FALSE GHARIAL (*TOMISTOMA SCHLEGELII*) SURVEYS IN SOUTHEAST SUMATRA, INDONESIA (1995-2002)

Wildlife Management International Pty Limited

PROJECT SPONSORS

Fauna & Flora International

Cleveland Zoological Society (Cleveland Metroparks Zoo)

Wildlife Management International Pty Limited

Wetlands International (Greater Berbak – Sembilang Integrated Coastal Wetland Conservation Project)

Sophie Danforth Conservation Biology Fund (Roger Williams Park Zoo)

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November 2002

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Report citation: Bezuijen, M.R., Hasudungan, F., Kadarisman, R., Webb, G.J.W., Wardoyo, S.A., Manolis, S.C. and Samedi (2002). False Gharial (*Tomistoma schlegelii*) surveys in southeast Sumatra, Indonesia (1995-2002). Unpublished Report, Wildlife Management International Pty Limited, Darwin.

Cover photos (M. Bezuijen): The Merang River, South Sumatra Province. Lower reaches (top left) & upper reaches (bottom left, showing intensive illegal logging); captive False Gharial (*Tomistoma schlegelii*) (upper reaches). In 2001-02, collection by logging personnel was a principle threat to False Gharial populations in the Merang River.

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Acknowledgments

This project was conducted at the invitation of the Indonesian Ministry of Forestry. The following government personnel kindly supported the project: Ir. R. Bintoro (Head, Way Kambas National Park), Ir. Dulhadi (Head, BKSDA Sum-Sel), Mr Haidir (BKSDA Sum-Sel), Ibu Faustina Ida Hardjanti (CITES Program), Ir. Istanto (Head, Berbak National Park), Ibu Dewi Kristina (BKSDA Lampung), Professor Benyamin Lakitan (Head, BAPPEDA Sum-Sel), Mr Mukhlisin (Head, Sub-section Way Kambas National Park), Ir. Agus Priambudi (Head, BKSDA Jambi), Ir. Kurnia Rauf (PHKA), Dr Samedi (Head, CITES Programme Indonesia), Ir. Sudarso (BKSDA Sum-Sel), Ir. Mat Suro (representative Governor Musi Banyuasin Regency), Ir. Adi Susmianto (Director, National Conservation Programs, Directorate-General for Forest Protection and Nature Conservation *PHKA*), Ir. Soetiadi Yoesoef (Head, Dinas Kehutanan Sum-Sel) and Ir. H. Robihi Yunus (Head, BAPPEDA Kabupaten Musi Banyuasin). Field assistance was given by Mr Nasrullah, Mr Ginting (BKSDA Jambi), Mr Sismanto, Mr A. Rachman (Berbak National Park), Mr Dadang (BKSDA Sum-Sel), Mr Marpaung (Dinas Kehutanan Sum-Sel), Mr Dedi and Mr Arodin (Way Kambas National Park).

Many other people gave of their time and assistance in the preparation and implementation of this project. We give our sincerest thanks to: Adiosyafri, Dr Amril Adnan, Ir. Belinda Arunarwati, David Ashwell, Mr Bage, Dr Adam Britton, Steven Broad, Dr Jenny Daltry, Andrew Edwards, Francis Hape, Mr Hasan, Yohny Hasan, Craig Hempel, Hellen Kurniati, Irwansyah Reza Lubis, Stacia Martin, Professor Harry Messel, Simon Mickleburgh, Mursan, David Ottway, Kym Parr, Dody Permadi, Dr Siti Prijono, Dr Perran Ross, Samsu, Ir. Dibjo Sartono, Dr Jito Sugardjito, Dandun Sutaryo, Dr Michael Vardon, Drs Prianto Wibowo, Katisha Wilson and Hengkie Wirawijaya. PD Budiman provided logistical assistance in Palembang. F. Hasudungan (Wetlands International) assisted with translation. The project was coordinated and implemented by Mark R. Bezuijen (WMI), who gave his time on a voluntary (unpaid) basis.

