur in one, Beung Pulone lake, in transect surveys (below). Crocodiles were probably not seen during spotlight surveys in Beung Ke and Pulone lakes because they are almost entirely covered with aquatic vegetation. The lack of crocodile sightings in spotlight surveys in the Xe Pian river and Cheo lake (Table 9) may reflect a genuine absence or low density of crocodiles in these sites, as both sites were open waterbodies with high visibility. At sites surveyed more than once, double-counting of crocodiles within same-size classes was prevented by recording only the highest number of individuals seen in each size class in a single survey and excluding other sightings. Crocodile vocalisations heard in different parts of a wetland during a survey were counted as separate individuals. A conservative minimum estimate of 12 crocodiles was recorded during spotlight surveys (excluding four 1-2 ft crocodiles and two "eyeshine").

**Table 10:** Crocodile Dung Recorded in Two Wetlands in Southern Lao PDR in 2005

Dung size class (mm)	Beung Pulone (2 - 3 April)	Kout Mark Peo (12 - 15 March)
13.0 – 16.9	1	
21.0 – 24.9		1
25.0 – 28.9		1
29.0 – 32.9	2	
37.0 – 40.9	1	1
45.0 – 48.9	3	1
Estimated number of crocodiles	4	3

*Daytime surveys.* Eighteen crocodile signs were recorded in two of eight sites surveyed (17 dung and one trail) (Appendix 3). Based on dung counts (Section 2.2.3), a minimum of four and three crocodiles respectively were recorded in Beung Pulone and Kout Mark Peo lakes (Table 10). The size of dung indicates both small and large individuals occur in each site. Both wetlands are permanently flooded and with 100% and 80% vegetation cover respectively (Appendix 6), which reduced visibility and possibly the number of signs recorded.

*Local information.* Local communities stated that crocodiles historically occurred at 24 of 25 wetlands visited. Crocodiles were said to have declined in nine sites, (n=14 interviewees, Appendix 4), and in remaining sites abundance was perceived to be unchanged or was unknown.

*Population estimates.* The minimum number of crocodiles in five sites where crocodiles or their signs were recorded ranged from 1-9+ (Table 11). Two estimates of the total non-hatchling crocodile population were made for these sites, by applying the known proportion of nesting individuals (of the total population) in two other crocodylian species: 4.3-13.9% (*C. porosus* in northern Australia, Webb *et al.* 1989); and, 5% (*Alligator mississippiensis* Alligator in Louisiana, USA, Joanen and McNease 1987). Based on these other species, total population size in five sites ranged from 115-372 non-hatchlings (Table 11). Local information suggests these may be overestimates for some sites. For example, Boua Thong lake was confirmed to support a single resident crocodile, and local people stated they “sometimes” saw two-three other individuals (2005 surveys; Baird 2001a,b; Phothitay and Somphanith 2003, 2004).

**Table 11:** Estimates of Crocodile Numbers in Five Lao PDR Wetlands in 2005

Province	District	Site	Min. number (field surveys)	Population Estimate (1)	Population Estimate (2)
Attapeu	Sanamxay	Beung Pulone lake	4+	29-93	70
Saravan	Saravan	Nongboua pond + Xe Don river	2+	14-47	35
Savannakhet	Champhone	Kout Mark Peo lake	9+	65-209	158
Savannakhet	Xaibouli	Boua Thong lake	1+	7-23	18
		Total	16+	115-372	281

**Note:** estimates based on a non-hatchling portion of total population of (1) 4.3-13.9%; (2) 5% (see text)

Further surveys are required to obtain more accurate estimates of *C. siamensis* population size in these sites.

## 6. Community Perceptions

### 6.1 Summary of 2005 Interviews

Thirty-one interviews concerning crocodiles were conducted from March-June 2005 in the provinces of Attapeu, Saravan and Savannakhet. Interviewees comprised: 29 local residents from 20 villages (including village elders  $n=8$  and village head/deputy head  $n=8$ ); border police post ( $n=1$ ); and, a district forestry office ( $n=1$ ) (Appendix 4). Four ethnic groups were represented: Lao Loum (10 interviews); Lao Theung ( $n=2$ ); Mangkong ( $n=7$ ); Sou ( $n=7$ ); Ta Oy ( $n=4$ ); and, Phou Thai ( $n=1$ ) (Table 12). Median distance of communities to the target wetland was 0.9 km i.e. most interviewed residents lived at or close to the wetland of interest (mean distance was  $1.8 \text{ km} \pm 2 \text{ SD}$ , range 0.1-8 km,  $n=28$  interviews).

**Table 12:** Interview Survey Effort March-June 2005

Province	District	Interviews	Villages	Other Sources	Ethnic Group	Wetland Sites
Attapeu	Sanamxay	13	4	2 (DAFO, border police post)	Sou (7), Lao Loum (6)	8 (5 lakes, 3 rivers)
Saravan	Saravan	2	1		Lao Theung (2)	2 (1 lake, 1 river)
Savannakhet	Champhone	3	1		Lao Loum (3)	3 (2 lakes, 1 river)
Savannakhet	Nong	10	8		Mangkong (7), Ta Oy (3)	3 (rivers)
Savannakhet	Sepon	1	2		Phou Thai (1), Ta Oy (1)	1 (river)
Savannakhet	Xaibouli	2	1		Lao Loum (1)	3 (lakes)
<b>Total</b>	<b>6</b>	<b>31</b>	<b>17</b>	<b>2</b>		<b>20</b>

Mean interviewee age was 54 years  $\pm 15 \text{ SD}$  (20-85 years,  $n=31$ ). Interviewee age is subject to error because residents frequently did not have birth certificates and were unaware of their exact age. When possible we requested the presence of at least one village elder (for historical data) and one active fisher (for current data). All interviewees were male. Due to time limitations, no attempt was made to systematically sample different age groups, professions or genders. In general, virtually all people observed fishing or hunting at wetlands in 2005 were male. A positive correlation exists between "age of interviewee" and "year of last crocodile sighting by interviewee" (Pearson product-moment correlation  $r=.65$ ,  $n=21$ ,  $P<.01$ ), suggesting that older residents are less likely to have seen crocodiles recently than younger residents (presumably time spent in wetlands decreases with age).

Interviewees reported that crocodiles historically occurred in 24 of 25 wetlands surveyed in 2005. Additional information about crocodiles was obtained during community interviews from 2003-04 (Phothitay and Somphanith 2003, 2004).

## 6.2 Crocodile Taxonomy

In Lao PDR and Thailand, the national term for “crocodile” is “*ke*” (Cheminaud 1939). “*Ke*” was the most commonly used term by all interviewees in 2005, but three ethnic minorities in the west of Savannakhet Province (Mangkong, Ta Oy and Ka Tong groups) also used an ethnic name, “*rabur*”. Three crocodile forms were described by communities in 2005. Most interviewees (n=27) knew of only one form of crocodile. Four interviewees described two forms. The most frequently described form (n=25 interviewees) was an unspecified “general” form of crocodile described simply as a large lizard, “much larger than a monitor lizard (*Varanus* sp.), with a long tail and scales along the back”. The second most frequently reported form (n=6 interviewees) was “*ke thin phet*” (“duck-foot crocodile”), said to differ from the first form by having feet shaped like duck’s feet. The third form (n=4 interviewees) was “*ke hear*” (“monitor lizard crocodile”), said to be a larger version of the “standard” form and with feet like a monitor lizard’s. The four interviewees who described two crocodile forms (“*ke thin phet*” and “*ke hear*”) stated these were the only two crocodile forms that occurred, and that the first “general” form referred to by most people was in fact one of these two. Both the “*ke thin phet*” and “*ke hear*” forms were said to occur in the same habitats and were reported by interviewees in Attapeu and Savannakhet Provinces.

## 6.3 Cultural Significance

“Cultural significance” was defined as any local beliefs or medicinal uses attributed to crocodiles. Twenty-three of 31 interviewees (74%) in 2005 had never heard of any crocodile attacks on humans, and 20 (65%) did not consider crocodiles a danger to humans. Two interviewees stated crocodiles were more dangerous in the past, when they were more common. Twenty-three interviewees (74%) did not regard crocodiles as a threat to fish resources (eight interviewees did not know). Thirteen interviewees (42%) (from eight villages and one district forestry office) stated that crocodiles had cultural significance, and 18 interviewees (14 villages and one border police post) stated that no cultural significance was associated with crocodiles (Appendix 4).

All 13 interviewees with crocodile cultural beliefs stated that crocodiles were “respected” and were part of the “forest spirits” believed to reside in the forests and wetlands near their communities. Such beliefs were reported from residents in five districts of three provinces in southern Lao PDR. Six of 25 wetlands surveyed in 2005 [Beung Ke and Pulone lakes (Attapeu), Nongboua pond (Saravan) and Boua Thong, Saiyan and Hor lakes (Savannakhet), see Appendices 2, 6] were subject to community restrictions on crocodile hunting and resource use due (at least partly) to these crocodile beliefs, suggesting they are an important tool for crocodile conservation in such sites. Specific crocodile-related beliefs encountered were: prohibition of women bathing where crocodiles occur (Boua Thong lake, n=1 interviewee); if a person was bitten by a crocodile, the wound would be covered to prevent geckos licking the wound [n=2, Pindong (Attapeu) and Beung Boua Thong

(Savannakhet) villages]; open discussion of crocodile sightings was disrespectful to “crocodile spirits” (n=1, Phoun Thong village, Savannakhet); and, crocodiles nest in “special” places, where humans will contract skin rash (n=1, Phoun Thong village). Three communities in Savannakhet Province reported the presence of “nagas” in rivers, mystical creatures described as large serpents with a long, red head and neck.

Table 13: Contingency Table: Frequency of Occurrence of (A) Crocodiles and (B) Crocodile Cultural Beliefs (Raw Data)

Variable	Crocodiles occur(ed) in sites?	
	Yes	No
Sites with crocodile cultural values		
Yes	17	0
No	6	8

We tested the null hypothesis that in the study sample (n=31 interviews), occurrence of crocodile cultural values was independent of crocodile occurrence (Table 13). Fisher's Exact Test was used because it is generally considered optimal for testing 2x2 contingency tables with small frequencies, and because the data violate a key assumption of chi-square analysis (minimum count of five values in all categories) (Zar 1999). A one-sided test was used as we hypothesised that crocodile cultural beliefs were more likely to occur in sites with crocodiles, than in sites where crocodiles had never occurred.

A significant relationship appears to exist between presence of crocodile cultural beliefs and presence of crocodiles (Fisher's one-sided test exact probability value  $P=.0004$ ,  $n=31$ , threshold  $\alpha=0.05$ ), although caution is required with this result due to the small sample size. We conclude from this that presence of crocodile cultural values in a community may indicate presence of crocodiles but not always so, and cannot be used as a sole predictor of crocodile occurrence in a wetland. In some sites where crocodiles occur, local communities clearly did not associate any value with crocodiles.

Twenty-five interviewees (81%) did not attribute any medicinal value to crocodiles. The most widely and consistently reported medicinal use of crocodiles (n=5 interviewees, from four villages in Attapeu, Saravan and Savannakhet Provinces, Appendix 4) was for treatment of dogbite. If someone was bitten by a "diseased" dog (perhaps meaning rabies), a crocodile tooth would be ground against a rock to form some powder, which was mixed with herbs and water. This mixture would then be placed over the wound, and would apparently lead to rapid healing. One other interviewee (Attapeu Province) stated that historically, stomachache would be cured in the village by drinking a mixture of crocodile bile and water.

The presence of crocodile cultural beliefs at some sites in Lao PRD, as well as the occurrence of sacred forests and "spirit protectors" for other wildlife species, provides some community protection to selected wildlife species and wetlands (Baird 2001a,b; Shoemaker *et al.* 2001; Steinmetz *et al.* 1999). Cultural respect of crocodiles is also present among ethnic minority communities in the Cardamom Mountains of south-west Cambodia, who do not hunt crocodiles and where no human attacks are known (Daltry *et al.* 2003).

## 6.4 Hunting

Twenty-two interviewees in 2005 (71%) stated they had never eaten crocodile meat or other products. Nine interviewees had eaten crocodile meat in the past, on an opportunistic and subsistence basis (not for medicinal or spiritual beliefs) and that it had been "many" years since they had eaten meat. In six of nine villages where crocodile cultural beliefs occurred, historic consumption of crocodile meat was also reported, possibly indicating cultural

“respect” of crocodiles was less important than subsistence requirements (perhaps especially during the Indochinese Conflict, when food was scarce). At two wetlands (Nongboua pond, Saravan and Boua Thong lake, Savannakhet), crocodile hunting was prohibited by two nearby villages (Nongboua and Beung Boua Thong villages respectively), although crocodiles were historically eaten in Beung Boua Thong village. Historic ( $\leq 1979$ ) commercial crocodile hunting was only reported in four of 20 villages surveyed (20%), although interviewees may have been reluctant to discuss hunting. Three hunting methods were described: use of a baited hook set over the water ( $n=7$  interviewees from five villages); shooting crocodiles at night ( $n=3$  interviewees from three villages); and, a spear attached to a line of rattan ( $n=2$  interviewees from one village). Commercial crocodile trade is described in Section 7.1.

## 6.5 Socio-Economic Conditions at Villages Surveyed in 2005

Baseline socio-economic conditions were recorded at 17 villages close to wetlands where crocodiles were reported to have occurred historically, to identify resource use and potential threats to crocodiles (Appendix 7). The principal form of subsistence in 16 of 17 villages was rain-fed (one crop/year) rice cultivation. Only one village practised extensive irrigated rice cultivation (two crops/year), although small areas of irrigated rice cultivation were observed at seven wetlands. Mean village population was 427 (Table 14).

Table 14: Baseline Socio-Economic Data From 17 Villages Near Wetlands Surveyed in 2005

Variable	Value $\pm$ SD (range, n)
Mean no. houses	71 $\pm$ 49 (23-195, 17)
Mean no. families	87 $\pm$ 61 (27-261, 17)
Mean village population	427 $\pm$ 358 (115-1539, 17)
Mean persons/household	5.7 $\pm$ 1.2 (3.7-7.9, 17)
Literacy	Low-9; Medium-2; High-6
Rice crop per year	1 (16 villages) – rain dependant
Primary school in village?	16
Secondary school in village?	1
Medical clinic in village?	No-10; Yes-7
Grid electricity?	No-13; Yes-4
Road access?	No-4; Yes-13
Land allocation map?	No-3; Yes-14

Sixteen villages had a primary school and one village had a secondary school. Ten villages did not have a medical clinic or any human medicinal supplies. Literacy was generally reported by the village head as a percent of the total village population. This was sometimes unclear and was apparently based on their personal estimates (not surveys). Based on values provided, literacy was classified as: “low” ( $<29\%$  population,  $n=9$  villages); “medium” (30-60% of population,  $n=2$ ); or, “high” ( $\geq 61\%$ ,  $n=6$ ).

All communities supplemented their rice diet to varying degrees with subsistence fishing, wildlife hunting and collection of other non-timber forest resources e.g. water snails, mushrooms, bamboo, monitor lizards (*Varanus salvator* and *V. bengalensis*) and turtles. Interviewees in 14 villages stated that traders “often” visited their villages, to purchase wildlife from residents and sell a range of domestic/consumer products. Residents stated they would sell wildlife to traders if any was available when traders visited. Local resource use in crocodile wetland habitats is described in Section 7.

Twelve wetland sites were subject to local community regulations related to fishing techniques (e.g. prohibition of poisons and electricity), harvest season and no-catch zones, and in one site non-residents were required to pay a village tax to fish at a local wetland.

Four of 17 villages had received various forms of technical assistance from international projects, and 13 villages had received assistance from government agencies, mainly between 1999 and 2005. All assistance was related to health, agriculture and poverty alleviation. All villages stated they had not received any conservation-related assistance or activities. This included two villages located in the Xe Pian NPA (Attapeu Province), although both villages were exposed to some assistance during two international projects in the park (IUCN, DANIDA) in the late 1990s, including construction of a primary school in Phonesaat village (Appendix 7).

## 7. Threats

### 7.1 Historic Commercial Trade ( $\leq 1979$ )

Historic commercial trade is attributed as a key factor responsible for the global decline of *C. siamensis* (Ross 1998). *Crocodylus siamensis* is commercially valued for its belly skin because of the small scale size and absence of an osteoderm (bony plate) within belly scales, which occur in some other crocodylians (King and Brazaitis 1971). This renders the skin more flexible for leather production. Hunting was widespread in some regions of central and southern Lao PDR from the 1950s-70s, and in some sites local communities attribute the decline or local extinction of crocodiles to hunting (Table 15). All crocodile hunting was illegal; there has never been any legal international crocodile trade from Lao PDR, and no trade records exist (Mr. Venevongphet pers. comm.). The UNEP-WCMC CITES Trade Database (UNEP-WCMC 2005) holds no records of crocodile exports/imports from Lao PDR from 1975-2004 (Lao PDR acceded to CITES in 2004).

**Table 15:** Records of Commercial Crocodile Hunting in Lao PDR

Province	District	Site	Years Of Hunting	Current ( $\geq 1980$ ) Crocodile Status	Source
Attapeu	Sanamxay	Xe Pian NPA (Xe Pian and Xe Kampho rivers)	1950s-70s	very rare/extinct; no known breeding	2005 survey; Salter (1993); WCS (1995)
Champasak	Mounlapamok	Dong Khanthung NPA (Xe Lamphao river)	1940s-50s	extinct due to hunting	Stuart (1998a)
Savannakhet	Champhone	Lower Xe Champhone river and wetlands	1950s-60s	small remnant populations	2005 survey; Salter (1993)
Savannakhet	Xaibouli	Boua Thong wetlands	1960s	<10 individuals in region; no known breeding	2005 survey; Shoemaker <i>et al.</i> (2001)

In 2005, four of 17 villages surveyed (Ban Mai, Phonesaat, Nong Ke, Tansoum) reported that crocodiles were hunted historically (Appendix 4). Surveys may have underestimated the extent of historic hunting in these 17 villages e.g. in Beung Boua Thong village (Savannakhet) residents stated no crocodile hunting had occurred, yet related to Shoemaker *et al.* (2001) that crocodiles were hunted and traded to Thailand in the 1960s. Local communities in 2005 and other studies reported that most historic trade was in live crocodiles or skins and was to Thailand (2005 surveys; Baird 1993; Claridge 1996; Salter 1993). In the Xe Pian NPA (Attapeu), one village reported in 2005 that crocodiles were hunted most intensively during the Indochinese Conflict (1961-75), to supplement diet and financial income. Skins were sold to Cambodian traders at the nearby national border, and hunting apparently decreased after the end of conflict as communities resumed agricultural activities (residents Phonesaat village pers. comm., Appendix 4). Some communities in Lao PDR attribute wildlife declines to food scarcity and increased hunting during this period of conflict (Steinmetz *et al.* 1999; WWF-Thailand 1997). Crocodile skin prices were measured in "thuk", a unit of 10 cm of

belly skin or “a closed fist”, measured hand-over-hand. In the Xe Pian NPA in the 1960s, skins were sold for 5-6,000 Kip/*thuk* (current US\$ price 0.5-0.6) (Appendix 4).

Historic trade in live *C. siamensis*, skins and eggs also occurred in Cambodia (Cheang and Ratanakorn 1994; Jelden *et al.* 2005; Nao Thuok 1998; Ross 1998; Simpson and Han 2004), Viet Nam (Cao Van Sung and Jenkins 1998; Platt and Ngo Van Tri 2000) and Thailand (Ratanakorn 1994). Most trade was apparently to supply farms in Thailand and Cambodia. Some crocodiles caught in Viet Nam were sold to Cambodia traders, and then exported to Thailand (Martin and Phipps 1996). *Crocodylus siamensis* have also been recorded in crocodile farms in Kalimantan (Indonesian Borneo), although little is known of the source of these individuals (Cox *et al.* 1993; Ross *et al.* 1996, 1998).