The project was made possible through the generous funding of the following organisations:

- Fauna & Flora International (Flagship Species Fund Small Grants Programme 02/16/04);
- Cleveland Zoological Society (Cleveland Metroparks Zoo);
- Wildlife Management International Pty Limited;
- Wetlands International (Greater Berbak–Sembilang Integrated Coastal Wetland Conservation Project – GEF MSP TF-0240011) South Sumatra; and,
- Sophie Danforth Conservation Biology Fund (Roger Williams Park Zoo).

SUMMARY

This report documents surveys of the False Gharial (*Tomistoma schlegelii*) undertaken by Wildlife Management International Pty Limited (WMI) and the Indonesian Ministry of Forestry in southeast Sumatra, Indonesia over the period 1995 to 2002. The False Gharial is an endangered, forest-nesting crocodilian restricted to Sumatra, Borneo and Peninsular Malaysia. Surveys in 2002 (August-September) were undertaken in four locations: the Merang River (South Sumatra Province), Berbak National Park and Simpang Datuk Lake (Jambi Province) and Way Kambas National Park (Lampung Province). This was the fourth year of surveys in the Merang River (previous surveys in 1995, 1996 and 2001) and third year of surveys in Berbak National Park (previous surveys in 1996 and 2001). Both sites support internationally significant populations of False Gharials and of peat swamp forest, itself a globally threatened tropical forest ecosystem that provides critical nesting habitat for the False Gharial.

Surveys in 2001 documented significant changes in both sites compared to 1995-96, including large-scale loss of peat swamp forest and nesting habitat, due to both illegal logging (in the Merang River) and forest fire (in Berbak National Park) (Bezuijen *et al.* 2001a). New monitoring results were obtained in 2002. The growing database of False Gharial densities in these sites is significant, as no other populations of this species are currently being monitored. Simpang Datuk Lake and Way Kambas National Park were previously unsurveyed for any crocodile species.

The survey results contained here were also presented in two False Gharial Workshops, held in South Sumatra Province, in September 2002. The aim of these workshops was to raise awareness among local agencies about both False Gharials and the peat swamp and other habitats in the Merang River area. Workshop results are described by Bezuijen *et al.* (2002) and are summarised in Section 7 of this report. Surveys and workshops were both conducted in cooperation with the Indonesian Directorate-General for Forest Protection and Nature Conservation (Ministry of Forestry). Funding and logistic support were provided by Fauna & Flora International, Cleveland Zoological Society (Cleveland Metroparks Zoo), WMI, Wetlands International (Greater Berbak–Sembilang Integrated Coastal Wetland Conservation Project) and the Sophie Danforth Conservation Biology Fund (Roger Williams Park Zoo).

The Merang River (South Sumatra Province)

1. Surveys in 2002 were conducted from the mouth to 61 km upstream. In previous years the river was surveyed to 67 km upstream, but this was not possible in 2002 due to low water levels. As in previous years, surveys were divided between the 'lower reaches' (the river mouth to 45 km upstream), which supports low secondary forest that has been logged and/or burnt to varying degrees, and the 'upper reaches' (45-67 km upstream), which supports peat swamp forest.

2. Only three False Gharials were seen in 2002, despite excellent survey conditions: one in the 'lower reaches' (density 0.02 False Gharials/km) and two in the 'upper reaches' (0.16/km). As documented in 2001, intensive illegal logging was the principle commercial activity in the upper reaches. Commercial fishing activity was low. Logging began in January 2001 and at the time of surveys (August), had been occurring for 20 months. All commercially valuable timber near the mainstream from 45-67 km upstream had been removed, and logging was expanding away from the mainstream. Log canals extending kilometres into the swamp forest (to float logs to the mainstream) were under construction. Loss and fragmentation of documented and potential nesting habitat was recorded throughout the upper reaches.