## 7.2 Current Commercial Trade ( $\geq 1980$ )

No evidence of subsistence or commercial crocodile hunting was observed at 25 wetland sites and 17 villages surveyed in 2005 (Appendix 4). In Vientiane (capital of Lao PDR, Figure 1), a cumulative total of 17 months of wildlife trade monitoring from 2003-04 (13 months in wildlife markets and four months in 20 restaurants) documented one occurrence of crocodiles in trade (WCS in prep.). This was of a crocodile skin owned by a local doctor, obtained from the Ban Kuen Zoo (below). In the early 1990s, crocodile trade occurred between Thailand and the southern provinces of Lao PDR. Crocodiles captured in Savannakhet Province or elsewhere were sold to Thai traders, or else crocodiles were transported from Cambodia to Thailand via Champasak Province (Lao PDR) (Baird 1993). Some crocodile products were sold in Thai markets opposite Savannakhet Province (Baird 1993; Srikosamatara and Suteethorn 1994). A proposal to establish a commercial, wild harvesting program in Lao PDR was unsuccessful (Salter 1993). No crocodile products were recorded in a wildlife survey of some Lao markets in 1992 (Martin 1992), although in the late 1990s, some crocodile products (skins, empty eggs) were for sale as “curio” items in the Vientiane Morning Market (Stuart 1999). In a detailed review of the wildlife trade of Lao PDR, there is little mention of crocodile products for sale (Nooren and Claridge 2001). Any trade in 2005 probably comprises unintentional capture of wild crocodiles (e.g. in fishing nets), which are sold to local or Thai traders. Such opportunistic captures, although perhaps infrequent, may cause disproportionately high impacts to recruitment in small remnant populations.

There are no commercial crocodile farms in Lao PDR and only one institution, the Ban Kuen Zoo (Vientiane Municipality), with a relatively large number (>300 individuals) of captive *C. siamensis*. Most individuals apparently originate from Thai crocodile farms, although some may be wild individuals from Lao PDR (Stuart and Platt 2000). Some of these may be hybrids (Phothitay *et al.* 2005; Thorbjarnarson 2003). In 1999, this zoo sold crocodile eggs and stuffed hatchlings to the general public, which apparently were purchased from regions in Lao PDR (Nooren and Claridge 2001). No evidence of crocodile sale was observed at the zoo in 2005, although it is unclear how the zoo will manage its captive crocodile population, which is increasing with breeding (Phothitay *et al.* 2005).

Demand for wild crocodiles remains strong from Cambodia crocodile farms (Daltry *et al.* 2003; Jelden *et al.* 2005; Simpson and Han 2004). This may encourage continued capture/sale of crocodiles in southern Lao PDR. Sale of crocodiles and products has apparently shifted from Thailand to China and Viet Nam (Jelden *et al.* 2005). In Cambodia,

current market prices are low, decreasing from US\$200-300/hatchling in the 1990s (Martin and Phipps 1996) to US\$28-40 in 2005 (Anon 2005; Jelden *et al.* 2005).

### 7.3 Habitat Loss

Habitat loss is another key factor considered responsible for the global decline of *C. siamensis*, with hunting (Ross 1998). In Lao PDR, the current (and possibly historic) centre of *C. siamensis* distribution largely overlaps with the Mekong Plain (Section 5), which supports the highest human densities and most intensely settled lands in the country. This has resulted in large-scale loss and degradation of wetland habitats used by crocodiles, principally for rice cultivation and other agriculture. Current threats to crocodile habitats were measured at 26 sites within 25 wetlands (including separate sections of rivers) surveyed in 2005 (Appendix 6) and are summarised below. Values provided are mean  $\pm$  standard deviation (range, n).

*Clearance and drainage.* Nearly all sites were impacted to varying degrees by clearance of native vegetation within and around the wetland. Mean cover of native vegetation within 50 m of wetlands was 83%  $\pm$  22 (10-100, n=26), indicating that many sites still retained a partial cover of native vegetation. Some sites were modified by roads/bare land (n=7 sites), or irrigated/rain-fed rice fields (n=14). Irrigation channels (1x1 m) had been constructed in six sites, from the wetland to nearby rice fields. In one of four nesting sites recorded in Lao PDR (Nongboua pond, Section 4.4), channel construction was reported to have caused lowering of wetland waterlevels and changes in aquatic vegetation, including increased weed invasion (Nongboua village residents pers. comm.). Channel construction was observed in 2005 at Kout Mark Peo lake, one of only two sites where successful breeding was confirmed in 2005.

*Burning.* In 23 of 26 sites (88%), local communities used fire to clear vegetation around wetlands, for cultivation and hunting. Mean percent of cover of land within 50 m around wetlands that had been burnt at least once in the previous two years was 42%  $\pm$  28 (0-80, n=26). Burning results in removal of bankside crocodile nesting habitats, loss of protective cover and changes in vegetation composition, and may also result in direct mortality of eggs and crocodiles.

*Weed invasion.* Frequency of occurrence and cover of two weed species, *Mimosa pigra* ("nha pi mop nyai") (a terrestrial species) and water hyacinth *Eichhornia* spp. ("pak dthop") (an aquatic species) were recorded in 2005 sites. Both are invasive species from South America that have colonised many waterways in south-east Asia, and which are difficult and expensive to control or eliminate once established (Ericson 2005). Eight of 26 sites (31%) were colonised by *M. pigra* (mean cover within 50 m of wetlands was 27%  $\pm$  15, range 10-50, n=8) and five sites (19%) by *Eichhornia* sp. (mean cover 22%  $\pm$  13, 10-40%, n=5). *Mimosa pigra* was only recorded at sites in Savannakhet Province, where extensive invasion has occurred (Claridge 1996). A smaller species, *M. pudica* ("nha nyup") was observed at one site, a cleared and grazed pond in the Xe Pian NPA (Attapeu). These weeds may cause large changes to native vegetation composition and potentially result in loss of crocodile nesting sites. The potential impacts to *C. siamensis* are unclear; it is also possible these weeds may benefit crocodiles, by reducing visibility of crocodiles to hunters. In South America, Spectacled Caiman (*Caiman crocodilus*) frequently use *M. pigra* wetland-forest or

wetland savanna ecotones as nesting sites; it is possible *C. siamensis* might also use such habitats (J. Thorbjarnarson pers. comm. 2005).

*Livestock.* Twenty-three of 26 sites (88%) were used by domestic livestock for water and grazing. Mean buffalo herd size at 12 sites (observed at time of visit) was  $16 \pm 12$  (1-43,  $n=12$ ). In 18 sites (lakes and ponds) where livestock had permanent access to the wetland, trampling impacts were high (mean percent cover of wetland trampled was  $57\% \pm 38$  (0-100,  $n=18$ ). Seven sites were 100% trampled by livestock i.e. the entire wetland surface was grazed. Grazing impacts are largely due to domestic buffalo, which range further and longer than cows (>8 km from one village in the Xe Pian NPA, pers. obs., and up to 15 km from one village in a national park in Viet Nam, Thu Nhung Mlo and Bezuijen 2004). Livestock grazing may damage wetland microhabitats where crocodiles nest, and potentially assist weed invasion.

*Other.* A range of other impacts threaten crocodile habitats. In one of four reported nesting sites in Lao PDR (Beung Ke lake, Section 4.4), commercial peat extraction was proposed in the 1990s (and later abandoned, Stuart and Platt 2000). This site is now threatened by construction of an electricity transmission easement, which has exposed the southern border of the wetland and created road access to it. Some wetlands in Lao PDR may also be threatened by hydropower projects, which may flood crocodile nest sites and increase hunter access (Claridge 1996).

The condition of four nesting sites documented in 2005 (Section 4.4) suggests that presence of a native vegetation cover around, or within, the wetland is important for nesting. Three of four sites had 100% native vegetation surrounding the wetland. All sites retained a relatively intact cover of native floating vegetation in the wetland or of surrounding forest. At three of four sites, the percent of cover burnt in the previous two years was <40%, and weed invasion was low (*M. pigra* was present in one site and *Eichhornia* sp. in two sites). Successful breeding was confirmed in only two sites and at these, type and extent of disturbance varied. In Kout Mark Peo lake (Savannakhet), 40% of the lake perimeter was highly modified (rice fields, paths, cleared land, with increasing *M. pigra* and *Eichhornia* sp. invasion), but the wetland itself supported a 90% intact layer of floating aquatic reeds and shrubs. This core area was ungrazed and unburnt. At Beung Pulone lake (Attapeu) 100% of the lake perimeter was intact (forest) but partly burnt, and the wetland itself was heavily grazed.

## 7.4 Fishing

Fishing is a key subsistence activity for most people in Lao PDR, and includes intensive use of monofilament gillnets, explosives, poisons, electrofishing, pumping out wetlands and overuse of fence traps (Claridge *et al.* 1997). Fishing may result in the direct mortality of crocodiles and also increases the likelihood of human encounters with crocodiles, which may increase disturbance of nesting females, reduce available nesting habitat or result in capture or drowning of crocodiles caught in fishnets. In 2005, subsistence fishing was observed at 24 of 26 sites (92%) and commercial fishing at two sites (Nong Kham Miem lake and Xe Pian river, Attapeu) (Appendix 6). No reports of crocodiles trapped in fishnets were received. Fishing and other resource use was prohibited at two of 26 sites (Boua Thong lake and Nong Boua pond) due to crocodile-related spiritual beliefs. In all permanent wetlands, fishing occurred all year, and at seasonally flooded wetlands, fishing generally

occurred from October – January. Fishing intensity varied from low (<five households in a site) to high (>100 households). A range of meshnets, hooks and traps were observed at most survey sites. At four reported nesting sites (Section 4.4), fishing was prohibited in two sites, and only low-intensity, seasonal fishing (<five families for three months/year) occurred in the other two sites. At these nest sites, low human visitation may contribute to crocodile nesting.

## 7.5 Hybridisation of Wild Populations

Hybridised *C. siamensis* (*C. siamensis* x *C. rhombifer* Cuban Crocodile, *C. siamensis* x *C. porosus* Saltwater Crocodile and *C. siamensis* x *C. porosus* x *C. rhombifer*) occur in crocodile farms in Thailand, Cambodia and Viet Nam, and some farm individuals have escaped (Jelden *et al.* 2005). Interbreeding of escaped hybrids with wild *C. siamensis* threatens the genetic integrity of wild populations (FitzSimmons *et al.* 2001). Hybrid individuals may not be easily distinguished from pure *C. siamensis*, and reintroduction efforts in Thailand and Viet Nam were accompanied by DNA analysis to ensure release of pure *C. siamensis* (FitzSimmons *et al.* 2001; Polet 2004). In Cambodia, a key management recommendation for *C. siamensis* conservation is the development of criteria to identify hybrids and prevent hybridised individuals entering wild populations (Jelden *et al.* 2005). In Lao PDR, the threat of hybridisation appears to be lower than in Cambodia and Thailand, due to the absence of crocodile farms except the Ban Kuen Zoo. Escaped hybrids from Ban Kuen Zoo (or even from Thailand or Cambodia) might interbreed with wild populations, and this risk should be addressed to prevent escape or inappropriate release of captive individuals.

## 7.6 Disturbance Index

A standardised “Disturbance Index” (DI) was developed to rank and compare the extent of seven threat variables to crocodiles and their habitats, at 24 wetlands surveyed in 2005 which historically supported crocodiles (Section 2.4). DI scores were compared with the relative conservation value of sites for crocodiles (Table 16). “Crocodile conservation value” could not be assessed only from quantitative data (e.g. number of individuals or nests) due to insufficient site data, so was assessed based on three simple factors: presence of local crocodile sightings  $\geq 1980$  (“current” sightings); confirmed crocodile presence (sightings in 2005); and, confirmed nesting (sightings during crocodile surveys from 2003-05). This enabled assessment of key disturbance variables at sites of high conservation value for crocodiles, summarised below.

- The extent of disturbance by seven variables (including historic crocodile hunting) was spread evenly between variables across all sites (DI range 52-63, or 54-65% of a maximum possible individual score of 96, Table 16). This indicates that no single disturbance variable dominated human disturbances to wetlands. The highest scoring DI variable (total score 63) was “proximity of wetland to nearest village”, indicating that wetlands closer to communities suffered higher disturbance than wetlands further away. In the six most highly disturbed sites (DI site scores of 17-21), the highest disturbance variables were “clearance” (i.e. habitat loss), “fishing”, “proximity of villages” and “weed invasion”.
- Excluding historic hunting, habitat disturbance (DI) scores range widely from 8-21 for each site, from a maximum possible DI score of 24 (33-89%). Nineteen of 24 sites (88%) had DI scores  $\geq 12$  (i.e.  $\geq 50\%$  of the maximum score, indicating that a range of relatively

high human disturbances were present in most wetlands. If this sample of 24 wetlands is representative of other wetlands in southern Lao PDR, it is evident that many crocodile habitats are highly impacted by human processes.

- “Current” occurrence of crocodiles (i.e.  $\geq 1980$ ) was reported by local communities from 15 of 24 sites, across the full range of DI site scores (including hunting) (i.e. 8-23), except the most highly disturbed site (DI score 24). This suggests that crocodiles may persist in disturbed wetlands for some time, although this may not indicate successful recruitment. DI scores at four wetlands where nesting was reported were relatively high (11-20) (Table 16), and three of four sites were subject to historic crocodile hunting. In fact, the only two sites where successful breeding was confirmed in 2005, were the most highly disturbed of these four sites (DI scores 16, 20).
- This ability to continue breeding in apparently highly disturbed sites may be explained by the presence of remnant wetland and/or bank-side vegetation cover. Comparison of individual vegetation classes for these four nest sites (Appendix 6) shows that: these sites had relatively intact native vegetation (forest, woodland, shrubland) within 50 m of the wetland (100% cover in three sites and 60% cover in one site). In contrast, the mean native vegetation cover around all 24 sites was only  $20\% \pm 22SD$  (0-100,  $n=96$ , calculated by pooling four native vegetation classes for all sites, Appendix 6). Extent of aquatic vegetation cover varied between the four sites (0%,  $n=1$ ; 40%,  $n=1$ ; 100%,  $n=2$ ). At the site with 100% aquatic vegetation cover, the nest was located on thick floating mats. These data suggest that maintenance of fringing forest around the wetland perimeter and/or aquatic wetland vegetation will contribute to crocodile nesting and recruitment, even if other disturbances are present.

**Table 16:** Comparison of Relative Wetland Disturbance ("Disturbance Index") in 24 Wetlands Surveyed in 2005 Where *Crocodylus Siamensis* Was Reported to Have Historically Occurred ( $\leq 1979$ ). Higher Values Indicate Greater Levels of Disturbance (Maximum = 4).

Province	District	Wetland	Disturbance Index (DI)							Current crocodile status				
			Clearance	Burning	Fishing	Cattle	Distance	Weed	Hunting	DI (-hunting)	DI (+hunting)	Local report >1980?	Confirmed (2005)	Nest (2003-06)
Savannakhet	Sepou	Xe Poi river	4	1	4	3	4	4	4	20	24	No		
Savannakhet	Kaibouli	Beung Hui lake	4	4	3	4	3	1	4	19	23	Yes		
Attapeu	Soukxay	Nong Ke wetland	4	1	4	4	4	4	0	21	21	No		
Savannakhet	Champone	Kout Mouk Peo lake	4	2	3	1	2	4	4	16	20	Yes	Yes	Yes
Savannakhet	Kaibouli	Beung Saipon lake	3	3	3	3	1	3	4	16	20	Yes	Yes	
Saravali	Saravali	Xe Don river	3	2	3	2	4	1	4	15	19	Yes	Yes	
Savannakhet	Champone	Kout Tao pond	3	3	2	1	2	4	4	15	19	Yes		
Savannakhet	Nong	Xe Loung river	3	2	4	2	4	3	0	18	18	Yes	Yes	
Attapeu	Soukxay	Nong Khum Miam lake	1	3	1	4	3	1	4	15	17	Yes		
Savannakhet	Nong	Xe Sinoan river	3	3	4	2	4	1	0	17	17	No		
Savannakhet	Nong	Xe Lou river	3	2	3	1	4	4	0	17	17	No		
Attapeu	Soukxay	Beung Phlene lake	1	3	1	4	2	1	4	12	16	Yes	Yes	Yes
Attapeu	Soukxay	Nong Hai pond	1	3	1	4	2	1	4	12	16	No		
Attapeu	Soukxay	Xe Pion river	1	1	4	1	4	1	4	12	16	No		
Savannakhet	Champone	Chao lake	4	3	1	2	2	4	0	16	16	Yes	Yes	
Savannakhet	Kaibouli	Boua Thong lake	1	2	1	4	3	1	4	12	16	Yes	Yes	Yes
Savannakhet	Champone	Kout Xe Hock lake	3	3	3	2	1	3	0	15	15	Yes		
Attapeu	Soukxay	Beung Ke lake	1	4	1	1	2	1	4	10	14	Yes		
Attapeu	Soukxay	Xe Kampha river	1	1	4	2	4	1	0	13	13	No		
Savannakhet	Champone	Kout Phimsy lake	2	3	1	2	1	4	0	13	13	Yes		
Attapeu	Soukxay	Nong Khung Hago lake	1	3	1	1	1	1	4	8	12	Yes		
Attapeu	Soukxay	Nong Pulo lake	2	2	1	4	1	1	0	11	11	No		
Saravali	Saravali	Nong Boua pond	1	1	1	1	3	4	0	11	11	Yes	Yes	Yes
Savannakhet	Champone	Kout Noy pond	1	1	1	2	2	1	1	8	8	Yes		
		Habitat disturbance	55	56	55	57	63	54	52	340	392			
		Maximum possible score	96	96	95	96	96	96	96	96	96			

**Notes:** A standardized scoring system ("Disturbance Index") was developed for 7 disturbance variables recorded at wetland sites (Section 2.4). "Clearance", "burning" and "cattle" are measures of "landcover" within 50 m radius of wetland impacted by each variable. "Weed invasion" is the percent of cover of two weed types (*Mimosa pigra* + *Eichhornia* sp.) over the wetland surface + within 50 m radius of wetland (aerially). "Fishing" impact is a measure of number of permanent residences at wetland. "Distance" is a measure of proximity of wetland to the nearest village. "Hunting" is presence/absence of historic commercial crocodile hunting (information from local communities). Because of high perceived impacts of historic hunting to crocodile densities, presence of hunting is awarded a maximum possible disturbance score of "4".

## 8. Conservation

### 8.1 Representation in Protected Areas

Lao PDR has one of the most extensive national protected area systems in Asia, but wetlands are underrepresented (Claridge 1996; ICEM 2003; Robichaud *et al.* 2001). Crocodile occurrence has been reported in 12 of 20 National Protected Areas, one proposed NPA and at least one Provincial Protected Area (Table 17, Figure 3). Twenty-five of 122 national crocodile records (20%) are within NPAs. All are unconfirmed local reports and 21 of 25 records are “rank 3”, indicating they may be unreliable.

**Table 17:** Crocodile Records in National Protected Areas (NPAs) in Lao PDR

Province	NPA	Data Source	Last Sighting	Records in Database	Reported Abundance	Current Crocodile Status	Source
Attapeu	Bolaven Southwest*	Local	1990s	1	Seen annually	Remnant populations?	1, 5
Attapeu	Dong Amphan	Local	1996	1	Seen annually	Remnant population?	12
Attapeu	Nam Ghong PPA**	Local	1996	1	Unknown	Remnant population?	5,11,12
Attapeu/Champ.	Xe Pian	Local	1990s	6	Unknown	Locally extinct/very rare	18, 19
Bolikhamxay	Phou Khao Khouay	Local	1980s	1	Infrequently seen	Locally extinct/very rare	1
Champasak	Dong Hua Sao	Local	1990s	2	Unknown	Locally extinct/very rare	1, 10
Champasak	Dong Khanthung	Local	1990s	3	Unknown	Locally extinct	1, 2
Champasak	Phou Xiang Thong	Local	1990s	2	Infrequently seen	Small populations (1993); locally extinct? (1996)	1, 17
Khammouane	Kham. Limestone	Local	1980s	2	Infrequently seen	Locally extinct/very rare	1, 3
Saravan	Xe Sap	Local	1999	1	Infrequently seen	Locally extinct/very rare	6
Saravan	Xe Bang Nouan	Local	1994	3	Infrequently seen	Very rare	1, 7, 10
Savannakhet	Dongphouvieng	Local	1997	1	Unknown	Unknown	9
Savannakhet	Phou Xang He	Local	1988	1	Infrequently seen	Locally extinct/very rare	1
Xaignabouli	Nam Phoun	Local	1960s	0 <sup>^</sup>	Unknown	Locally extinct	1
Negative record							
Houaphanh	Phou Louey	Local	None	1	Never seen	Unsuitable habitat?	13
Khammouane	Hin Nam No	Local	None	1	Never seen	Unsuitable habitat?	14
Khammouane, Bholikhamxay	Nakai-Nam Theun	Local	None	1	Never seen	Outside range?	15
Bholikhamxay	Phou Khao Khouay	Local	None	1	Never seen	That Xay waterfall - unsuitable habitat?	16

\*Proposed NPA. \*\*Provincial Protected Area. ^record not entered in national database (insufficient data). Source: 1-Salter (1993); 2-Stuart (1998a); 3-Stuart (1998c); 4-Stuart (1998d); 5-R. Tizard pers. comm. June 2005; 6-Steinmetz *et al.* (1999); 7-Timmins and Bleisch (1995); 8-Duckworth *et al.* (1999); 9-WWF-Thailand (1998); 10-Claridge (1996); 11-R. Timmins in litt. June 2005; 12-Davidson *et al.* (1997); 13-Stuart (1998e); 14-Stuart (1998b); 15-Timmins and Evans (1996); 16-Stuart (1998d); 17-Evans *et al.* (1996); 18-2005 surveys (App. 4); 19-Timmins *et al.* (1993)

Despite an apparently strong representation in the NPA system, the species is considered very rare or locally extinct in 10 of 14 sites (71%). Sixty-five biologist survey weeks in the Xe Pian NPA and 11 biologist-weeks in Dong Kanthung NPA in the 1990s resulted in no sightings or signs of crocodiles (Stuart and Platt 2000). Targeted crocodile surveys in the Xe Pian NPA in 2005 also indicated that *C. siamensis* is very rare or locally extinct in the park, and was extensively hunted from the 1950s-60s (Section 7.1). Status surveys are urgently required in the Dong Amphan NPA and Nam Ghong PPA, where local reports in 1996 indicated populations still occur (Davidson *et al.* 1997). These sites are contiguous with the Xe Kong river and Virachey National Park in Cambodia, where crocodiles are confirmed to occur (J. Daltry pers. comm.; Simpson and Han 2004), and this network of trans-border protected areas may be significant for *C. siamensis* conservation. Crocodile declines are also evident in other NPAs. In the Phou Xiang Thong NPA (Figure 3), local reports in the early 1990s suggested crocodiles persist (Salter 1993) but in 1996 only “vague” or negative reports were obtained (Evans *et al.* 1996).

In the Xe Sap NPA, local reports were unconfirmed (Steinmetz *et al.* 1999) or unclear and possibly of monitor lizards (*Varanaus* sp.) (Showler *et al.* 1998). Most available records from protected areas are >10 years old.

The NPA system currently provides little protection for remnant *C. siamensis* populations in Lao PDR, but given the range of records from NPAs, is a potential tool for *C. siamensis* if populations could recover. The Provincial Protected Areas system is also an important potential resource for *C. siamensis* conservation (there are >1,000 PPAs in Lao PDR), but most PPAs are unmapped (M. Hedemark pers. comm.) and were not examined in this review. “Negative” occurrence was reported in four NPAs, where local residents had never seen or heard of crocodiles.

## 8.2 Community-Based Conservation

Conservation of wild *C. siamensis* in Lao PDR will largely depend on implementation of community-based conservation approaches. Ninety-seven of 122 national crocodile records (79%) are outside the NPA system; national records are from a total of 51 sites, of which 40 (78%) are outside NPAs. The only four documented nest sites in 2005 were all in community lands. In many community-managed wetlands, traditional resource use systems are breaking down due to lack of finances for other methods, a need for quick returns and desire to access expanding markets (Claridge *et al.* 1997). Factors that hinder adoption of sustainable practices include a focus on aquaculture and cultural reluctance of community members to confront other individuals of inappropriate fishing practices, even if wetland damage is occurring (Claridge *et al.* 1997). Community crocodile conservation may contribute to sustainable wetland use, and in Lao PDR will involve at least three factors: perceived spiritual value of crocodiles and wetlands, current wetland use, and, local socio-economic conditions.

*Spiritual values.* Eight of 17 villages surveyed in 2005 considered crocodiles to be a sacred forest spirit, and in two sites, crocodiles and wetlands were strictly protected under local community regulations (Section 6.3). In such sites, crocodile-related spiritual values may be an important tool for crocodile conservation. Spiritual values vary between communities (many communities hold no cultural value for crocodiles), and a site-specific approach would be required for individual wetland complexes, involving documentation of current attitudes toward crocodiles and mapping of sacred wetlands.

*Wetland resource use.* In 2005, 14 of 15 wetlands where crocodiles were reported to currently occur were subject to varying resource use, particularly fishing. Resource use was prohibited in two of 15 sites due to crocodile-related spiritual beliefs. Assessment of disturbance variables (Section 7.6) indicated that crocodiles may persist in sites utilised by communities, if a fringing cover of bankside vegetation and/or aquatic vegetation in the wetland is retained. This suggests that some regulated wetland use (e.g. fishing) may be balanced with crocodile conservation. The value of community-based wetland regulations has been shown for fish conservation in Lao PDR (Baird 2000; Baird and Flaherty 1999).

*Local socio-economic conditions.* In 17 villages surveyed in 2005, rain-fed rice cultivation and subsistence NTFP collection (including hunting) were the main forms of subsistence. Literacy levels varied between villages and only one village had access to a secondary school. Fifteen of 17 villages had never been exposed to any conservation activities (Section 6.5). These conditions suggest a low current awareness of conservation. Community-based crocodile conservation would need to consider site-specific socio-economic conditions of villages closest to wetlands that support crocodiles, including: community ownership, land allocation and zoning around the wetland, current resource use around the wetland, planned regional developments at/near the wetland, and, appropriate techniques to deliver conservation awareness.

### 8.3 High-Priority Sites Identified in 2005

Conservation of *C. siamensis* in Lao PDR will require at least two approaches: a landscape-level approach for management of a range of permanent and seasonal wetlands utilised by crocodiles, between provinces and possibly national borders (especially with Cambodia); and, protection of documented nesting sites, particularly where successful breeding is occurring. In 2005, surveys and analysis of available national crocodile records (Section 5) identified seven river systems that support sites of high conservation priority (below). Survey priorities for other sites of potential conservation importance for *C. siamensis* are described in Section 8.4.

**(Highest priority)** Xe Pian-Xe Kampho-Xe Kong river systems: Attapeu Province  
2005 surveys confirmed that crocodiles are very rare/extinct in the Xe Pian NPA but that small breeding populations persist in wetlands north of the NPA (Sanamxay District). Unconfirmed records (1996) occur from the Xe Kong and Xe Sou rivers, east of the Xe Pian-Xe Kampho rivers (Davidson *et al.* 1997). Crocodiles are confirmed to occur nearby in Cambodia, in the Xe Kong river (10+, Simpson and Han 2004) and Virachey National Park (J. Daltry pers. comm.), suggesting the occurrence of connected populations between Lao PDR and Cambodia. *Confirmed nesting: Beung Pulone wetlands complex*

**(High priority)** Xe Don river system: Saravan Province

A single nest with eggs was observed in 2004-05, and crocodiles were reported from two districts (Saravan and Khong Xe Don). The extent of wetland complexes along the Xe Don river is unclear but may support other breeding crocodiles. *Confirmed nesting: Nongboua pond and Xe Don river*

**(Medium priority)** Xe Bangfai river system: Savannakhet Province

A single nesting crocodile is confirmed in one wetland and small numbers of crocodiles are reported (Xaibouli District). The extent of wetland complexes along the Xe Bangfai river is unclear but may support other breeding crocodiles. *Confirmed nesting: Boua Thong lake (and potentially Beung Saiyan lake)*

**(High priority)** Xe Banghiang river system: Savannakhet Province

The lower reaches of this river are close to confirmed crocodile locations along the Xe Champhone river (below), and records reported since the 1960s suggest crocodiles persist. Nesting was reported in the upper reaches in the 1960s (J. Johnston pers. comm.) and a crocodile was killed in an upstream tributary (Xe Lanong river) in 2004. Four of six communities interviewed in 2005 (Nong District) had never seen crocodiles, suggesting surveys should target the lower reaches. *Confirmed nesting: unknown*

**(Highest priority)** Xe Champhone river system: Savannakhet Province

At least one small confirmed breeding population occurs along this river and others are reported (Atsaphone and Champhone Districts). Many additional, unsurveyed wetland complexes occur along this river that may support crocodiles. This is among the most important river systems for crocodile conservation in Lao PDR. *Confirmed nesting: Kout Mark Peo wetlands complex*

Surveys in 2005 confirmed the occurrence of crocodiles at six sites within the above river systems. Key threats and priority follow-up actions for five sites are presented in Table 18. The sixth site where crocodiles were confirmed, the Xe Lanong river (an upper tributary of the Xe Banghiang river, above) is not included because the species now appears to be very rare in this system.

**Table 18: Threats and Suggested Management Actions at Five Confirmed *Crocodylus Siamensis* Nesting Sites in Lao PDR**

Site	Threats to Crocodiles in 2005	Potential Management Actions	Regional Programs
Attapeu Province Beung Pulone wetland complex (Xe Phan river system, Sanamkay District)	<ul style="list-style-type: none"> <li>Intensive farming/grazing of nesting habitat;</li> <li>frequent burning of forests around wetlands;</li> <li>construction/operation of new electricity assessment next to Beung Ke wetland (habitat loss: new road access)</li> </ul>	<ul style="list-style-type: none"> <li>initiate EIA/EMP for assessment construction/operation;</li> <li>designate community no-burn zones to reduce/halt burning of forests around wetlands;</li> <li>identify and map crocodile nesting sites;</li> <li>designate seasonal restricted-access zones to avoid fishing disturbance of nesting areas (Nov-April);</li> <li>incorporate crocodile conservation measures with existing community wetland regulations;</li> <li>develop community conservation agreements to prohibit crocodile collection/sale (site conservation may involve at least 4 nearby villages: Pindang, Ban Mai, Hinlath, Samong, Thak);</li> <li>maintain awareness of district enforcement staff raised in 2005 about crocodile values;</li> <li>develop and implement a DAFO monitoring/reporting system for crocodile sightings;</li> <li>assess whether on-going crocodile conservation may be assisted through the MWBF pilot project</li> </ul>	1.2.3
Savannakhet Province Nong Boua porn/Xe Don river (Xe Don river system, Saravan District)	<ul style="list-style-type: none"> <li>80 m from a logging access road;</li> <li>noise/visual disturbance to nesting females;</li> <li>human disturbance of nesting females or nests;</li> <li>site partly protected by community regulations- resource use is prohibited.</li> </ul>	<ul style="list-style-type: none"> <li>develop management guidelines for nearby logging company not to access wetland;</li> <li>maintain awareness of enforcement staff raised in 2005 about crocodile values, monitoring and reporting of any capture/sale of crocodiles</li> <li>assess potential for crocodile-related ecotourism, with direct benefits toward Nongboua village</li> </ul>	Unknown
Savannakhet Prov Kout Mark Poo wetland complex (Xe Champhone river system, Champhone District)	<ul style="list-style-type: none"> <li>clearance and burning of surrounding forest;</li> <li>weed invasion of wetland;</li> <li>increasing exposure of crocodile nesting areas to human disturbance, fire and weed invasion;</li> <li>construction of drainage channels to nearby rice fields.</li> </ul>	<ul style="list-style-type: none"> <li>immediate halt to forest clearance is critical (this will also reduce subsequent impacts of fire and weed invasion);</li> <li>designate KMP lake as a community-protected site;</li> <li>assess value of designating site as a Provincial Protected Area;</li> <li>conduct village land zoning for resource use near KMP;</li> <li>develop site-specific community resource regulations for KMP wetlands complex (site conservation may involve at least 2 nearby villages: Tamoum and Laoneth);</li> <li>identify alternative fuelwood collection sites, to halt cutting of fire timber;</li> <li>maintain awareness of enforcement staff raised in 2005 about crocodile values;</li> <li>incorporate KMP wetlands in DAFO patrol routes to ensure monitoring of crocodile status;</li> <li>consider long term weed management (removal of <i>Mimosa pigra</i> and <i>Eichhornia</i> sp.);</li> <li>assess potential for crocodile-related ecotourism, with direct benefits toward local communities</li> </ul>	Unknown
Savannakhet Prov Boua Thong wetland complex (Xe Banglai river system, Xaibouli District)	<ul style="list-style-type: none"> <li>site visited daily by many people;</li> <li>reasons for lack of unsuccessful breeding unclear but may be due to low crocodile numbers;</li> <li>nesting habitat absent in 1 wetland (B. Hor lakel);</li> <li>other threats unclear</li> </ul>	<ul style="list-style-type: none"> <li>wetland complex under community protection and most resource use prohibited;</li> <li>further assessment of wetland complex required (location of other wetlands and extent of crocodile numbers);</li> <li>assess potential for crocodile-related ecotourism, with direct benefits toward local communities</li> </ul>	Unknown

1-MWBF (Attapeu Province is project pilot site); 2-CEFF (Upper Xe Kaman is identified as a priority site for CEFF funding, CEFF 2004); 3-WWF "Forest Management in Attapeu Province: Xe Khamphou Component" (in preparation, 2005)

## 8.4 New Status Surveys

Unsurveyed wetlands of potential importance for *C. siamensis* conservation were identified from assessment of reliability, distribution, habitat and date of 122 national crocodile records. The following sites were excluded: sites surveyed in 2003-05; sites where other scientists had clearly reported that crocodiles were extinct/very rare (Dong Kanthung NPA); and, sites with only single or historical records ( $\leq 1979$ ) and which appeared to be toward the historic limits of range (records from Bholikhamxay, Luang Namtha and Khammouane Provinces and Vientiane Municipality, and extreme east of Savannakhet Province). Status surveys are recommended in four provinces (Attapeu, Champasak, Saravan and Savannakhet) (Table 19).

**Table 19:** Locations and Priorities for Further Status Surveys of *Crocodylus Siamensis* in Lao PDR

Province	District(S)	River System	Records	Survey Site And Justification	Survey Priority
Attapeu	Hadxaifong, Sanamxay	Xe Pian-Xe Kampho rivers	4	Bung Nong Ngom and Houay Soymong wetlands. Confirmed breeding in region (2005); local reports (1990s)	High
Attapeu	Sanxai	Xe Kong-Xe Kaman	2	Dong Amphan NPA and Nam Ghong PPA. Local reports (1996); crocs confirmed in Xe Kong river and Virachey NP (Cambodia); potential transborder populations	High
Champasak	Khong	Mekong River	1	Seephandon wetlands. Local reports (1990s); extensive wetland habitats; crocs historically abundant	Medium
Champasak	Phathoom-phone	Houay Thouay	1	Dong Hua Sao NPA. Local reports (1990s); crocs historically abundant	Medium
Champasak	Sanasomboon	Mekong River	1	Phou Xiang Thong NPA. Local reports (1990s); crocs historically abundant	Medium
Champasak	Sukuma	Houay Khammouane	1	Houay Khammouane, Houay Khala and nearby tributaries. Local reports (1990s); crocs historically abundant	Medium
Saravan	Khong Xe Don	Xe Don	3	Thouang stream and nearby wetlands. Local reports (2004); breeding status unclear	Medium
Saravan	Xe Bang Nouan, Lakhonepheng	Xe Bang Nouan	4	Xe Bang Nouan NPA. Local reports (1993-4)	Medium
Savannakhet	Champhone	Xe Banghiang	2	Nong Louang wetlands. Local reports (1990s, 2003); near confirmed breeding sites in Xe Champhone river system	High
Savannakhet	Atsaphone, Champhone	Xe Champhone	2	Wetlands near confluence with Xe Xangxoy; upper reaches near Nathom village. Confirmed breeding in one area (2005); juvenile seen (1998); other reports (2004)	Highest
Savannakhet	Champhone	Xe Xangxoy	2	Wetlands near confluence with Xe Champhone. Local reports (2003); near 2005 confirmed breeding site	High

The “highest” priority site for status surveys is the Xe Champhone river system in Savannakhet Province. Surveys from 2003-05 confirmed the presence of one small breeding population in a single lake (Kout Mark Peo) in Champhone District. Many unsurveyed wetland complexes exist along the lower and upper reaches of this river, which may potentially support crocodiles. The sighting of a juvenile crocodile in 1998 (Mateus 2001) indicates breeding may still be occurring in the upper reaches.

## 8.5 Reintroduction

Reintroduction has been considered in some countries as a potential method for conservation of *C. siamensis*. It has been conducted in Viet Nam (Polet 2004), is being planned in Thailand (IUCN-CSG Working Group unpublished minutes 2004; Temsiripong 2001) and has been suggested for some sites in Cambodia (Jelden *et al.* 2005). Many *C. siamensis* exist in farms in Thailand, Cambodia and Viet Nam, and are a significant resource for potential reintroduction efforts (Ross 1998). In Lao PDR, a potential reintroduction source of *C. siamensis* is the Ban Kuen Zoo in Vientiane, which houses the only known large captive collection of *C. siamensis* in Lao PDR (Phothitay *et al.* 2005; Thorbjarnarson 2003).

Any reintroduction program in Lao PDR would need to consider the following:

- Is reintroduction really needed, or should conservation efforts first focus on protecting the remaining crocodiles and their habitats?
- Are the crocodiles to be introduced 100% genetically “pure” *C. siamensis* or are they hybrids with other species? Genetic testing would be essential to confirm that only distinct *C. siamensis*, not hybrids, are used.
- How do local communities feel about reintroduction? Are crocodiles protected by community beliefs at the site? It is possible that in some sites, introduced crocodiles would be caught and sold for the skin trade.
- Is there enough financial and technical support to monitor the status of crocodiles that have been reintroduced? Any reintroduction program would need to include monitoring of the individual crocodiles, to assess the success and any problems of the project.
- Adherence to IUCN reintroduction guidelines, particularly the need to ensure that health animals (with no diseases or parasites) are released into the wild (IUCN 1995).

At the current time, reintroduction of *C. siamensis* is not recommended for crocodile conservation in Lao PDR. This is because crocodile surveys have confirmed that Lao PDR still supports globally important crocodile populations. Current conservation efforts should focus on maintaining these existing populations.

## 8.6 Capacity and Awareness-Raising in 2005

One objective of 2005 surveys was to introduce crocodile survey techniques to government counterparts, and raise public awareness of *C. siamensis*. The following were achieved from March-June 2005.

Capacity building. Project planning, selection of survey sites, fieldwork and reporting were conducted in cooperation with LARReC (Ministry of Agriculture and Forestry), provincial and district forestry divisions (PAFO, DAFO). Surveys were conducted in six districts of three provinces, and a total of 10 forestry officials (PAFO/DAFO) accompanied surveys. Informal field training was provided in spotlight and transect survey techniques, habitat measurements and use of datasheets. Information on crocodile conservation and threats were explained during surveys and meetings with national counterparts. A field data sheet for spotlight surveys was translated to Lao language (Appendix 1). Three LARReC officials (Mr. C. Phothitay, Mr. S. Chanrya and Mr. Somphanith) received WCS field training during crocodile surveys in 2003 and 2005 (Thorbjarnarson 2003), and in 2004, undertook independent crocodile surveys. Four progress reports describing key findings of 2005 field surveys and suggestions for follow-up work, were translated to Lao language and submitted to relevant national, provincial and district forestry offices.