3. Surveys in 2002 recorded the lowest number of False Gharials in any survey year, and a rapid decline in False Gharial density in the upper reaches since 2001 (density 0.16/km vs 0.64/km in 2001, Section 3.1.3). This decline, which corresponds with the start of illegal logging and influx of many logging personnel in 2001, appears to be due to removal of False Gharials from the river by non-local logging personnel. From 2001-02, at least 18 False Gharials were found in fish traps and were kept

by non-local loggers, who also collected or killed at least two large (>4 m) False Gharial in 2001. This is more than the total number of False Gharials recorded during 2001-02 spotlight surveys (17). Collection does not appear to be commercially motivated: loggers stated captive individuals were unintentionally caught in fishnets or traps, and were kept as 'curiosity items'. The cumulative loss of False Gharials by collection and mortality (intentional killing or incidental drowning in fishnets) since 2001, as well as loss of any False Gharials from 1997-2000 (before logging began), appears to be resulting in a net decline in False Gharial numbers. Combined with the impact of logging, which probably suppressed nesting activity in the 2001-02 nesting seasons, it is likely that False Gharial density in the upper reaches will continue to decline.

4. In the lower reaches, a less rapid but consistent decline in False Gharial density has occurred since 1995 (Section 3.1.3), accompanied by a decline in local distribution. In 1995, False Gharials were recorded from the river mouth to 67 km upstream, but in 2001-02, were only recorded >35 km upstream. This decline may have been occurring for many years, due to a combination of historic clearance of nesting habitats (little or no nesting appears to have occurred in the lower reaches for many years) and increasing human activity. This decline will probably continue as human activities in the river increase. The dispersal of any False Gharials from the upper to lower reaches may also be affected as human pressures on the wild populations in the upper reaches continue to increase.

5. Illegal logging is resulting in the decline of an internationally significant population of False Gharials in the Merang River. New information in 2002 confirmed the high commercial incentive of illegal logging compared with fishing for local and non-local people (Section 3.2.1). Most loggers are non-local, have no cultural or religious attachment to the river and intend to leave when timber resources are exhausted. At least one large, organized logging operation with personnel extending to Jakarta is present in the river. These facts have important implications for management.

6. The Merang River still retains significant conservation and economic values, and international assistance to manage these values is justified and urgently needed. However, a local and national commitment to halt the illegal logging is required immediately. Without this, the continuing rapid decline of values in the river will soon reduce the effectiveness of international assistance.

Berbak National Park (Jambi Province)

7. Surveys were conducted in the Air Hitam Laut River and Simpang Melaka Creek. Six crocodiles were seen in the Air Hitam Laut River: one False Gharial, two Saltwater Crocodiles *Crocodylus porosus* and three unidentified eyeshines (density 0.22/km). False Gharial density (excluding eyeshines) was 0.03/km. In Simpang Melaka Creek, one eyeshine was seen during spotlight surveys, which was assumed to be a False Gharial (Saltwater Crocodiles have never been recorded in the creek during surveys or by local people). False Gharial density was 0.14/km. Two other False Gharials were recorded in the creek: a nesting female (unseen but whose nest was found), and a 4-5 ft individual seen in the day. This yielded a total of three False Gharials in Simpang Melaka Creek (density 0.42/km).

8. A gradual decline in False Gharial densities has occurred in both waterways since 1996 (Section 4.1.3). This is probably due to large forest fires in 1997-98, which destroyed many kilometres of potential nesting habitat and probably prevented nesting in burnt areas.

9. A single False Gharial nest was located in Simpang Melaka Creek in 2002. This was the first False Gharial nest documented in the park. The nest was in primary peat swamp forest, on a raised peat platform (mound) near the high water mark. The nest contained 13 intact eggs with a total clutch weight of 2.2 kg. Nesting habitat was similar to nest sites documented in the Merang River and elsewhere in Southeast Asia. The availability of raised peat platforms as critical nesting microhabitat

for the False Gharial may be an important factor affecting low nest densities in the park and other sites with large areas of apparently suitable nesting habitat.

Simpang Datuk Lake (Jambi Province)

10. Simpang Datuk Lake is located in an agricultural region near Berbak National Park, in a degraded remnant of peat swamp forest. Local sightings of small False Gharials near the lake, and the documented presence of crocodile slidetrails in lakeside vegetation, indicate a small breeding False Gharial population is probably still present. The lake is visited only intermittently by local people and some form of land designation that retains remaining nesting habitat may still be a viable conservation option.