Public awareness. Popular-press articles describing the 2005 survey results were prepared by WCS, MWBP and LARReC and published in:

- IUCN *Asia Newsletter* (May 2005: 7-8);
- IUCN International *Species Newsletter* (Bezuijen and Phothitay in press June 2005);
- IUCN *Crocodile Specialist Group Newsletter* – two articles (Phothitay *et al.* 2005; Bezuijen and Phothitay in press June 2005);
- Vientiane Times Newspaper (Lao PDR) (May 26, Issue 99) (cover article); and,
- a MWBP media release of 2005 surveys was published in Asia (six regional newspapers), the USA (38 state and local newspapers), South Africa (one newspaper), Canada (one newspaper) and the UK (two newspapers).

*NGO co-operation.* Informal discussions were held with World Wildlife Fund (Lao and Cambodia branches) concerning *C. siamensis* conservation in Lao PDR and Cambodia, and technical input was provided for the crocodile component of the draft (2005) “*Biological Assessment of the Lower Mekong Dry Forests Ecoregion*” being prepared by WWF. The Fauna and Flora International–Cambodia Programme provided information and technical reports about FFI crocodile conservation efforts in Cambodia, and was regularly updated about progress of the 2005 Lao PDR surveys.

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# Appendix 1: 2005 Field Survey Forms

## Crocodile Survey (Day-Time)

COUNTRY:		SURVEY TEAM (names):
PROVINCE:		
DISTRICT:		
RIVER SYSTEM:		
SITE:		
GPS location:		
DATE:		

## Daytime Search Results

Type of sign*	GPS location (N/E)	Dist. from waterbody (m)	Size**	Notes

\*choose: Trail (includes tracks, haul-out points) / Dung / Nest / Crocodile / Other (describe)

\*\*if dung, measure length x width (cm)

SEARCH AREA		SEARCH EFFORT	
Length (1) (m) =		Start time	
Width (1) (m) =		Finish time	
Length (2) (m) =		No. people (if searching different areas)	
Width (2) (m) =		Total person-hours:	





**ແບບຟອມການເກັບກຳຂໍ້ມູນຈຸດສຳຄັນທີ່ມີແຂ້ອາໄສຢູ່ (ຕອນກາງຄືນ)**

ປະເທດ:		ວັນທີ:	
ແຂວງ:		ເວລາເລີ່ມ:	
		ເວລາສິ້ນສຸດ:	
ເມືອງ:		ໄລຍະທາງທັງໝົດ (ກມ):	
ແມ່ນ້ຳ:		ສະຖານທີ່ເລີ່ມຕົ້ນ	
ຜູ້ສຳຫລວດ:		1. ຈີພີເອັດ (GPS):	
ໂຊເພີລິດ:		2. ໄລຍະທ່າງແຕ່ປາກນ້ຳ (ກມ):	
ຜູ້ນຳທາງໃນການສຳຫລວດ:		3. ລາຍລະອຽດ:	
ວິທີການ (ຂີດວົງມົນອ້ອມ):	ເຮືອພາຍ/ ເຮືອໄວ ແລະ ແຮງມ້າຂອງເຄື່ອງຈັກ: 6 / 15 / 40	ສະຖານທີ່ສິ້ນສຸດ 1. ຈີພີເອັດ (GPS):	
ອຸປະກອນ (ຂີດວົງມົນອ້ອມ):	ໄຟສາຍ / Spotlight	2. ໄລຍະທ່າງແຕ່ປາກນ້ຳ (ກມ) :	
		3. ລາຍລະອຽດ:	

ເງື່ອນໄຂໃນການສຳຫລວດ	(ຂີດວົງມົນອ້ອມ)
ການປົກຫຸ້ມຂອງເມກ, ເຜືອ	1/4 (=ບໍ່ມີເມກ ຫລື ເຜືອປົກຄຸມ) 2/4 3/4 4/4 (=ມີເມກ ຫລື ເຜືອປົກຄຸມ)
ຝົນຕົກ	ບໍ່ມີ ຄ່ອຍ ປານກາງ ໜັກ
ດວງເດືອນ	ບໍ່ມີ ເຕັມດວງ >ເຄິ່ງດວງ
ກະແສນ້ຳ	ສູງ ຕ່ຳ ບໍ່ມີອິດທິພົນຈາກກະແສນ້ຳ
ຖ້າວ່າບໍ່ມີອິດທິພົນຈາກກະແສນ້ຳ	ລະດັບຂອງກະແສນ້ຳສູງ ລະດັບຂອງກະແສນ້ຳຕ່ຳ ລະດັບຂອງກະແສນ້ຳປານກາງ

ໄລຍະທ່າງແຕ່ປາກນ້ຳ (ກມ)	ຈຸດຕັດກັນ (ແຜນທີ່/ຈຸດ GPS)	ຊະນິດພັນ (ES=ແສງຕາ)	ຂະໜາດ (ຟຸດ)	ເວລາ	ບັນທຶກ (ຕົວຢ່າງ: ຖິ່ນທີ່ຢູ່ອາໄສ)



11. Notes

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## Waterbody And Resource Use Data Form

SITE:		SURVEY TEAM (names):
GPS location:		
DATE:		

Waterbody (circle): natural / artificial (earth) / artificial (dam). Duration (circle): permanent / seasonal

Wetland classification(Claridge1996):

Nearest village: Under land ownership of (list village):

### 1. Wetland structure and vegetation cover *on top of water surface*

Perimeter (m):	% Open water:	%cover groundlayer:	NTFPs harvested in wetland:
Length (m):	%cover <i>Eichhornia</i> weed:	%cover canopy:	
Width (m):	% <i>Mimosa</i> within 50 m of bank:	height groundlayer (m):	
Depth (m):	Substrate (circle): mud / sand / gravel	height tree canopy (m):	

### 2. Bankside habitat and landuse within 50 m of waterbody

Category	%cover (must add up to 100%)	Canopy height (m)	%understory cover (over area of natural vegetation)	Notes (eg NTFPs harvested)
Forest			(single overall value for 50 m around waterbody):	
Woodland				
Savannah				
Shrubland				
Cleared land/road				
Irrigated Rice (channels from swamp)				
Rain-fed Rice				

### 3. Resource use at wetland

Fish traps? Y / N	Hooks? Y / N	Nets? Y / N	Fishing for: Subsistence <b>and/or</b> Local trade <b>and/or</b> External trade
Fishing months (list):		No. households fishing at wetland:	Wildlife hunting (circle): Subsistence <b>and/or</b> Local trade <b>and/or</b> External trade

Timber logging w/in 50 m of waterbody: Subsistence and/or Local trade and/or External trade		Fuelwood collection w/in 50 m of waterbody: Yes / No		
Waterbody is watersource for cattle? Y / N	No. village buffalo:	No. village cows:	%area grazed by domestic cattle:	Cattle access to waterbody restricted in any months? (list):
No. seasonal huts at waterbody:	No. permanent homes at waterbody:	%cover w/in 50 m of waterbody burnt in last 2 yrs = %		Fire used to clear land for agri/other purposes? Y / N

5. List any village resource regulations for wetland:

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6. General habitat description/notes:

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7. Variables recorded on "waterbody and resource use" form

*Waterbody permanence* (seasonal/permanent), *type* (natural/artificial) and *structure*:

Perimeter, length and width of discrete waterbodies (lakes, ponds) were measured with GPS by walking around the waterbody. Along rivers, the specific length and section of river that was visited was measured, by GPS or topographic map. Waterbody depth: recorded in the centre of the waterbody or midstream, with a graduated pole.

Vegetation cover in the wetland:

(a) %open water surface, percent of cover groundlayer, percent of cover canopy (adding to 100%, visual estimate, minimum 10% increments);

(b) height of groundlayer and tree/shrub canopy (m) (visual estimate)

Weed invasion in the wetland:

(a) percent cover *Eichhornia* weed within the waterbody;

(b) percent cover *Mimosa pigra* within 50 m around the waterbody (visual estimates, 10% increments).

*Perimeter habitat and landuse within 50 m around the waterbody:* Entire perimeter within 50 m radius of waterbody is walked or, at least five points perpendicular to the waterbody (up to 50 m from waterbody) are visited. All categories below are given a value (visual estimate, 10% increments). Natural vegetation categories modified from Claridge (1996).

*(a) Natural vegetation categories*

Forest:	Tree cover with crowns generally touching. Canopy >80% of cover
Woodland:	Tree cover with crowns not touching. Canopy 30-79% of cover
Savannah:	Tree cover where trees are scattered. Canopy <30% cover
Shrubland:	Vegetation consisting primarily of woody vegetation with multiple stems
Bare land/roads:	Defined in this project as entirely cleared/burnt land or roads and paths
Irrigated Rice:	On Floodplain or Backswamp/Marsh, channels constructed from waterbody
Rain-fed Rice:	On Floodplain or Backswamp/Marsh

All categories add to 100%. The "dominant" habitat was any single category which occupied  $\geq 50\%$  of total cover, or else the overall habitat was regarded as "mixed".

*(b) Understorey cover.* The percent cover of non-agricultural understorey cover within 50 m of the waterbody was recorded (visual estimate, 10% increments). %understorey cover for any "forest", "woodland", "savannah" or "shrubland" categories within the 50 m transect were summed and divided to derive a single overall value.

*(c) Mean canopy height (m).* Visual estimate of canopy height within 50 m of waterbody. In each transect, canopy heights of all vegetation categories present were summed and divided, to derive a single overall canopy height value for each transect.

*Burning within 50 m of the waterbody.* (a) Local guide was asked – 'Is fire used to clear the land for agricultural or other purposes? Yes / No'. (b) percent cover within 50 m radius of waterbody that has been burnt within previous 2 years. Age of fire scars/burns was obtained from local guides (visual estimate, 10% increments).

*Local resource use at waterbody.* A series of simple questions about fishing, wildlife hunting, timber logging and number of village livestock was asked of local guides that accompanied surveys (see survey form). For *wildlife hunting* and *timber logging*: "local trade" = hunting conducted by local residents for sale within village or to nearby villages; "external trade" = hunting conducted by non-residents from other villages/districts or, hunting conducted by residents in order to supply an organised commercial trade with district/provincial/regional traders.

*Traditional resource regulations.* Local guides or village head was asked: "are there village rules for traditional use of the waterbody?" If further clarification was needed, examples were given such as 'are there fishing and non-fishing areas?'

## Socio-Economic and Interview Form

COUNTRY:		Name of interviewer:
PROVINCE:		
DISTRICT:		
VILLAGE:		Name of person interviewed:
GPS LOCATION:		
DATE OF VISIT:		
Nearest wetland site:		

No. houses:		Primary school?	Yes / No
No. families:		Secondary school?	Yes / No
Total population:		Medical clinic?	Yes / No
Ethnic group:		Road access?	Yes / No
Year of settlement:		Grid electricity?	Yes / No
Water source:	natural / dam / well	Land allocation?	Yes / No
How many residents can read?		Village land use map?	Yes / No

Wildlife hunting:	Subsistence <b>and/or</b> Local trade <b>and/or</b> External trade <b>(circle)</b>
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Are there village rules and/or traditional use of waterbody? Yes / No

If yes, describe. Write name of waterbody

Any current village assistance programs? Y / N If Yes, describe: When? Who? What?	Any previous village assistance programs? Y/N If Yes, describe: When? Who? What?
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Current regional development near village?

Eg roads, dams, pipelines, etc

When?

Who?

What?

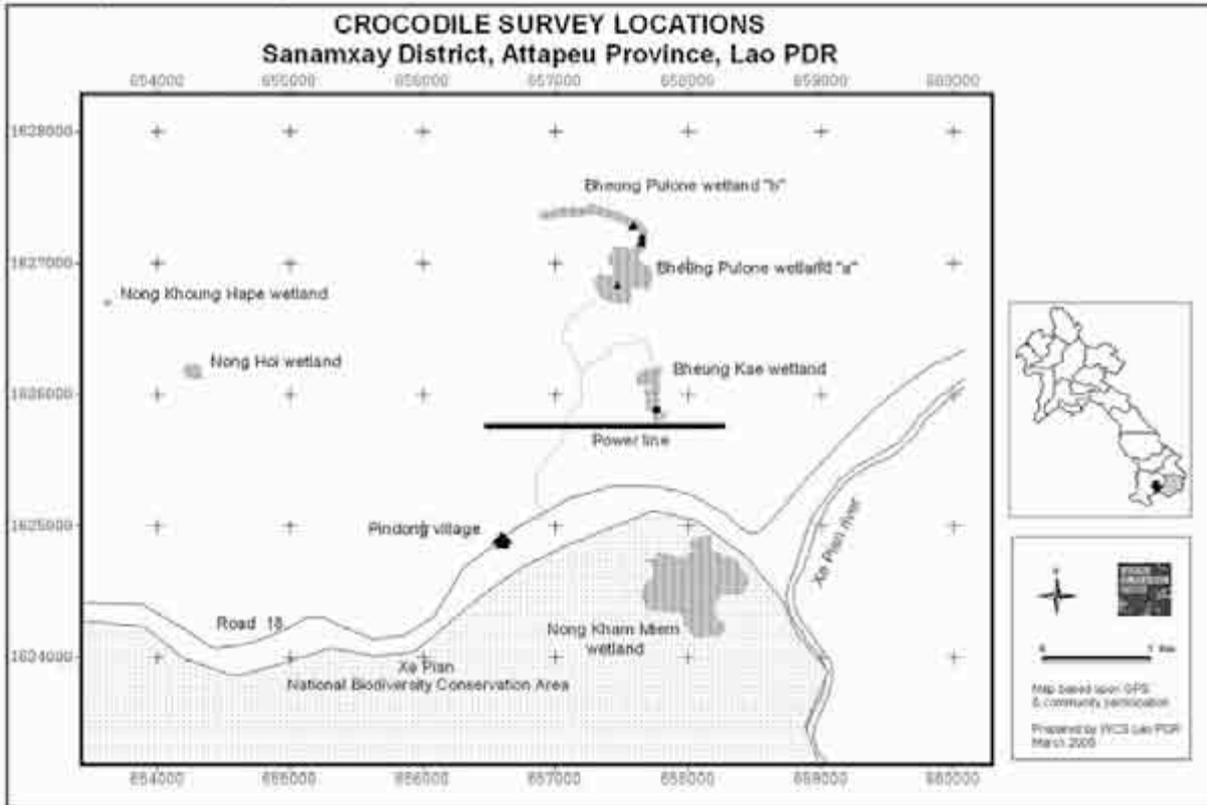
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**NOTES** (eg any nearby protected areas?)

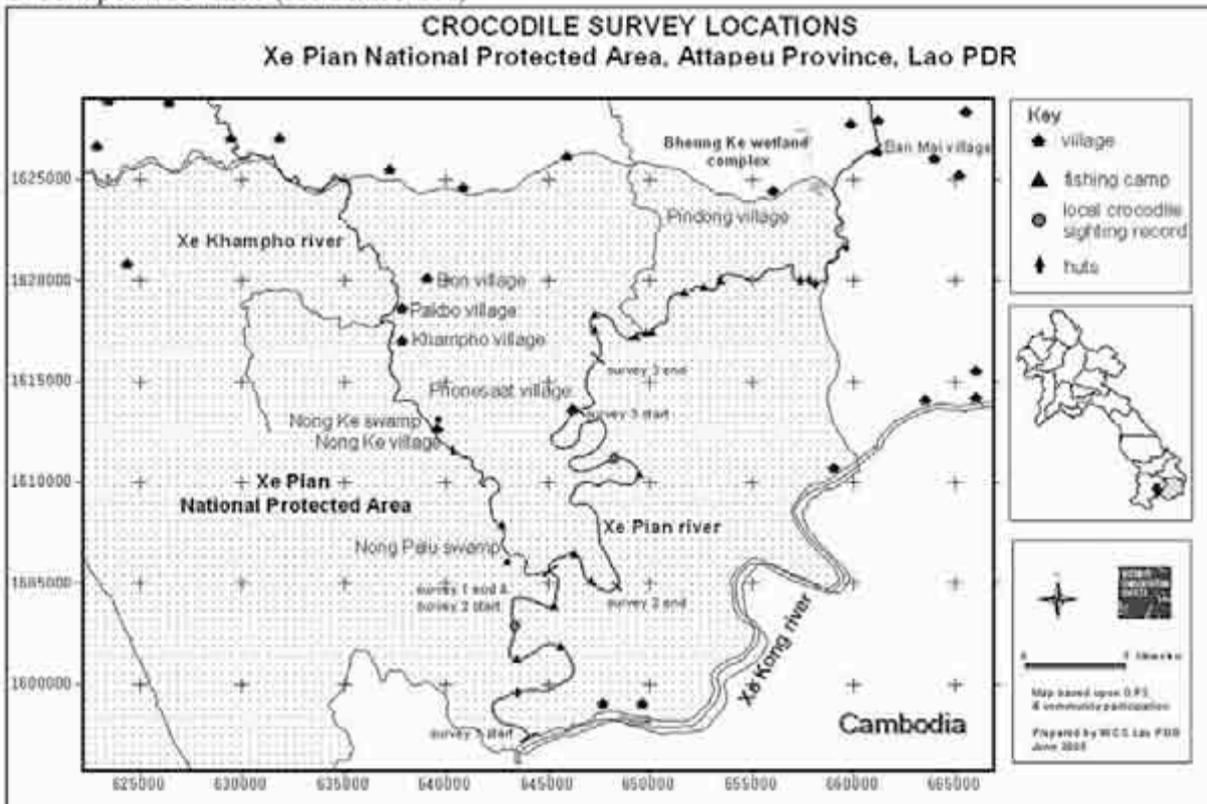
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# Appendix 2: Maps of 2005 Wetland Survey Sites

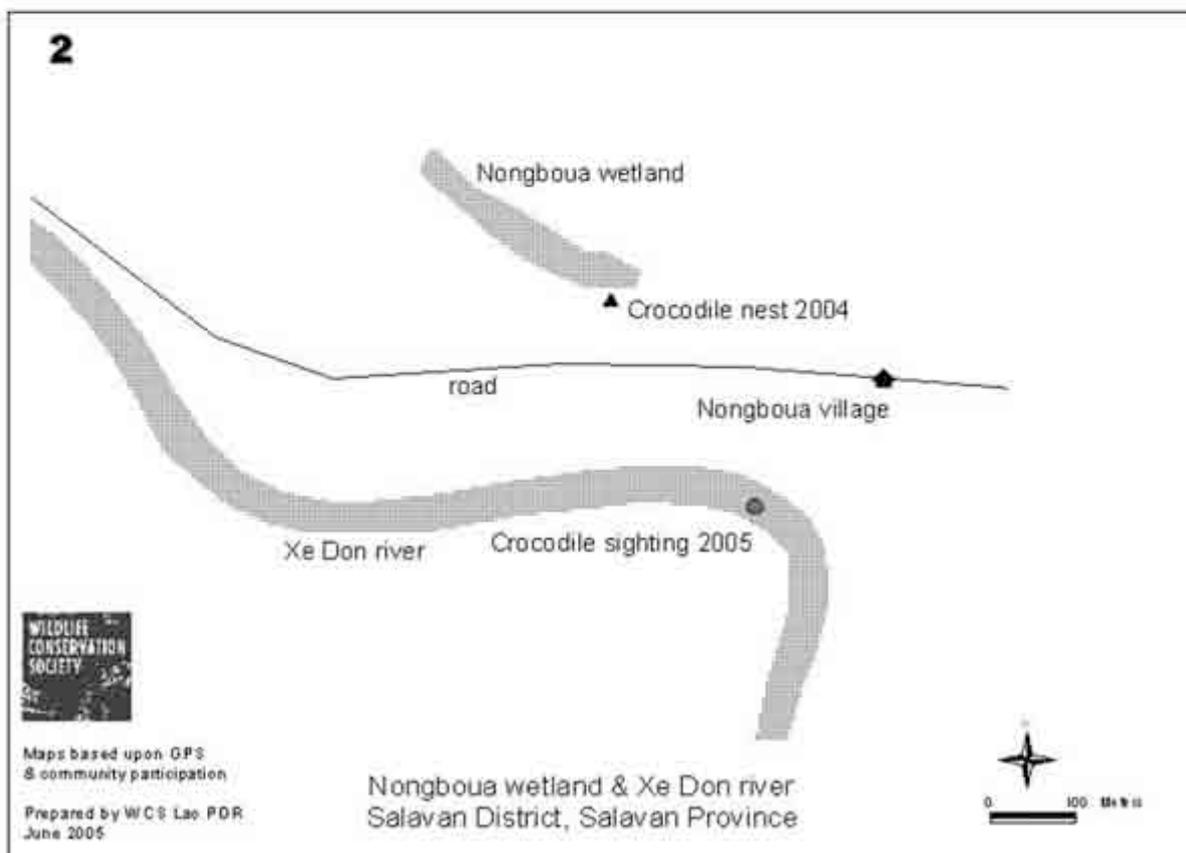
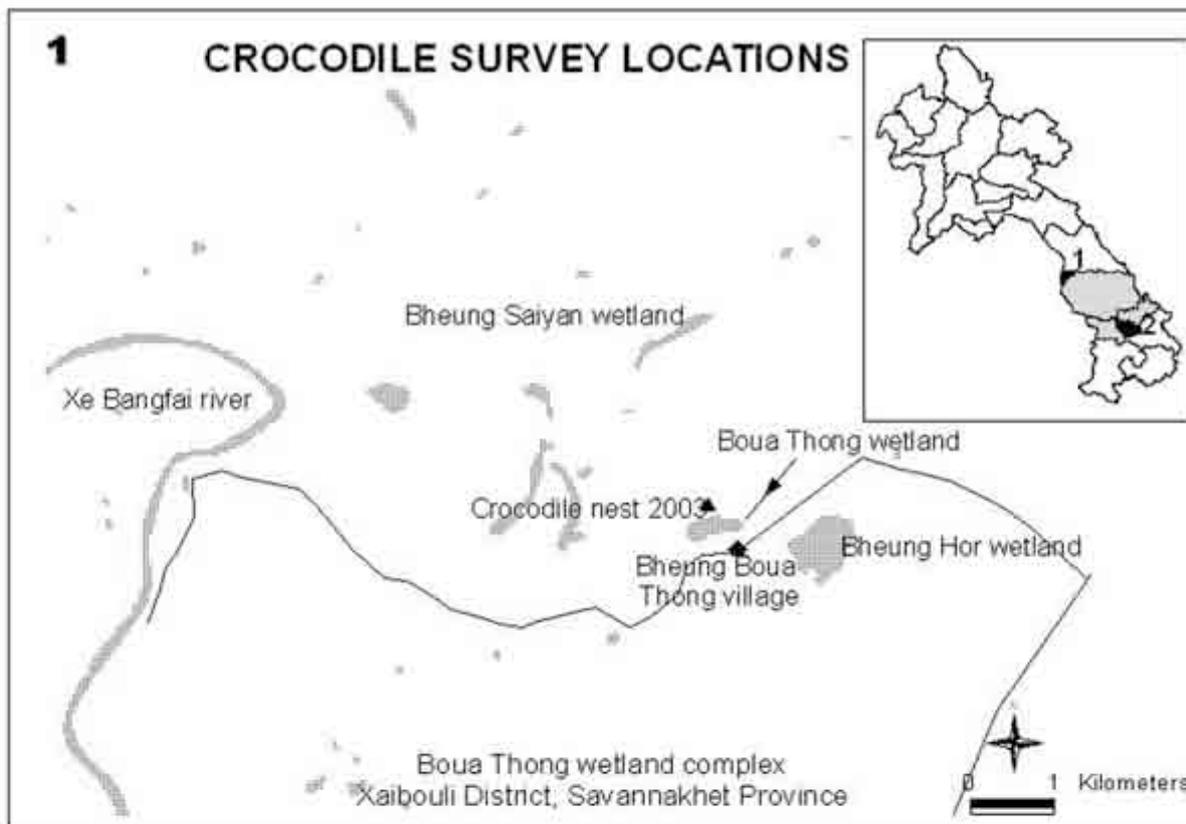
## 1. Attapeu Province (Sanamxay District)



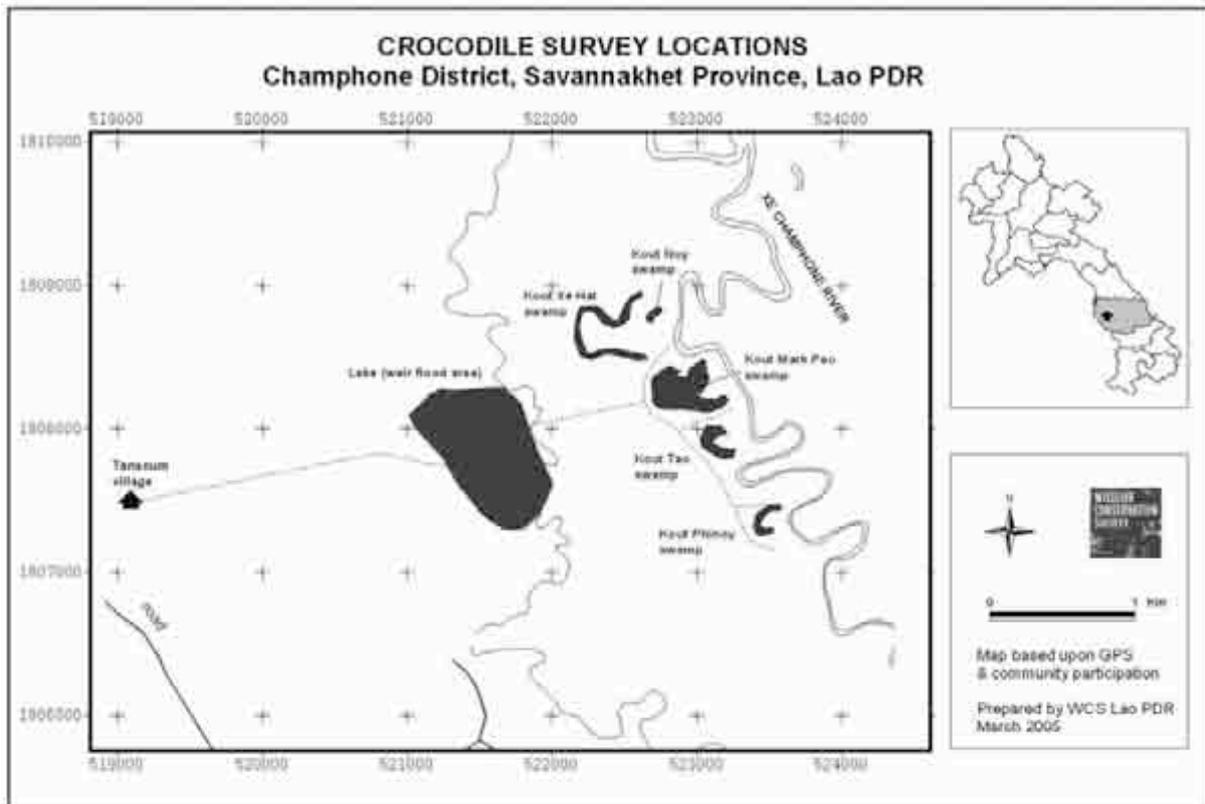
## 2. Attapeu Province (Xe Pian NPA)



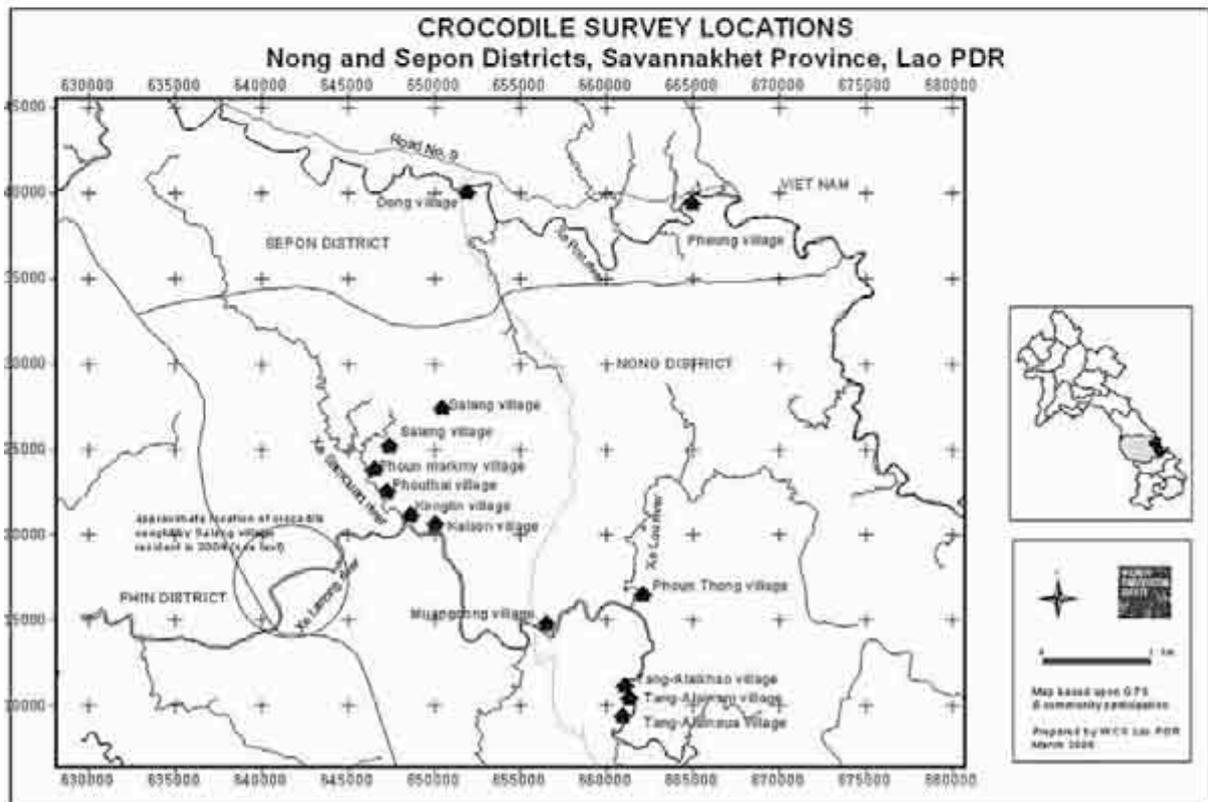
3. Saravan and Savannakhet Provinces (Saravan and Nong Districts)



4. Savannakhet Province (Champhone District)



5. Savannakhet Province (Nong District)



# Appendix 3: 2005 Crocodile Survey Data

J. Crocodile spotlight survey data March-June 2005, Lao PDR. UTM coordinates recorded with a Garmin eTrex Vista GPS.

Prov	District	Site	Survey ID	Survey Date	Method	Start (h:m)	Morning start	Ending start	Finish (km)	Northing finish	Easting finish	Km	No. crocs	Density (no./km)	Spot. tag	Start time	Finish time	Survey hours	DC	Moan	Rain	Water level	Survey conditions
Att	Saravay	Beung Ke lake	N6	5-Apr-05	Walk	n/a	05:56:18	16:25:50	n/a	058624	162557	0.48	0	0	EA/SL	1900	2000	1	3	1	1	Low	Poor
Att	Saravay	Beung Pholone lake	N7	7-Apr-05	Walk	n/a	05:30:09	18:28:46	n/a	n/a	n/a	0.1	0	0	BA/SL	1830	1930	1	2	1	1	Low	Poor
Att	Saravay	Xe Pian river (Xe Pian NPA)	N8	1-Jun-05	Boat	0	04:43:75	15:09:30	18	645432	1635218	18	0	0	EA/BO	1900	2200	3	4	1	1	Low	Good
Att	Saravay	Xe Pian river (Xe Pian NPA)	N9	3-Jun-05	Boat	18	04:54:32	16:05:18	23	648850	1604509	5	0	0	PE	2000	2200	2	3	1	1	Low	Good
Att	Saravay	Xe Pian river (Xe Pian NPA)	N10	4-Jun-05	Boat	45.5	04:47:19	16:13:73	48.8	647319	1615628	5.3	0	0	PE/BA	2000	2045	0.75	1	1	1	Low	Good
Sav	Saravay	Xe Don river	N11	28-May-05	Walk	n/a	06:54:11	17:53:56	n/a	665411	1733256	0.3	2	6.7	MB	1730	2130	1	1	1	1	Low	Good
Sav	Champone	Chao dam	N1	13-Mar-05	Canoe	n/a	52:742	18:07:33	n/a	522742	1807733	2	0	0	MB/CP	1830	2000	3	1	2	1	Medium	Medium
Sav	Champone	Kout Mark Peo lake	N2	13-Mar-05	Walk	n/a	52:597	18:07:30	n/a	523597	1807930	0.01	4	400	MB/CP	2200	2230	0.5	2	2	1	Low	Poor
Sav	Champone	Kout Mark Peo lake	N3	14-Mar-05	Walk	n/a	52:597	18:07:30	n/a	523597	1807930	0.01	7	700	MB/CP	1845	2000	1.25	1	2	1	Low	Poor
Sav	Champone	Kout Mark Peo lake	N4	15-Mar-05	Walk	n/a	52:597	18:07:30	n/a	523597	1807930	0.01	4	400	MB/CP	1830	2100	1.5	1	3	1	Low	Poor
Sav	Xaibouli	Boua Thong lake	N5	17-Mar-05	Walk	n/a	44:243	18:77:37	n/a	448743	1877737	0.88	1	0.08	MB/CP	1900	1930	0.5	1	3	1	Low	Good

**KEY:** Provinces: Att-Attapeu; Sar-Saravay; Sav-Savannakhet; **SurveyID** - link to national database (see methods); **Start/Finish (km)** - distance upstream from river mouth; **Km** - distance surveyed; **Spotters:** BA-Banlith (DAPOL); BO-Boorithay; MB-Mark Beungthay; PE-Perigum (PAPOL); SL-Sisouat (PAPOL); **Weather:** CP-Cloud cover (scale of 1-4, 1=100% cloud cover)

2. Crocodile day transect survey data March-June 2005

Prov	District	Site	Survey ID	Date	Northing start	Easting start	Northing finish	Easting finish	Transect (km)	Survey area(ha)	Croc signs	Signs	Density (signs/km)	Person-hours	Density*	Start time	Finish time	Total hours	People searching	Water level	%cover in search area
Att	Saenay	Beang Fulone lake	D3	2-Apr-05	658209	1626546	as start	as start	0.12	0.1	2	Dung	17	0.5	33.33	1500	1530	0.5	1	Low	90
Att	Saenay	Beang Fulone lake	D4	3-Apr-05	658309	1626546	as start	as start	1.5	0.8	0	None	0	0	0.00	0915	1000	0.75	6	Low	100
Att	Saenay	Beang Fulone lake	D5	3-Apr-05	658427	1627008	as start	as start	0.785	1.3	8	Dung	8	45.8	0.17	1100	1145	0.75	2	Low	10
Att	Saenay	Beang Fulone lake	D6	3-Apr-05	658427	1627008	as start	as start	0.952	0.2	0	None	0	0.5	0.00	1200	1230	0.5	1	Low	100
Att	Saenay	Nong Hin pond	D7	4-Apr-05	655185	1625870	as start	as start	0.136	1.6	0	None	0	0	0.00	1040	1058	0.25	6	Low	90
Att	Saenay	Nong Khoeng Hippo lake	D8	4-Apr-05	654435	1626472	as start	as start	0.175	0.1	0	None	0	0.5	0.00	1425	1438	0.2	4	Low	40
Att	Saenay	Beang Ka lake	D9	5-Apr-05	659464	1625807	as start	as start	1.345	0.3	0	None	0	0	0.00	1610	1700	0.8	2	Low	100
Att	Saenay	Nong Kham Miam lake	D10	6-Apr-05	658675	1624275	658656	1624233	0.103	0.2	0	None	0	0.0	0.00	1430	1436	0.1	5	None	50
Att	Saenay	Nong Kham Miam lake	D11	6-Apr-05	658638	1624123	658818	1624065	0.192	0.4	0	None	0	0.0	0.00	1440	1445	0.1	5	None	50
Att	Saenay	Nong Ka pond	D12	3-Jun-05	639638	1612639	as start	as start	0.27	0.1	0	None	0	0.0	0.00	1100	1120	0.3	1	Low	0
Att	Saenay	Nong Pahu lake	D13	3-Jun-05	643413	1605789	as start	as start	0.598	0.3	0	None	0	0.0	0.00	1500	1520	0.3	5	Low	10
Siv	Champasak	Kout Mark Poo lake	D1	12-Mar-05	523558	1807889	523568	1807889	0.25	0.4	6	Dung, Trail	24	1.75	13.71	1000	1148	1.75	8	Low	100
Siv	Champasak	Kout Mark Poo wetland	D2	15-Mar-05	523558	1807889	523568	1807889	0.1	0.1	4	Dung	40	1	40.00	0900	1000	1	3	Low	100

KEY: Survey ID-link to national database (see methods); \*Density of signs/total person-hours search effort.