Way Kambas National Park (Lampung Province)

11. Spotlight surveys were undertaken in three waterways in the south of the park: the Way Kambas River, Way Kanan River and Way Negara Batin River. One Saltwater Crocodile (9-10 ft) and one eyeshine were recorded, in the Way Kambas River. The eyeshine was in saline habitat near the ocean and was probably a Saltwater Crocodile.

12. Based on survey results, habitat assessment and discussions with long-term park officials, False Gharials are either absent or rare in the park. Recent crocodile sightings by park officials were from brackish or saline waterways and appeared to be Saltwater Crocodiles; officials were familiar with Saltwater Crocodiles but not with False Gharials. Habitats in the park appear largely unsuitable for False Gharials. Most rivers are saline or brackish in the lower and upper reaches, and in at least one waterway (Way Negara Batin River), sections >15 km upstream have a sandy substrate and are in dry forest, quite different from documented False Gharial habitats. Surveys remain to be conducted in remote upstream waterways, and in the north of the park, but it is considered unlikely that a breeding population of False Gharials will occur there. The park is considered a low priority for False Gharial conservation.

13. The park probably supports regionally significant Saltwater Crocodile populations. Abundant potential nesting habitat for this species is present, and the range of different sized (small and large) individuals documented during surveys and by park officials indicates successful breeding and recruitment takes place. The species was extensively hunted in Sumatra from the 1950s to 1970s (Bezuijen *et al.* 1997), and protected populations such as this contribute to the recovery of regional populations in Sumatra.

Training

14. As in previous years, field training was provided to local personnel that accompanied the survey team. Training included spotlight survey and data entry techniques, concepts in crocodile conservation and general peat swamp ecology. Since 1995, the number of local agencies accompanying WMI staff in the surveys has increased. In 2002, additional team members included forestry officers from the Department of Conservation of Natural Resources in South Sumatra and Jambi Provinces, rangers from the Berbak National Park and Way Kambas National Park Units, and staff from two local conservation NGOs: Wetlands International-Indonesia Program and Wahana Bumi Hijau.

RECOMMENDATIONS

Merang River and Berbak National Park

Bezuijen *et al.* (2001a) described 12 recommendations for the conservation and management of False Gharials and peat swamp forest in the Merang River and Berbak National Park. These included the preparation of a 'Conservation and Management Plan', control of illegal logging in the Merang River, implementation of an annual False Gharial monitoring program in the Merang River and Berbak National Park, and the hosting of workshops to alert local agencies to these conservation issues. In 2002, two False Gharial workshops and monitoring at both sites took place. Recommendations for the long-term conservation of the Merang River were refined on the basis of input from a wide variety of local agencies and stakeholders during the 2002 workshops (Bezuijen *et al.* 2002). The following recommendations are now made:

RECOMMENDATION 1

Support and implement the 2002 False Gharial Workshop recommendations for the Merang River, namely:

1. Designate a 'Special Protection Region' to protect False Gharial habitat. This zone should encompass the river itself between 40 km and 65 km (upstream from the mouth) and extend to one kilometre each side of the river.

2. Classify the Merang-Kepahyang Rivers swamp forest system as a single 'integrated management planning unit'.

3. Conduct an operation to halt the illegal logging as soon as possible.

4. Review and manage illegal sawmill operations near the river as soon as possible.

5. Identify potential alternatives (to illegal logging) for local communities to earn income.

6. Place limits on the number of non-local people attempting to colonise the Merang River.

7. Invite and encourage the private sector to be involved in management activities.

8. Review and amend annual river 'ownership' lease conditions for the aims of: sustainable use of natural resources; ensuring that local people are the principle benefactors of this system; protection of False Gharial nesting habitat.

9. Conduct an assessment of the biological and economic values of the river.

10. Develop local regulations in the Musi Banyuasin Regency (the administrative region the river is located in) that support the above recommendations.

RECOMMENDATION 2

Organise and conduct as soon as possible a fieldtrip to the Merang River for senior officials from the Local Government of Musi Banyuasin Regency. This will increase local appreciation of the importance of the river, enable continued lobbying for local government support and will maintain an impetus for action between international, national and local agencies.

RECOMMENDATION 3

Initiate a program to encourage local and non-local people in the Merang River not to keep False Gharials.