## Appendix 4: 2005 Interview Data

No.	Province	District	Wetland	Village	Ethnic Group	Date	Interviewees (all males)	Age	Prof	Crocodiles seen by interviewee	Described correctly?	Occurred at site?	Last sighting	No. years ago of last sighting*	Last nest seen	Nesting season
1	Atapea	Sasamory	Nong Hai pond	Frandong	Sou	4-Apr-05	Vyven	35	1	Yes	Yes	Never	0	Never	0	
2	Atapea	Sasamory	Nong Khum Mien lake	Ban Samang-Thai	Sou	6-Apr-05	Hanth	40	1	Yes	Yes	2002	3	Never	0	
3	Atapea	Sasamory	Boung Pulonee lake	Frandong	Sou	2-Apr-05	Vyven, Ban	46	1	Yes	Yes	2001	4	Never	1	
4	Atapea	Sasamory	Boung Pulonee lake	Ban Brilath	Sou	3-Apr-05	Das	45	1	Yes	Yes	2004	1	Never	0	
5	Atapea	Sasamory	Boung Xe lake	Frandong	Sou	2-Apr-05	Vyven, Ban	46	1	Yes	Yes	Feb-05	0.5	Never	0	
6	Atapea	Sasamory	Boung Xe lake	Frandong	Sou	4-Apr-05	Phin	40	1	Yes	Yes	Jun-80	19	Jun-80	1	
7	Atapea	Sasamory	M. Khoung Hap lake	DAFO Sasamory	Sou	8-Apr-05	Thongavath	40	2	Yes	Yes	Aug-01	4	Never	0	
8	Atapea	Sasamory	Xe Poin river	Ban Mai	Lao Loum	30-May-05	Chane	67	3	Yes	Yes	2003	2	Never	0	
9	Atapea	Sasamory	Xe Poin river	Phonsaot	Lao Loum	31-May-05	Puffan, Si	47	4	Yes	Yes	2000	5	Never	0	
10	Atapea	Sasamory	Xe Poin river	Phonsaot	Lao Loum	1-Jun-05	Vuthong	46	1	Yes	Yes	2005	0.5	Never	0	
11	Atapea	Sasamory	Xe Kung river	police post	Lao Loum	1-Jun-05	Mangpant	40	5	yes	Yes	2002	3	Never	0	
12	Atapea	Sasamory	Xe Kampo river	Nong Ke	Lao Loum	2-Jun-05	Supan	57	1	yes	Yes	Never	0	Never	0	
13	Atapea	Sasamory	Xe Kampo river	Nong Ke	Lao Loum	2-Jun-05	Boulan	51	3	Yes	Yes	1975	30	Never	0	
14	Saravali	Saravali	Xe Dan river	Nong Boup	Lao Thiang	27-May-05	Bouala, Utahan	52	3	Yes	Yes	May-05	0.5	Apr-04	2	
15	Saravali	Saravali	Xe Dan river	Nong Boup	Lao Thiang	28-May-05	unknown	40	1	Yes	Yes	Jun-05	0.5	Never	0	
16	Svaynakhiet	Champene	Kout Mark Pea lake	Tessum	Lao Loum	11-Mar-05	Yave	72	1	Yes	Yes	1990s	10	>20 yrs ago	0	
17	Svaynakhiet	Champene	Kout Mark Pea lake	Tessum	Lao Loum	17-Mar-05	5-6 residents	50	1	Yes	Yes	2004	1	Never	0	
18	Svaynakhiet	Champene	Kout Mark Pea lake	Tessum	Lao Loum	13-Mar-05	Sone	20	1	Yes	Yes	Feb-05	0.5	Aug-04	2	
19	Svaynakhiet	Kabouli	Boua Saiphan, Her lakes	Beung Boun Thong	Lao Loum	17-Mar-05	Bouth, Saouh	68	3	Yes	Yes	Mar-05	0.5	Jun-03	1	
20	Svaynakhiet	Nong	Xe Luning river	Saling	Mangkhong	8-May-05	Chia	45	1	Yes	Yes	May-04	1	Never	0	
21	Svaynakhiet	Nong	Xe Samean river	Phouthei	Mangkhong	8-May-05	Vinh	65	4	Yes	No	Never	0	Never	0	
22	Svaynakhiet	Nong	Xe Samean river	Phoune markny	Mangkhong	7-May-05	Boukong	78	4	No	No	Never	0	Never	0	
23	Svaynakhiet	Nong	Xe Samean river	Saling	Mangkhong	7-May-05	Amang, Young	60	4	No	No	Never	0	Never	0	
24	Svaynakhiet	Nong	Xe Samean river	Phouthei	Mangkhong	7-May-05	Mang, Lou	75	3	Yes	Yes	1990s	55	Never	0	
25	Svaynakhiet	Nong	Xe Luning river	Kaion	Mangkhong	7-May-05	Choune, Eang, Phan	70	4	No	No	Never	0	Never	0	
26	Svaynakhiet	Nong	Xe Luning, Lou rivers	Phou Thong	Mangkhong	8-May-05	Boukel	73	3	Yes	Yes	1990s	55	Never	0	
27	Svaynakhiet	Nong	Xe Luning river	Tang-Alakhan	Ta Oy	8-May-05	Thun, Bhalai, Leth	55	3	No	No	Never	0	Never	0	
28	Svaynakhiet	Nong	Xe Luning river	Tang-Alansan	Ta Oy	8-May-05	Onhies, Thakok	55	4	No	No	Never	0	Never	0	
29	Svaynakhiet	Nong	Xe Luning river	Tang-Alaneua	Ta Oy	8-May-05	Auf, Jet	85	4	No	No	Never	0	Never	0	
30	Svaynakhiet	Sepon	Xe Poin river	Dong	Ta Oy	9-May-05	Lan	78	3	Yes	Yes	1940s	65	Never	0	
31	Svaynakhiet	Sepon	Xe Poin river	Phouy	Phou Thai	9-May-05	Bounthouy	48	4	No	No	Never	0	Never	0	

KEY: Profession: 1=local, usually lifetime resident (farmer/fisher); 2=DAFO District Head; 3=village elder; 4=night head/deputy head; 5=head border police post \* assigned to recent sightings within 2005 assigned value of 0.5; Nesting season: 0=did not know; 1=early nest season (June-July); 2=dry season (Dec-Jan)

Table continued from previous page

No.	Historic trade / use of crocodiles				Beliefs and perceptions				Cultural values	Other local information			
	Current use?	Eat meat / eggs?	Medicinal use?	Commercial trade?	Hunting methods	Croc farms recognized	Local croc name	Danger to residents?			Known attacks / fatalities?	Threat to village fish resources?	Croc no.'s declined?
1	None	No	1	1	1	1	1	No	None	No	Yes	0	2002: locals found dead croc
2	None	No	1	1	1	1	1	No	None	No	Yes	1	
3	None	No	1	1	1	1	1	No	None	No	Yes	0	
4	None	No	1	1	1	1	1	No	None	No	Not know	0	
5	None	No	1	1	2,3	2,3	2,3	Yes	None	No	Yes	0	Nest-glass mound 40 cm high, 28 eggs-all white, "long at finger", "Lamp" croc by nest
6	None	Eggs	1	1	1	1	1	No	None	No	Yes	0	1-2 H croc in Aug-Sept 2001, in net. Released
7	None	No	1	1	1	1	1	No	None	No	Not know	0	Croc space "very" common in Xe Kham river eg "Houby Moneg Khant", H. Chiboung", "H. Ngao"
8	None	Meat	2	2	3,4	2,3	1	No	None	No	Yes	7	Shot at a croc in 1990s in "Houby Moneg" stream
9	None	Meat	2	2	3	2,3	1	No	None	No	Yes	0	Multiple deep "boom" call when gun was fired
10	None	No	2	2	3,4	1	1	Yes	None	No	Yes	0	
11	None	No	1	1	1	1	1	No	None	No	Not know	0	
12	None	Meat	2	2	3,4	1	1	No	None	No	Not know	0	
13	None	Meat	1	1	1	2	1	No	None	No	Not know	0	Called Mong Xa vill ("crocodile swamp village") bc crocs nested in swamp "a long time ago"
14	None	No	2	1	1	1	4	No	None	No	No	3	Croc skull found in river in 2000, 2-3 km upstream of Moneg Khant vill (same by team)
15	None	No	1	1	1	1	1	Yes	None	No	Yes	0	Croc once could be brought to surface by prayer
16	None	Meat	1	2	2,3	1	1	No	None	No	Yes	0	Croc-will return. Food offerings to crocs, other "forest spirits" for good harvest etc
17	None	Meat	1	2	2,3	1	1	No	None	No	Yes	2	Croc caught in creek "1 day walk from vill close Xe Lanong river". "Died after capture". Team saw skin
18	None	No	1	1	1	1	1	No	None	No	Yes	2	Grandparents said crocs were present in 1950s "before US war". None seen since
19	None	Meat	2	1	1	2,3	1,2	No	None	No	Yes	3	Croc occurred in river "before US war"
20	None	No	1	1*	1	1	5	Not know	Not know	Not know	Not know	0	
21	None	No	1	1	1	1	5	Not know	Not know	Not know	Not know	0	
22	None	No	1	1	1	1	5	Not know	Not know	Not know	Not know	0	
23	None	No	1	1	1	1	5	Not know	None	No	Not know	0	
24	None	No	1	1	2	5	5	Yes/historicaly	None	No	Yes	0	
25	None	No	1	1	1	1	1	Not know	Not know	Not know	Not know	0	
26	None	No	1	1	1	1	5	Yes/historicaly	None	No	Not know	0	
27	None	No	1	1	1	1	5	Not know	Not know	Not know	Not know	0	
28	None	No	1	1	1	1	5	Not know	Not know	Not know	Not know	0	
29	None	No	1	1	1	1	5	Not know	Not know	Not know	Not know	0	
30	None	Meat	1	1	3	1	1	No	None	No	Yes*	0	
31	None	No	1	1	1	1	1	Not know	Not know	Not know	Not know	0	

\*croc very uncommon even before. Trends and US wars" and none had been seen for decades". **Medicinal use:** 1- whole croc, 2- ogglets/treatment (see text); 3- crocodile treatment (see text); **Commercial trade:** 1- whole croc, 2- crocodile skin trade (1950s-60s). "Vietnamese trader offered 2m Kip for skin. Croc did not sell" (field of 2007). **Hunting methods:** 1- not know, 2- spear/hook line, 3- animal trap, 4- 4-5-6-7-8-9-10-11-12-13-14-15-16-17-18-19-20-21-22-23-24-25-26-27-28-29-30-31-32-33-34-35-36-37-38-39-40-41-42-43-44-45-46-47-48-49-50-51-52-53-54-55-56-57-58-59-60-61-62-63-64-65-66-67-68-69-70-71-72-73-74-75-76-77-78-79-80-81-82-83-84-85-86-87-88-89-90-91-92-93-94-95-96-97-98-99-100-101-102-103-104-105-106-107-108-109-110-111-112-113-114-115-116-117-118-119-120-121-122-123-124-125-126-127-128-129-130-131-132-133-134-135-136-137-138-139-140-141-142-143-144-145-146-147-148-149-150-151-152-153-154-155-156-157-158-159-160-161-162-163-164-165-166-167-168-169-170-171-172-173-174-175-176-177-178-179-180-181-182-183-184-185-186-187-188-189-190-191-192-193-194-195-196-197-198-199-200-201-202-203-204-205-206-207-208-209-210-211-212-213-214-215-216-217-218-219-220-221-222-223-224-225-226-227-228-229-230-231-232-233-234-235-236-237-238-239-240-241-242-243-244-245-246-247-248-249-250-251-252-253-254-255-256-257-258-259-260-261-262-263-264-265-266-267-268-269-270-271-272-273-274-275-276-277-278-279-280-281-282-283-284-285-286-287-288-289-290-291-292-293-294-295-296-297-298-299-300-301-302-303-304-305-306-307-308-309-310-311-312-313-314-315-316-317-318-319-320-321-322-323-324-325-326-327-328-329-330-331-332-333-334-335-336-337-338-339-340-341-342-343-344-345-346-347-348-349-350-351-352-353-354-355-356-357-358-359-360-361-362-363-364-365-366-367-368-369-370-371-372-373-374-375-376-377-378-379-380-381-382-383-384-385-386-387-388-389-390-391-392-393-394-395-396-397-398-399-400-401-402-403-404-405-406-407-408-409-410-411-412-413-414-415-416-417-418-419-420-421-422-423-424-425-426-427-428-429-430-431-432-433-434-435-436-437-438-439-440-441-442-443-444-445-446-447-448-449-450-451-452-453-454-455-456-457-458-459-460-461-462-463-464-465-466-467-468-469-470-471-472-473-474-475-476-477-478-479-480-481-482-483-484-485-486-487-488-489-490-491-492-493-494-495-496-497-498-499-500-501-502-503-504-505-506-507-508-509-510-511-512-513-514-515-516-517-518-519-520-521-522-523-524-525-526-527-528-529-530-531-532-533-534-535-536-537-538-539-540-541-542-543-544-545-546-547-548-549-550-551-552-553-554-555-556-557-558-559-560-561-562-563-564-565-566-567-568-569-570-571-572-573-574-575-576-577-578-579-580-581-582-583-584-585-586-587-588-589-590-591-592-593-594-595-596-597-598-599-600-601-602-603-604-605-606-607-608-609-610-611-612-613-614-615-616-617-618-619-620-621-622-623-624-625-626-627-628-629-630-631-632-633-634-635-636-637-638-639-640-641-642-643-644-645-646-647-648-649-650-651-652-653-654-655-656-657-658-659-660-661-662-663-664-665-666-667-668-669-670-671-672-673-674-675-676-677-678-679-680-681-682-683-684-685-686-687-688-689-690-691-692-693-694-695-696-697-698-699-700-701-702-703-704-705-706-707-708-709-710-711-712-713-714-715-716-717-718-719-720-721-722-723-724-725-726-727-728-729-730-731-732-733-734-735-736-737-738-739-740-741-742-743-744-745-746-747-748-749-750-751-752-753-754-755-756-757-758-759-760-761-762-763-764-765-766-767-768-769-770-771-772-773-774-775-776-777-778-779-780-781-782-783-784-785-786-787-788-789-790-791-792-793-794-795-796-797-798-799-800-801-802-803-804-805-806-807-808-809-810-811-812-813-814-815-816-817-818-819-820-821-822-823-824-825-826-827-828-829-830-831-832-833-834-835-836-837-838-839-840-841-842-843-844-845-846-847-848-849-850-851-852-853-854-855-856-857-858-859-860-861-862-863-864-865-866-867-868-869-870-871-872-873-874-875-876-877-878-879-880-881-882-883-884-885-886-887-888-889-890-891-892-893-894-895-896-897-898-899-900-901-902-903-904-905-906-907-908-909-910-911-912-913-914-915-916-917-918-919-920-921-922-923-924-925-926-927-928-929-930-931-932-933-934-935-936-937-938-939-940-941-942-943-944-945-946-947-948-949-950-951-952-953-954-955-956-957-958-959-960-961-962-963-964-965-966-967-968-969-970-971-972-973-974-975-976-977-978-979-980-981-982-983-984-985-986-987-988-989-990-991-992-993-994-995-996-997-998-999-1000-1001-1002-1003-1004-1005-1006-1007-1008-1009-1010-1011-1012-1013-1014-1015-1016-1017-1018-1019-1020-1021-1022-1023-1024-1025-1026-1027-1028-1029-1030-1031-1032-1033-1034-1035-1036-1037-1038-1039-1040-1041-1042-1043-1044-1045-1046-1047-1048-1049-1050-1051-1052-1053-1054-1055-1056-1057-1058-1059-1060-1061-1062-1063-1064-1065-1066-1067-1068-1069-1070-1071-1072-1073-1074-1075-1076-1077-1078-1079-1080-1081-1082-1083-1084-1085-1086-1087-1088-1089-1090-1091-1092-1093-1094-1095-1096-1097-1098-1099-1100-1101-1102-1103-1104-1105-1106-1107-1108-1109-1110-1111-1112-1113-1114-1115-1116-1117-1118-1119-1120-1121-1122-1123-1124-1125-1126-1127-1128-1129-1130-1131-1132-1133-1134-1135-1136-1137-1138-1139-1140-1141-1142-1143-1144-1145-1146-1147-1148-1149-1150-1151-1152-1153-1154-1155-1156-1157-1158-1159-1160-1161-1162-1163-1164-1165-1166-1167-1168-1169-1170-1171-1172-1173-1174-1175-1176-1177-1178-1179-1180-1181-1182-1183-1184-1185-1186-1187-1188-1189-1190-1191-1192-1193-1194-1195-1196-1197-1198-1199-1200-1201-1202-1203-1204-1205-1206-1207-1208-1209-1210-1211-1212-1213-1214-1215-1216-1217-1218-1219-1220-1221-1222-122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## Appendix 5: Methods for Biometric Measurements

### Methods for measurements of living individuals

Methods follow Bezuijen *et al.* 1995 and Ross and Mayer (1983). Measurement unit in parentheses. Intended accuracy of measurements to 1 mm. Measured with Vernier callipers for small individuals and a 5 m tape rule for larger individuals.

TL (total length):	tip of snout to tail (cm)
SVL (snout-vent length):	tip of snout to anterior extremity of cloaca (cm)
HL (head length):	tip of snout to median posterior edge of cranial platform (i.e. parietal bone) (cm)
HW (head width):	widest part of head, near posterior edges of surangular bones (cm)
SE (snout-eye):	tip of snout to anterior edge of orbit (i.e. concavity of lacrimal bone) (cm)
SW (snout-width):	minimum snout width, across third large tooth socket from snout tip (cm)
PP (point-to-point):	width of cranial platform, between posterior lateral extremities of squamosal bones (cm)
MP (mid-point):	width of cranial platform, across middle of the platform (cm)
IO (inter-ocular):	minimum width between orbits (eye sockets) (cm)
Sex:	determined by direct observation of cliteropenis
Belly:	number of transverse scale rows from <i>posterior</i> to collar until anterior margin of cloaca
Gular:	number of transverse scale rows from anterior extremity of mandibular symphysis to <i>and including</i> collar
DCV and SCV:	double- and single-caudal verticils. Number of raised scales along the lower body of the individual, which merge to a single row along the tail. After Ross and Mayer (1983)
PC pattern:	the arrangement of scales exhibited in the anterior set of precaudal scales (i.e. before the nuchal plate). See Bezuijen <i>et al.</i> (1995a,b, 1997) for further details
PC1-25:	number of individual scales in each transverse row of precaudal scales from anterior extremity of precaudal scales until the junction of precaudals / caudals (after Ross and Mayer 1983)
Teeth:	no. tooth sockets in: upper jaw (notch to snout tip=T:UF; <i>behind</i> notch to back of jaw=T:UB) and lower jaw (4 <sup>th</sup> large socket to snout tip=T:LF; 5 <sup>th</sup> tooth to back of jaw=T:LB)

### Skull measurements (cm). As for living animals:

Length:	from anterior of premaxilla bone to posterior of parietal bone
Width:	across the surangular / quadratojugal bones, the widest part of the skull
Snout-eye:	from anterior of premaxilla to anterior of prefrontal
Snout width:	across the narrowest section of the maxilla
PP width:	across the extreme posterior extremities (or "points") of the squamosals
MP width:	across the mid-section of the squamosals
IO width:	minimum width between the orbits (eye sockets)

## Appendix 6: Dry-Season Wetland Profiles (2005 Survey Sites)

Dry-Season Wetland Profiles (2005 Survey Sites) Table 1 of 3

No.	Province	District	Wetland	Easting	Northing	Does occurred ≤19/3/05	Does occur now? surveys?	Confirmed in 2005 surveys?	Nests?	Villages land	Wetland category (IUCN 1996)	Sub- cat.	Type	Duration	Area (ha)	Long axis (m)	Wide axis (m)	Circum- ference (m)	Area measure	Depth (m)	Wetland substrate
1	Attapeu	Sainamxay	Beung Xe lake	858464	1625907	Yes	Yes	No	Yes	Paixing	Pan freshwater Pond	1	Natural	Pan	4.8	380	100	1345	GPS	2	Mud
2	Attapeu	Sainamxay	Beung Pubone lake "a"	858328	1626546	Yes	Yes	Yes	No	Paixing	Pan Freshwater Lake	1	Natural	Pan	12	419	290	1500	GPS	3	Mud
2	Attapeu	Sainamxay	Beung Pubone lake "b"	858427	1627008	Yes	Yes	Yes	No	Paixing	Seas freshwater Lake	1	Natural	Seas	6.5	952	70	2084	GPS	0.5	Mud
3	Attapeu	Sainamxay	Nong Noi pond	855185	1625820	Yes	No	No	No	Paixing	Seas freshwater Marsh	2	Natural	Seas	1.6	135	117	409	GPS	0	Mud
4	Attapeu	Sainamxay	Nong Ke pond (Xe Pan NPA)	839836	1617633	Yes	No	Yes	No	Nong Ke	Seas Freshwater Pond	2	Natural	Seas	0.5	88	69	270	GPS	1	Mud
5	Attapeu	Sainamxay	Nong Khani Mijim lake	858847	1624303	Yes	Yes	No	No	ST	Seas freshwater Marsh	3	Natural	Seas	35.4	793	792	3014	GPS	0	Loam
6	Attapeu	Sainamxay	Nong Khoung Hope lake	854435	1629422	Yes	No	No	No	Paixing	Pan Freshwater Pond	3	Natural	Pan	0.24	54	44	175	GPS	0.8	Mud
7	Attapeu	Sainamxay	Nong Pulu lake (Xe Pan NPA)	843403	1605789	Yes	No	No	No	Nong Ke	Seas Freshwater Pond	2	Natural	Seas	1.9	223	128	589	GPS	0	Mud
8	Attapeu	Sainamxay	Xe Kamfio river (12 km)**	843403	1605789	Yes	No	No	No	Nong Ke	Perennial river	4	Natural	Pan		12,000	20	24040	GPS	1	Sand, rock
9	Attapeu	Sainamxay	Xe Pan river (7 transects over 45 km)*	845432	1605218	Yes	No	No	No	Phonsaai, Nong Ke	Perennial river	4	Natural	Pan		45,000	30	90060	GPS	1.5	Mud, sand, rock
10	Savannakhet	Savannakhet	Nong Boua pond	865271	1733610	Yes	Yes	Yes	Yes	Nong Boua	Pan Freshwater Pond	1	Natural	Pan	1.1	278	48	624	GPS	0.4	Mud