RECOMMENDATION 4

Obtain medium-large scale funding to prepare and implement the above recommendations for the Merang River. Conservation activities in 2001 and 2002 were supported by short-term, small-scale funding. Future project activities require sustainable funding and a staff presence to implement recommendations.

Simpang Datuk Lake

RECOMMENDATION 5

Conduct a survey to clarify the local conservation status of False Gharials. The survey should be in the False Gharial nesting season (June-September) to enable nest searches. Spotlight surveys are not feasible due to thickly overgrown waterways. Survey methods should include monitoring of haul-out points and slide trails, and baiting and trapping. If a breeding population is confirmed, consideration should be given to designation of some form of protected area status. This should be defined in consultation with local landowners and would allow continued (sustainable) use of natural resources by local communities.

Way Kambas National Park

RECOMMENDATION 6

The park has a low conservation priority for False Gharials, but probably supports an important Saltwater Crocodile population. Future crocodile surveys should include waterways in the north and west of the park (which were unsurveyed here) to confirm the presence/absence of False Gharials in these areas. Future surveys should also monitor the same survey routes undertaken in 2002, in the Way Kambas, Way Kanan and Way Negara Batin Rivers, for repeat monitoring of Saltwater Crocodile populations.

General

RECOMMENDATION 7

Discussions with senior Ministry of Forestry and IUCN Crocodile Specialist Group personnel in 2002 have indicated national and international interest in captive breeding of the False Gharial. A captive breeding program would increase knowledge of the husbandry of this little-known species, assist conservation efforts and create new opportunities for training Indonesian government agencies and NGOs in crocodile conservation. Discussions between key national and international agencies, including WMI, the IUCN-CSG, Indonesian Ministry of Forestry (PHKA) and Indonesian Institute of Sciences (LIPI) could forward this concept, and should include consideration of breeding programs within and outside Indonesia.

RINGKASAN (SUMMARY)

Laporan ini menjelaskan tentang survei-survei yang dilakukan pada Buaya Senyulong (*Tomistoma schlegelii*) pada tahun ke-empat yang dilakukan di Sumatea bagian Tenggara, Indonesia. Buaya Senyulong merupakan satwa yang terancam kepunahan, jenis buaya yang bersarang dalam hutan, penyebarannya terbatas di Sumatera, Kalimantan dan Semenanjung Malaysia. Survei-survei, berlangsung sejak bulan Agustus hingga September 2002, meliputi dua lokasi yang penting secara internasional bagi jenis ini: Sungai Merang (Propinsi Sumatera Selatan), yang juga dikunjungi pada tahun 1995, 1996, dan 2001, serta Taman Nasional Berbak (Propinsi Jambi), yang juga disurvei pada tahun 1996 dan 2001. Kedua lokasi merupakan hutan rawa gambut, suatu ekosistem hutan tropis yang secara global terancam kepunahan yang menyediakan habitat persarangan bagi jenis ini.

Kegiatan survei pada tahun 2001 mencatat perubahan yang signifikan di kedua lokasi bila dibandingkan dengan hasil tahun 1995/96, termasuk hilangnya hutan rawa gambut dalam skala besar dan habitat persarangan, oleh penebangan liar (di Sungai Merang) dan kebakaran hutan (di Taman Nasional Berbak) (Bezuijen *et al.*2001a). Data pemantauan yang baru, dikumpulkan pada tahun 2002. Database ini berkembang secara signifikan, menjadikan kedua daerah tersebut satu-satunya lokasi dimana jenis ini dapat dipantau. Survei-survei singkat juga telah dilakukan pada dua lokasi yang sebelumnya belum dikunjungi yaitu: Danau Simpang Datuk (Propinsi Jambi) dan Taman Nasional Way Kambas (Propinsi Lampung).

Data survei telah dipresentasikan dalam dua kesempatan Lokakarya Buaya Senyulong, yang diselenggarakan di Propinsi Sumatera Selatan pada bulan September 2002, yang bertujuan untuk meningkatkan kesadaran diantara instansi-instansi setempat akan adanya ancaman terhadap konservasi Buaya Senyulong di wilayah Sungai Merang. Hasil lokakarya dijelaskan dalam Bezuijen *et al.* (2002) dan diringkas pada Bab 7. Survei-survei dan lokakarya ini terselenggara atas kerjasama Direktorat Jenderal Perlindungan dan Konservasi Alam (Departemen Kehutanan). Dukungan dana dan logistik disediakan oleh Fauna & Flora International, Cleveland Zoological Society (Cleveland Metroparks Zoo), Wetlands International (Greater Berbak–Sembilang Integrated Coastal Wetland Conservation Project), Sophie Danforth Conservation Biology Fund (Roger Williams Park Zoo) dan Wildlife Management International Pty. Limited.

Sungai Merang (Propinsi Sumatera Selatan)

1. Kegiatan survei di tahun 2002 dilakukan mulai dari muara sungai hingga 61 km ke bagian hulu (pada tahun-tahun sebelumnya sungai ini dapat disurvei hingga 67 km ke arah hulu, namun hal ini tidak dapat dilakukan pada tahun 2002 mengingat rendahnya permukaan air sungai). Seperti pada tahun sebelumnya, survei terbagi menjadi "bagian hilir" (muara sungai hingga 45 km ke arah hulu), yang terdiri dari hutan sekunder yang telah terbakar atau ditebang dalam beberapa tingkatan, serta "bagian hulu" (km 45-67 ke arah hulu), yang masih menyimpan hutan rawa gambut yang relatif utuh.

2. Hanya tiga individu Buaya Senyulong yang teramati pada tahun 2002, meskipun kondisi survei yang sangat mendukung: satu di "bagian hilir" (kerapatan 0,02 Buaya Senyulong/km) dan dua di "bagian hulu' (kerapatan 0,16 Buaya Senyulong/km). Seperti yang tercatat pada tahun 2001, penebangan liar yang intensive merupakan aktivitas komersial yang utama yang berlangsung di bagian hulu. Aktivitas perikanan komersial rendah. Pada saat survei berlangsung, penebangan liar telah berlangsung selama 20 bulan. Seluruh kayu yang bernilai komersiil di dekat aliran sungai utama mulai dari km 45-67 ke arah hulu telah hilang dan penebangan telah semakin jauh dari aliran sungai utama. Parit-parit sejauh berkilo-kilometer mencapai hutan rawa gambut (untuk mengapungkan kayu ke aliran sungai utama) tengah dibangun. Hilang serta terfragmentasinya habitat persarangan yang potensial dan tercatat di sepanjang bagian hulu.

3. Suatu penurunan drastis kerapatan populasi Buaya Senyulong di bagian hulu telah terjadi antara tahun 2001 (kerapatan 0,64/km, bagian 3.1.3) dan 2002 (0,16/km). Hal ini terjadi akibat pemindahan Buaya Senyulong dari sungai oleh penebang dari luar daerah ini. Penurunan ini berhubungan dengan masuknya penebang dalam jumlah besar, dan memulai penebangan liar di bagian hulu pada tahun 2001. Sepanjang tahun 2001-2002, sekurangnya 18 Buaya Senyulong telah ditangkap dan dipindahkan dari bagian hulu oleh penduduk dari luar daerah ini, dan sedikitnya satu ekor Buaya Senyulong berukuran cukup besar (>3 m) terbunuh oleh penebang kayu pada tahun 2001. Jumlah tersebut lebih banyak dari total jumlah Buaya Senyulong yang tercatat dalam survei-survei tahun 2001-02 (17). Penangkapan buaya tidak teramati didorong oleh kepentingan komersil: individu yang ditangkap disimpan sebagai 'barang aneh/unik' oleh penebang dari luar, yang menyatakan bahwa mereka tidak sengaja menangkapnya tertangkap dalam jaring atau bubu. Dampak kumulatif dari penangkapan dan angka kematian mulai tahun 2001, sama dengan hilangnya Buaya Senyulong selama kegiatan penangkapan ikan komersil dari tahun 1997-2000 (sebelum kegiatan penebangan dimulai), hal-hal tersebut menghasilkan suatu penurunan jumlah Buaya Senyulong. Dikombinasikan dengan dampak dari penebangan, yang kemungkinan menekan aktivitas dan usaha bersarang pada musim bersarang tahun 2001-02, hal ini menunjukkan bahwa penurunan kerapatan Buaya Senyulong pada bagian hulu akan terus berlanjut.