No.	Province	District	Wetland	Easting	Northing	Cross occurred <math>\leq 19/97</math>	Cross occur row?	Confirmed in 2005 surveys?	Nests?	Village land	Wetland category (Claridge 1996)	Sub-category	Type	Duration	Area (ha)	Long axis (m)	Wide axis (m)	Cross-fence (m)	Area estimate	Depth (m)	Wetland substrate
11	Saravali	Saravali	Xo Dan river (0.5 km at Nongboia vill)	805411	1733236	Yes	Yes	No	No	Nongboia	Perennial River	4	Natural	Perm		500	20	500	GPS	2	Mud, sand, rock
12	Savannakhet	Champhone	Chao lake	522076	1807486	Yes	Yes	No	No	Tansoum	Freshwater Lake	1	Dam	Perm	67	1170	666	3180	sat image	1	Mud
13	Savannakhet	Champhone	Kout Mark Poo lake	523598	1807889	Yes	Yes	Yes	Yes	Tansoum	Freshwater Lagoon	1	Natural	Perm	11	245	528	1779	GPS	4	Mud
14	Savannakhet	Champhone	Kout Noy lake	523555	1808504	Yes	Yes	No	No	Tansoum	Freshwater Pond	3	Natural	Perm	0.5	130	57	478	GPS	4	Mud
15	Savannakhet	Champhone	Kout Phiny lake	524102	1807140	Yes	Yes	No	No	Tansoum	Freshwater Pond	3	Natural	Perm	1.7	363	50	828	GPS	4	Mud
16	Savannakhet	Champhone	Kout Tao lake	523948	1807697	Yes	Yes	No	No	Tansoum	Freshwater Pond	2	Natural	Perm	3	367	95	929	GPS	3	Mud
17	Savannakhet	Champhone	Kout Xe Hock lake	523229	1808548	Yes	Yes	No	No	Tansoum	Freshwater Pond	3	Natural	Perm	6	1227	50	2554	GPS	5	Mud
18	Savannakhet	Nong	Sapong stream (0.3 km at Phoum Markay vill)	846793	1821526	No	No	Yes	No	PM	Soas River	5	Natural	Seas	0.8	300	20	640	map	0	Rock
19	Savannakhet	Nong	Xe Lanong riv (18 km MG-AL villa)	862428	1804881	Yes	Yes	Yes	No	Various	Perennial River	4	Natural	Perm	180	18000	100	30200	GPS	2.7	Rock
20	Savannakhet	Nong	Xe Lou river (4 km, mauch-Phouffou vill)	863345	1811710	Yes	No	No	No	Phouffou	Perennial River	4	Natural	Perm	12	4003	38	8060	map	1.4	Mud
21	Savannakhet	Nong	Xe Samsouan riv (0.3 km at Salong vill)	845657	1820026	Yes	No	No	No	Salong	Perennial River	4	Natural	Perm	0.6	300	20	640	map	0.7	Rock
21	Savannakhet	Nong	Xe Samsouan riv (0.4 km at Kenglin vill)	848506	1818558	Yes	No	No	No	Kenglin	Perennial River	4	Natural	Perm	2.8	400	20	940	map	1	Rock

No.	Province	District	Wetland	Easting	Northing	Cross occurred <1979	Cross occurred now?	Confirmed in 2005 surveys?	Nests?	Village land?	Wetland category (Claridge 1998)	Sub category	Type	Duration	Area (ha)	Long axis (m)	Wide axis (m)	Crossing fence (m)	Area measure	Depth (m)	Wetland substrate
22	Savannakhet	Sepon	Xe Fom river (0.2 km at Dong vill)	651721	1836346	Yes	No	No	No	Dong	Perennial River	4	Natural	Perm	2	200	100	600	map	1	Mud
22	Savannakhet	Sepon	Xe Fom river (0.3 km at Phoung vill)	686557	1837638	No	No	No	No	Phoung	Perennial River	4	Natural	Perm	2.1	300	70	740	map	1.2	Mud
22	Savannakhet	Xaibouli	Beung Hoi lake	490556	1877925	Yes	Yes	No	No	BBT	Perm Freshwater Lake	3	Natural	Perm	39.6	613	443	2539	GPS	1.5	Mud
24	Savannakhet	Xaibouli	Beung Siyam lake	496499	1890081	Yes	Yes	No	No	BBT	Perm Freshwater Lake	1	Natural	Perm	10.6	1000	134	2363	vis est	1.5	Mud
25	Savannakhet	Xaibouli	Boua Thong lake	488585	1877709	Yes	Yes	Yes	Yes	BBT	Perm Freshwater Lake	3	Natural	Perm	13.5	675	200	1480	GPS	1.5	Mud

**KEY:** \*measured by river mouth and Phonsaat village (see field datasheet for raw values); \*\*measured byv Turk Xe Kampho/Xe Phan rivers and Nong Xe Village upstream Xe Kampho river (see field datasheet for raw values). **Village land:** A- Abandoned; MG- Mangroove; BBT-Beung Boua Thong; ST-Samrong; Thoi- Floating and Emergent Rooted Vegetation; 1- Vegetated water - Floating water - Emergent Rooted Vegetation; 2- Vegetated water - Emergent Rooted Vegetation; 3- Open water - Unvegetated; 4- Perennial River Channel; 5- Seasonal River Channel

Table 2 of 3

Vegetation cover in wetland (i.e. over the water surface)				%Scrub weed invasion in and around wetland				%Land cover in a 50 m radius, around wetland (7 categories, add to 100%)							Burning in a 50 m radius around wetland			Wildlife hunting	
No.	% open water	% cover w/stray canopy	Ht w/stray (m)	Ht canopy (m)	Fraxinea in wetland	% Mimosa pigra w/m 50 m of waterbody	Forest	Woodland	Savannah	Shrubland	Clearcut land/roads	Impacted rice (drainage channels)	Rain-fed rice	Dominant category	Mean %/stray cover (native category only)	Mean canopy ht (m)	Fire used to clear land?	%landcover burnt in last 2 yrs	
1	0	50	10	1	3	0	0	60	20	0	20	0	0	Forest	10	15	Yes	80	Subsistence
2	0	100	0	1	0	0	10	90	0	0	0	0	0	Woodland	30	25	Yes	70	Subsistence
2	0	80	20	0.5	2	0	10	90	0	0	0	0	0	Woodland	30	20	Yes	70	Subsistence
3	20	80	0	0.5	0	0	40	0	0	0	60	0	0	Shrubland	40	15	Yes	70	Subsistence
4	100	0	0	0	0	30	0	0	0	0	40	0	60	Rain-fed rice	10	5	No	0	Subsistence
5	100	0	0	0	0	0	20	20	0	0	60	0	0	Shrubland	10	15	Yes	70	Subsistence
6	100	0	0	0	0	0	0	0	30	20	0	0	0	Shrubland	40	5	Yes	70	Subsistence
7	40	60	0	0	0	0	70	20	0	0	10	0	0	Forest	80	25	Yes	20	Subsistence
8	100	0	0	0	0	0	60	20	0	0	0	0	0	Forest	70	20	Yes	10	Subsistence
9	100	0	0	0	0	0	60	10	0	0	10	0	0	Forest	80	25	Yes	10	Subsistence
10	60	40	0	0.3	0	40	0	30	20	0	0	0	0	Mixed	50	20	No	0	None (prohibited)
11	100	0	0	0	0	0	40	0	0	40	20	0	0	Mixed	50	20	Yes	20	Subsistence / Local trade
12	50	50	0	1	0	30	50	0	0	40	0	40	0	Mixed	50	10	Yes	60	Subsistence
13	0	60	20	1.5	5	10	20	0	0	60	10	30	0	Shrubland	70	10	Yes	40	Subsistence
14	100	0	0	0	0	0	100	0	0	0	0	0	0	Forest	60	15	Yes	10	Subsistence
15	100	0	0	0	0	0	40	0	0	60	10	0	0	Shrubland	50	10	Yes	70	Subsistence
16	0	50	50	0.5	3	20	10	0	0	20	0	30	0	Shrubland	50	10	Yes	50	Subsistence
17	100	0	0	0	0	0	10	20	0	0	60	0	0	Shrubland	60	10	Yes	60	Subsistence
18	100	0	0	0	0	0	0	90	0	0	10	0	0	Woodland	50	20	Yes	10	Subsistence
18	100	0	0	0	0	0	40	0	0	50	10	0	10	Shrubland	60	20	Yes	20	Subsistence / Local trade
20	100	0	0	0	0	0	40	0	0	30	0	0	30	Forest	50	20	Yes	40	Subsistence / Local trade
21	100	0	0	0	0	0	20	20	0	40	10	0	10	Shrubland	40	20	Yes	50	Subsistence
21	60	20	20	1	2	0	0	20	0	40	0	0	10	Shrubland	50	20	Yes	50	Subsistence
22	100	0	0	0	0	0	40	0	0	50	10	0	0	Shrubland	60	15	Yes	0	Subsistence / Local trade
22	100	0	0	0	0	0	20	0	0	30	30	0	20	Mixed	30	10	Yes	0	Subsistence / Local trade
23	100	0	0	0	0	0	10	0	0	0	20	10	60	Mixed	10	0	Yes	80	None (prohibited)
24	50	40	10	1.5	3	10	0	40	10	0	20	0	0	Mixed	70	10	Yes	60	Subsistence
25	100	0	0	0	0	0	100	0	0	0	0	0	0	Forest	10	5	No	20	None (prohibited)

KEY: Native vegetation subcategories (Forest, Woodland) etc modified from Charles (2000) and defined in Appendix 1

No.	Province	District	Wetland	Easting	Northing	Cross occurred <1979	Cross occurred in 2005 survey?	Nests?	Village land	Wetland category (Claridge 1998)	Sub category	Type	Duration	Area (ha)	Long axis (m)	Wide axis (m)	Crossing fence (m)	Area measure	Depth (m)	Wetland substrate
22	Savannakhet	Sepon	Xe Fon river (0.2 km at Dong vill)	651721	1836346	Yes	No	No	Dong	Perennial River	4	Natural	Perm	2	200	100	600	map	1	Mud
22	Savannakhet	Sepon	Xe Fon river (0.3 km at Phoung vill)	686557	1837638	No	No	No	Phoung	Perennial River	4	Natural	Perm	2.1	300	70	740	map	1.2	Mud
22	Savannakhet	Xaibouli	Beung Haa lake	490556	1877925	Yes	No	No	BBT	Perm Freshwater Lake	3	Natural	Perm	39.6	613	443	2539	GPS	1.5	Mud
24	Savannakhet	Xaibouli	Beung Siyam lake	496499	1890081	Yes	No	No	BBT	Perm Freshwater Lake	1	Natural	Perm	10.6	1000	134	2363	vis est	1.5	Mud
25	Savannakhet	Xaibouli	Boua Thong lake	488585	1877709	Yes	Yes	Yes	BBT	Perm Freshwater Lake	3	Natural	Perm	13.5	675	200	1480	GPS	1.5	Mud

**KEY:** \*measured by river mouth and Phonsaat village (see field datasheet for raw values); \*\*measured byv Turk Xe Kampho/Xe Phan rivers and Nong Xe Village upstream Xe Kampho river (see field datasheet for raw values). **Village land:** A- Abandoned; MG-Mangrove; BBT-Beung Boua Thong; ST-Samrong; Thoi- Floating and Emergent Rooted Vegetation; 1= Vegetated water - Floating water - Emergent Rooted Vegetation; 2= Vegetated water - Emergent Rooted Vegetation; 3= Open water - Unvegetated; 4= Perennial River Channel; 5= Seasonal River Channel

Table 2 of 3

Vegetation cover in wetland (i.e. over the water surface)				%Scrub weed invasion in and around wetland				%Land cover in a 50 m radius around wetland (7 categories, add to 100%)							Burning in a 50 m radius around wetland			Wildlife hunting	
No.	% open water	% cover w/stray canopy	Ht w/stray (m)	Ht canopy (m)	Fraxinea in wetland	% Mimosa pigra w/m 50 m of waterbody	Forest	Woodland	Savannah	Shrubland	Clearcut land/roads	Impacted rice (drainage channels)	Rain-fed rice	Dominant category	Mean %/stray cover (native category only)	Mean canopy ht (m)	Fire used to clear land?	%landcover burnt in last 2 yrs	
1	0	50	10	1	3	0	0	60	20	0	20	0	0	Forest	10	15	Yes	80	Subsistence
2	0	100	0	1	0	0	10	90	0	0	0	0	0	Woodland	30	25	Yes	70	Subsistence
2	0	80	20	0.5	2	0	10	90	0	0	0	0	0	Woodland	30	20	Yes	70	Subsistence
3	20	80	0	0.5	0	0	40	0	0	0	60	0	0	Shrubland	40	15	Yes	70	Subsistence
4	100	0	0	0	0	30	0	0	0	0	40	0	60	Rain-fed rice	10	5	No	0	Subsistence
5	100	0	0	0	0	0	20	20	0	0	60	0	0	Shrubland	10	15	Yes	70	Subsistence
6	100	0	0	0	0	0	0	0	30	20	0	0	0	Shrubland	40	5	Yes	70	Subsistence
7	40	60	0	0	0	0	70	20	0	0	10	0	0	Forest	80	25	Yes	20	Subsistence
8	100	0	0	0	0	0	60	20	0	0	0	0	0	Forest	70	20	Yes	10	Subsistence
9	100	0	0	0	0	0	60	10	0	0	10	0	0	Forest	80	25	Yes	10	Subsistence
10	60	40	0	0.3	0	40	0	30	20	0	0	0	0	Mixed	50	20	No	0	None (prohibited)
11	100	0	0	0	0	0	40	0	0	40	20	0	0	Mixed	50	20	Yes	20	Subsistence / Local trade
12	50	50	0	1	0	30	50	0	0	40	0	40	0	Mixed	50	10	Yes	60	Subsistence
13	0	60	20	1.5	5	10	20	0	0	60	10	30	0	Shrubland	70	10	Yes	40	Subsistence
14	100	0	0	0	0	0	100	0	0	0	0	0	0	Forest	60	15	Yes	10	Subsistence
15	100	0	0	0	0	0	40	0	0	90	10	0	0	Shrubland	50	10	Yes	70	Subsistence
16	0	50	50	0.5	3	20	10	0	0	20	0	30	0	Shrubland	50	10	Yes	50	Subsistence
17	100	0	0	0	0	0	10	20	0	0	60	0	0	Shrubland	60	10	Yes	60	Subsistence
18	100	0	0	0	0	0	0	90	0	10	0	0	0	Woodland	50	20	Yes	10	Subsistence
18	100	0	0	0	0	0	40	0	0	50	10	0	10	Shrubland	60	20	Yes	20	Subsistence / Local trade
20	100	0	0	0	0	0	40	0	0	30	0	0	30	Forest	50	20	Yes	40	Subsistence / Local trade
21	100	0	0	0	0	0	20	20	0	40	10	0	10	Shrubland	40	20	Yes	50	Subsistence
21	60	20	20	1	2	0	0	20	0	40	0	0	10	Shrubland	50	20	Yes	50	Subsistence
22	100	0	0	0	0	0	40	0	0	50	10	0	0	Shrubland	60	15	Yes	0	Subsistence / Local trade
22	100	0	0	0	0	0	20	0	0	30	30	0	20	Mixed	30	10	Yes	0	Subsistence / Local trade
23	100	0	0	0	0	0	10	0	0	0	20	10	60	Mixed	10	0	Yes	80	None (prohibited)
24	50	40	10	1.5	3	10	0	40	10	0	20	0	0	Mixed	70	10	Yes	60	Subsistence
25	100	0	0	0	0	0	100	0	0	0	0	0	0	Forest	10	5	No	20	None (prohibited)

KEY: Native vegetation subcategories (Forest, Woodland) etc modified from Charles (2000) and defined in Appendix 1

22	S, I1	S	Permanent	12	85	Yes	Yes	Yes	Subsistence	Subsistence	Yes	Yes	0	0	NI	NI	0	0.1	55	NI	09-Mar-05
22	S, I1	S	Permanent	12	50	Yes	Yes	Yes	Subsistence	Subsistence	Yes	Yes	0	0	NI	NI	0	0.1	55	NI	09-Mar-05
23	P	S	Permanent	12	>40	Yes	Yes	Yes	Subsistence	Subsistence	Yes	Yes	5	20	100	1,2,3	0.5	0.2	30	3,4	17-Mar-05
24	S	S	Permanent	12	>20	Yes	Yes	Yes	Subsistence	Subsistence	Yes	Yes	15	0	50	1,2,3	3	4	5	3,4	17-Mar-05
25	P	P	None	0	0	No	No	No	None	Subsistence	Yes	Yes	0	0	100	1,2,3	0.5	0.2	0	1	17-Mar-05

**KEY: Wildlife hunting and Fishing categories:** S=subsistence; 1=local trade; P=Prohibited; **NTFP** (non-timber forest product) 1=watersnails, 2=bamboo shoots; 3=mulberries; 4=crustaceans; 5=turtles; 6=birds; 7=dipodomys; 8=duck  
 hunting: 1 = Distance to nearest permanent wetland (km); 2 = Distance to nearest village (km); 3 = Huts/fences at wetland (permanent + seasonal); **Village regulations for resource use at wetland:** 0=no regulations; 1=all resource harvesting prohibited; 2=fish harvesting zones; 4=wildlife hunting prohibited (except fishing); 5=non-residents pay a village fee to fish at wetland; NI=not recorded

## Summary Descriptions of *C. Siamese*s Nesting Sites Surveyed in 2005

Attapeu Province (Sanamxay District): Beung Pulone / B. Ke wetland complex

Mosaic of permanent/seasonal lakes and ponds in the Xe Pian river catchment, east of the river and immediately north-east of the Xe Pian NPA. Both wetlands are surrounded by tall dry dipterocarp forest and support thick grassbeds and floating aquatic vegetation. Beung Pulone and B. Ke are the largest wetlands in this area and smaller wetlands are located nearby. Previous surveys reported the potential presence of crocodiles (WWF Thailand 1997), which was confirmed in 1997 (Davenport et al. 1997). Breeding in B. Pulone/B. Ke was confirmed in 2005. These wetlands are more intact than two visited in the Xe Pian NPA (Nong Palu, Nong Ke), and are of high conservation significance for crocodiles. Both B. Pulone and B. Ke are currently threatened by frequent burning of fringing forest, and trampling and grazing by livestock. At B. Ke, an electricity transmission line is currently being built at the southern end of the wetland, and an irrigation scheme is being assessed. The Xe Pian NPA once supported crocodile populations (GOL 2000; WCS 1995) but 2005 surveys revealed crocodiles are now very rare/locally extinct in the NPA, increasing the relative significance of this wetland complex.

Saravan Province (Saravan District): Nong Boua pond/Xe Don river complex

Small pond 200 m from the Xe Don river. The site is protected by crocodile-related community beliefs of Nongboua village, and evergreen forest (>20 m high) surrounding the pond is relatively intact. The eastern edges of the pond support dry dipterocarp forest and are grazed. No fishing, hunting or other NTFP collection occurs at the pond. The water surface is partly covered by a weed, water hyacinth. A relatively intact forest corridor links the pond to the Xe Don river, which is intersected by a small unsealed road. In 2005, this road was frequently used by a nearby commercial logging company. Near Nongboua village, the Xe Don river is slow-flowing, with 4-5 m high, steeply sloping banks. The river is 2 m deep (at the time of dry-season survey) and fringed by evergreen forest (20-30 m high) and bamboo stands (15 m).

Savannakhet Province (Champhone District): Kout Mark Peo lake

Habitat. Located within a mosaic of permanent/seasonal wetlands extending east and west of the Champhone river. A large, permanent artificial lake (Cheo lake) is adjacent to KMP lake, which was constructed for rice irrigation. Two villages (Tansoum, Laonath) are within 4 km of KMP lake. Natural wetlands include open ponds, small vegetated swamps and oxbow lakes. The Champhone river (15-20 m wide, with sandy, steeply sloping banks) is subject to seasonal flooding and rises several metres in the wet season, flooding nearby wetlands. In the dry season, the river comprises a series of long, slow-flowing or standing pools. Historically, this region was dominated by dry dipterocarp forest. KMP lake is partly encompassed by remnant stands of dry dipterocarp forest, thick stands of spiny bamboo shrubland and rice fields. The lake's water surface is 100% covered by thick floating mats of native vegetation (reeds, grasses), with a 3-5 m canopy of trees. In contrast to nearby wetlands, the waterbody itself is relatively intact and is unburnt. In the wet season, the lake probably connects with nearby wetlands, including Kout Tao and Kout Noy. Comparison with nearby, more impacted wetlands indicated that lake margins are slowly being invaded by water hyacinth and riparian trees, which may result in reduced water surface and crocodile nesting habitat in the long-term.

Human impacts. Much of the region is cleared and frequently burnt. The banks of KMP lake are currently being cleared/burnt to create rice fields. *Mimosa pigra* has invaded nearby areas and is currently invading areas of KMP lake that are being opened up. Water hyacinth *Eichhornia* has invaded most open water areas of the lake. Until 2005, much of the lake's inner and bankside vegetation was intact, and weed invasion, fire and drainage were low threats. The site is visited by low numbers of residents from at least two villages (Tansoum and Laonath) for wet season fishing. The western bank is bordered by a raised earthen bund/path (1 m high), which is used for tractor and person access. The southern edge has been partly cleared and burnt and has two small irrigation canals (0.5x0.5 m) from the lake to nearby rice fields. One canal (1x0.5 m) was dug in the western bank in the 1970s, but has dried out. The eastern and northern banks maintain a relatively intact cover of bamboo shrubland. Fire risk is increasing due to these activities and if the core area of wetland is burnt, this will probably result in conversion to grass and *Mimosa*, and a permanent loss of crocodile nesting habitat. Other activities around the lake include regular trap- and line-fishing, opportunistic (subsistence) hunting (birds, small mammals, turtles), watersnail collection.

Savannakhet Province (Xaibouli District): Boua Thong lake complex

Small wetland complex (Boua Thong, Hor and Saiyan lakes) close to Xe Bangfai river. All are protected to varying degrees by community regulations, which relate partly to local spiritual beliefs in crocodiles. Boua Thong lake is surrounded by relatively intact, seasonally flooded riparian forest. The site is 100 m from Beung Boua Tong Village and is frequently visited by residents, partly to see a single resident crocodile in the lake. Hor lake is largely cleared and surrounded by terraced rice fields, with some remnant forest occurring >200 m from the lake. Both lakes are open and have no surface vegetation. Saiyan lake is the largest and >50% vegetated, and some of the margins are bordered by evergreen/dipterocarp forest. Additional, unsurveyed wetlands occur along the Xe Bangfai and other crocodiles may still occur in the region. Further surveys are required to assess the extent and condition of other wetlands.

## Appendix 7: Socio-Economic Data in 2005

## Socio-Economic Data in 2005

No	Province	District	Village	Ethnic Group	Existing	Northing	Date of Visit	Nearest wetland	Interviewer	Interviewed (all males)	Title	Age	Houses	Families	Pop	Mean Persons/hhd	Settlement	Water
1	Attapeu	Saravay	Phoung	Sou	667266	1624555	01-Apr-05	Boung Ke Puloat	MB, CP	Bounmy	VH	35	41	42	246	6	1981	well
2	Attapeu	Saravay	Mai	Lao Loum	661472	1628012	30-May-05	Xa Phan river	MB, BV, SO	Somai	VH	45	109	120	591	5	1962	natural
3	Attapeu	Saravay	Nong Ke	Lao Loum	639898	1612321	2-Jun-05	Xa Kapho river	MB, BV, SO	Buabon	VH	51	62	77	377	6	1962	natural
4	Attapeu	Saravay	Phonssat	Lao Loum, Sou	646719	1613173	4-Jun-05	Xa Phan river	MB, BV, SO	Puthon	VH	42	91	106	603	6	1972	natural
5	Saravan	Saravan	Nong Boua	Lao Loum, Sou	665674	1733219	27-May-05	Xa Don river	MB, SO	Utkao	DV	51	136	251	1539	8	>200 years	filter
6	Souvannakhet	Chiangkhong	Tarsaun	Thiung Lao Loum	519810	1807179	11-Mar-05	Kaot Mak Peo	MB, CP	Khangthor	VH	40	87	88	573	7	>200 years	dam
7	Souvannakhet	Xabouli	Biang Boua Thiung	Lao Loum	468880	1877946	17-Mar-05	Boua Thiung	MB, CP	Seuth	VH	42	173	206	967	6	1903	natural
8	Souvannakhet	Nong Sabang	Sabang	MK	650960	1822702	6-May-05	None	MB, CP	Chanot	VH	30	40	95	268	6	1975	natural
9	Souvannakhet	Nong Phouthai	Phouthai	MK	646506	1818558	6-May-05	Xa Sarcouan river	MB, CP	Vanh	VH	65	23	27	118	5	1975	natural
10	Souvannakhet	Nong Phou maitkny	Phou maitkny	MK	646968	1821592	7-May-05	Xa Sarcouan river	MB, CP	Boukong	VH	78	45	67	327	7	1974	natural
11	Souvannakhet	Nong Sabang	Sabang	MK	646657	1820028	7-May-05	Xa Sarcouan river	MB, CP	Anang	DV	42	27	36	115	4	1976	natural
12	Souvannakhet	Nong Phou Thiung	Phou Thiung	MK, KT, TO	663367	1811968	8-May-05	Xa Lou river	MB, CP	At	VH	40	51	70	327	6	1973	natural
13	Souvannakhet	Nong Tang Abakso	Tang Abakso	TO	7	7	8-May-05	Xa Lanong river	MB, CP	Bhouai	Elder	35	26	31	148	6	7	natural
14	Souvannakhet	Nong Anam	Tang Anam	TO	662148	1805591	8-May-05	Xa Lanong river	MB, CP	Obkhen	VH	55	63	75	380	6	1973	natural
15	Souvannakhet	Nong Tang Abreum	Tang Abreum	TO	7	7	8-May-05	Xa Lanong river	MB, CP	Abat	VH	63	48	63	181	4	1974	natural
16	Souvannakhet	Sepen Dong	Dong	TO	661721	1838382	9-May-05	Xa Ton river	MB, CP	Lan	Elder	78	65	87	408	6	1978	natural
17	Souvannakhet	Sepen Phoung	Phoung	Phou Thiung	666567	1837638	9-May-05	Xa Ton river	MB, CP	Bouthuy	DV	48	56	60	208	4	1978	natural

**KEY:** Ethnic group: MK-Munkong, KT-Ka Tong, TO-Ta Oy. **Interviewer:** MB-Max Bouquien (WCS); BV-Bouthuy (WCS); CP-Chantone Phouthay; SC-Somboun Chanya (LAPReC). **Title:** VH-Village head; DV-Deputy village head.

No.	Literacy (%) <sup>a</sup>	Prim School	Sec'y School	Medical Clinic	Road Access	Grid Electricity	Land Allocation	Land Use Map	Rice	Other Subsistence / Income	Village Assistance Programs			Other Activities Near Village			Traders Buy Wildlife?
											Year	Agency	Activity	Year	Agency	Activity	
1	Low	Yes	No	No	Yes	No	Yes	No	1	Wildlife hunting / local trade	1980s	?	Build drinking well	2005	GOJ	Elec transmission line	Yes
2	20	Yes	No	Yes	Yes	No	Yes	Yes	1	Commercial fishing	1990s	PAFO	Irrigation pipeline (local project failed)	2005	GOJ	Elec transmission line	Yes
3	85	Yes	No	Yes	No	No	No	No	1	Wildlife hunting	1999	IUCN	Build primary school				No
4	70	Yes	No	Yes	Yes	No	Yes	Yes	1	Wildlife hunting / local trade	2001	Health United World Concerns	Build medical clinic				No
5	80	Yes	No	Yes	Yes	No	Yes	No	1	Wildlife hunting / local trade	2005	World Concerns	Drinking water system (65 houses)	2005	Log etc.	Logging Villagers employed	Yes
6	High	Yes	No	No	Yes	Yes	No	No	2	Wildlife hunting	1996-97	GOJ	Build dam (noo-ungubank)				Yes
7	High	Yes	Yes	No	Yes	Yes	No	No	1	Wildlife hunting	none	none	none				No
8	2	Yes	No	No	Yes	No	Yes	No	1	Wildlife hunting / local trade	2005	BTC	Education, agriculture, poverty				Yes
9	8	Yes	No	No	Yes	No	Yes	No	1	Wildlife hunting / local trade	2005	BTC	Education, agriculture, poverty				Yes
10	5	Yes	No	Yes	Yes	No	Yes	No	1	Wildlife hunting / local trade	2005	GOJ	Build drinking well, supply soil for rice cultiva				Yes
11	8	No	No	No	Yes	No	Yes	No	1	Wildlife hunting / local trade	?	GOJ	Build/upgrade road				Yes
12	30	Yes	No	No	No	No	Yes	Yes	1	Wildlife hunting / local trade	2005	BTC	Education, agriculture, poverty				Yes
13	7	Yes	No	No	No	No	Yes	Yes	1	Wildlife hunting / local trade	none	none	none				Yes
14	8	Yes	No	No	No	No	Yes	Yes	1	Wildlife hunting / local trade	2005	BTC	Education, agriculture, poverty				Yes
15	7	Yes	No	No	No	No	Yes	Yes	1	Wildlife hunting / local trade	2005	BTC	Education, agriculture, poverty				Yes
16	60	Yes	No	Yes	Yes	Yes	Yes	Yes	1	Wildlife hunting / local trade							Yes
17	80	Yes	No	Yes	Yes	Yes	Yes	Yes	1	Wildlife hunting / local trade	none	none	none				Yes

**KEY:** Rice = 1=rain fed 11 crop/year; 2=irrigated 22 crop/year; **Village assistance:** BTC=Belgium Technical Concerns; GOJ=Government of Lao

## Appendix 8: 2005 Project Meetings and Survey Itineraries

### Project meetings

#### 1. Informal meeting with Tansoum Village, Champhone District, Savannakhet Province: Kout Mark Peo swamp

**Date:** 16<sup>th</sup> March 2005. **Present: Tansoum Village** (Village Head Mr. Khamphor, Deputy Head, village elders); **Provincial Forestry and Agriculture Office Savannakhet** (Mr. Somchan Phanthanlangsy PAFO, Mr. Chompeth DAFO); **LARReC** (Mr. Chanthone Sophithay); **WCS** (Mark R. Bezuijen). **Minutes:**

Chanthone/Mark: Summary of survey results and possible issues

Mr. Khamphor: Request PAFO/DAFO assistance to develop site regulations.

Mr. Somchan: Detailed landuse map required for follow-up. Will report to PAFO to develop district/village regulations. Landuse map approved and distributed to nearby villages.

Mr. Khamphor: PAFO should legally zone the swamp to Tansoum village, because current land ownership is unclear.

All: Agreement that follow-up is needed, especially regarding land zonation and community regulations.

#### 2. Informal meeting with PAFO Savannakhet, Savannakhet town: results of field surveys March 2005

**Date:** 18<sup>th</sup> March 2005. **Present: Provincial Forestry and Agriculture Office Savannakhet** (Mr. Thong Eth Phayvanh, Deputy Director PAFO); **LARReC** (Mr. Chanthone Sophithay); **WCS** (Mark R. Bezuijen). **Minutes:**

Chanthone/Mark: Summary of survey results and potential management, esp. conservation of KMP for crocodile breeding.

Mr. Phayvanh: Tansoum village should be focus for KMP conservation; village benefits required to replace what is lost if fishing etc restricted; ecotourism should be explored; he will propose site management to Head PAFO and Provincial Governor; more surveys required for such a submission; DAFO will be involved surveys.

#### 3. Informal meeting with PAFO Attapeu, Attapeu town: results of field surveys April 2005

**Date:** 8 April 2005. **Present: Provincial Forestry and Agriculture Office Attapeu** (Mr. Khampao Suptavi, Head Administration Unit PAFO); **LARReC** (Mr. Chanthone Sophithay); **WCS** (Mark R. Bezuijen).

**Minutes:** Head and Deputy Heads of PAFO away on business. Presented field results to Mr. Suptavi.

#### 4. Field surveys Nong District, Savannakhet May 2005

PAFO visited after surveys, but heads away. Mr. Somchan/Sisangvon (PAFO) would report on survey results.

#### 5. Field surveys Saravan and Attapeu Provinces, May 2005

No PAFO/DAFO meetings after surveys (returned to town on Sundays). Progress reports sent to PAFO/DAFO with survey results. The officers who accompanied surveys stated they report on survey results on behalf of the team.

### Survey itinerary

#### First field survey (Champhone and Xaibouli Districts, Savannakhet Province)

- 10 March Drive Vientiane to Savannakhet town. Overnight.
- 11 March Meet Mr. Somphong Chanthavong (Deputy Director Division Agriculture and Forestry). Discuss survey objectives. Meet Mr. Somchan Phanthalangsy (PAFO field staff). Purchase field supplies. Drive to Champhone District. Meet DAFO. Discuss survey objectives. Meet Mr. Chompeth (DAFO field staff). Drive to Laonath village. Due to a festival, residents unable to assist surveys. Drive to Tansoum village. Meet Mr. Khamphor, village head. Discuss surveys. Overnight.
- 12-15 March Field work at Kout Mark Peo, Kout Tao, Kout Xe Hack and Kout Noy swamps.
- 16 March Return to Tansoum village. Discuss survey results with village head. Identify key threats to crocodile habitats. Return to Savannakhet town. Overnight.
- 17 March Drive to Xaibouli District. Meet DAFO, discuss survey objectives. Meet Mr. Boundouan Monepadith (DAFO field staff). Drive to Ban Beung Boua Thong village. Meet Mr. Seuth (village head). Visit three wetlands close to village. Overnight.
- 18 March Return to Savannakhet town. Meet Mr. Thong Eth Phayvang (Deputy Director PAFO). Discuss survey results and identify potential follow-up activities. Return to Vientiane.

#### Second field survey (Sanamxay District, Attapeu Province)

- 31 March Drive Vientiane to Pakse town. Overnight.
- 1 April Drive Pakse to Attapeu town. Meet PAFO (Mr. Sisavath). Purchase field supplies. Drive to Sanamxay District. Meet Mr. Thongsavath (Head DAFO) and Mr. Bandith (field staff). Drive to Pindong Village.
- 2-8 April Field work in Sanamxay District (Beung Kae, B. Pulone, Nong Hoi, N. Khoung Hape wetlands).
- 8 April Drive to Sanamxay District. Meet Mr. Thongsavath. Discuss survey results. Drive to Attapeu. Meet Mr. Khampao Suptavi (Head Administration Unit PAFO). Discuss results. Overnight Attapeu.
- 9 April Drive Attapeu to Pakse. Overnight Pakse.
- 10 April Fly Pakse to Vientiane.

#### Third field survey (Nong District, Savannakhet Province)

- 4 May Drive Vientiane to Savannakhet town. Overnight.
- 5 May Purchase field supplies. Meet Mr. Sompon Chantavong (Deputy Director Forest Division PAFO), Mr. Somchan and Mr. Sisangvon (PAFO officers). Drive to Nong District. Overnight Ban Muangnong Village (district centre).
- 6 May Meet Mr. Keoudone (Deputy Head Nong District) and Mr. Sivilay (Head DAFO). Drive to Ban Salang Village and other villages. Overnight Ban

	Phouthai Village. Night survey commenced (Xe Samouan river) but stopped due to heavy rains.
7 May	Conduct interviews in villages in district. Overnight Ban Muangnong Village (district centre).
8 May	Boat trip up Xe Lanong river to conduct interviews at villages. Overnight Ban Muangnong Village (district centre).
9 May	Drive to Sepon District. Conduct interviews in some villages. Return to Savannakhet town. Overnight.
10 May	Drive Savannakhet to Vientiane.

#### Fourth field survey (Saravan District, Saravan Province and Xe Pian NPA, Sanamxay District, Attapeu Province)

26 May	Drive Vientiane to Pakse town. Overnight.
27 May	Purchase field supplies. Drive Pakse to Saravan town. Meet Mr. Somkhith Senthavy (Deputy Head PAFO Saravan). Meet DAFO (Mr. Kholakhanh). Drive to Nongboua Village. Overnight.
28 May	Field surveys Xe Don river and Nongboua wetland. No boat available for river survey. Overnight.
29 May	Return to Saravan town. Drive to Attapeu town. Purchase field supplies. Overnight.
30 May	Purchase field supplies. Meet Mr. Soulisack (Head PAFO Attapeu). Drive to Sanamxay District. Meet DAFO. Drive to Ban Mai village. Overnight.
31 May	Boat ride Ban Mai to Phonesaat village (Xe Pian NPA). Overnight.
1 June	Boat ride Phonesaat village to fork Xe Pian/Xe Kong rivers. Spotlight survey. Overnight Xe Pian/Kampho fork.
2 June	Boat ride to Xe Kampho river to Nong Ke village. No spotlight survey (heavy rain). Overnight.
3 June	Boat ride Xe Kampho river to fork Xe Pian/Xe Kampo rivers. Overnight.
4 June	Boat ride Xe Pian/Xe Kampho fork to Phonesaat village. Overnight.
5 June	Boat ride Phonesaat to Ban Mai village. Drive to Attapeu then to Pakse. Overnight.
6 June	Drive Pakse to Vientiane.

#### River distances travelled in Xe Pian National Protected Area, June 2005

##### Xe Pian river

River mouth (fork with Xe Kong river) (=km 0) - fork with Xe Kampho river (=km 18)	18 km
Fork with Xe Kampho river (=km 18) – Phonesaat village (=km 45.5)	27.5 km
Phonesaat village (=km 45.5) – Ban Mai village (=km 75)	29.5 km

##### Xe Kampho river

River mouth (fork with Xe Pian river) (=km 0) – Nong Ke village (=km 12)	12 km
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## Mekong Wetlands Biodiversity Conservation and Sustainable Use Programme

The Mekong Wetlands Biodiversity Conservation and Sustainable Use Programme (MWBP) is a joint programme of the four riparian governments of the Lower Mekong Basin – Cambodia, Lao PDR, Thailand and Viet Nam – managed by the United Nations Development Programme (UNDP), the World Conservation Union (IUCN) and the Mekong River Commission (MRC), in collaboration with other key stakeholders. With funding from the Global Environment Facility (GEF), UNDP, the Royal Netherlands Government, MRCS, the Water and Nature Initiative (WANI) and other donors, the programme addresses the most critical issues for the conservation and sustainable use of natural resources in the Mekong wetlands. MWBP aims to strengthen the capacity of organisations and people to develop sustainable livelihoods and manage wetland biodiversity resources wisely. It is a five-year (2004-2009) intervention at three levels – regional, national and local – with demonstration wetland areas in each of the four countries: in the Songkhram river basin, Thailand; in Attapeu province in southern Lao PDR; in Stung Treng, Cambodia; and in the Plain of Reeds in the Mekong Delta, Viet Nam. The programme aims to:

- Improve coordination for wetland planning from regional to local levels
- Strengthen policy and economic environments for wetland conservation
- Generate and share information
- Train and build capacity for the wise use of wetlands
- Create alternative options for sustainable natural resource use and improve livelihoods

MWBP is a partnership between governments, aid agencies and NGOs, and provides a framework for complementary work for wetland conservation and sustainable livelihoods in the Lower Mekong Basin.

PROGRAMME MANAGEMENT UNIT  
PO Box 4340, 082/02 Fa Ngum Road, Vientiane, Lao PDR  
Phone: + 856 (0)21 240 904 Fax: + 856 (0)21 216 127  
Email: [info@mekongwetlands.org](mailto:info@mekongwetlands.org)  
Web: [www.mekongwetlands.org](http://www.mekongwetlands.org)

A JOINT UNDP - IUCN - MRC GEF-FUNDED PROGRAMME



CAMBODIA



LAO PDR



THAILAND



VIETNAM



The World Conservation Union