4. Pada bagian hilir, penurunan kerapatan Buaya Senyulong terus berlangsung sejak tahun 1995 (Bagian 3.3), diikuti dengan penurunan distribusi lokal. Pada tahun 1995, Buaya Senyulong ditemukan mulai dari muara hingga jauh ke bagian hulu sungai, namun pada tahun 2001-02, hanya ditemukan di atas km 35 ke bagian hulu. Penurunan ini mungkin telah berlangsung beberapa tahun, berdasarkan kombinasi dari kebijakan lama terhadap daerah habitat bersarang (sedikit atau tidak ada lagi ditemukan sarang di bagian hilir) dan meningkatnya aktivitas manusia di bagian hilir. Penurunan ini diperkirakan akan terus berlanjut sejalan dengan meningkatnya aktivitas manusia di sungai. Pengusiran Buaya Senyulong dari bagian hulu ke bagian hilir (kemungkinan sumber utama pengerahan Buaya Senyulong di bagian hilir) mungkin akan mengurangi kerapatan seperti pada bagian hulu yang juga menurun.

5. Penebangan liar mengakibatkan penurunan populasi Buaya Senyulong yang signifikan secara international. Informasi baru pada tahun 2002, menyebutkan besarnya keuntungan komersiil dari penebangan liar dibandingkan dengan kegiatan penangkapan ikan. Kebanyakan penebang bukan penduduk setempat, tidak memiliki budaya dan kepedulian terhadap sungai dan cenderung untuk pergi saat sumber kayu telah habis. Setidaknya satu perusahaan besar, dengan kegiatan penebangan yang terorganisasi dengan baik dan berhubungan hingga ke Jakarta berada di sungai ini. Kenyataan ini sangat berpengaruh penting bagi pengelolaan daerah ini.

6. Sungai Merang masih menyimpan nilai-nilai konservasi dan ekonomi yang signifikan, dan bantuan internasional secara terus-menerus sangat layak untuk mengelola nilai-nilai tersebut. Meski demikian, komitmen dari unsur lokal dan nasional untuk menghentikan penebangan liar sangatlah penting. Sebaliknya, penurunan nilai-nilai yang terus berlangsung di sungai ini akan menyebabkan diragukannya efektifitas dari bantuan internasional.

Taman Nasional Berbak National (Propinsi Jambi)

7. Survei-survei juga telah dilakukan di Sungai Air Hitam Laut River dan Simpang Melaka. Enam buaya teramati di sungai Air Hitam Laut: satu Buaya Senyulong, dua Buaya Muara *Crocodylus porosus* serta tiga mata merah *eyeshines* (Kerapatan 0,22/km). Kerapatan Buaya Senyulong (selain mata-merah *eyeshines*) adalah 0,03/km. Di Sungai Simpang Melaka satu mata-merah *eyeshines* teramati selama survei berlangsung, ini diperkirakan adalah jenis Buaya Senyulong (*C. porosus* belum pernah tercatat ditemukan diadaerah ini selama survei juga menurut penduduk setempat) kerapatan Buaya Senyulong di sungai ini 0,14/km, dua Buaya Senyulong lainnya juga teramati di sungai ini (tidak teramati pada saat survei malam berlangsung): seekor betina yang tengah bersarang

(tidak terlihat namun sarangnya ditemukan) dan individu berukuran 4-5 kaki teramati pada siang hari, menjadikan jumlah total tiga Buaya Senyulong (kerapatan 0,24/km) untuk sungai ini.

8. Suatu penurunan yang bertahap pada kerapatan Buaya Senyulong teramati pada kedua sungai setelah survei pertama WMI/PHPA pada tahun 1996 (Bagian 4.1.3). Berkurangnya kerapatan pada tahun 2001-02 dibandingkan dengan tahun 1996 diperkirakan akibat terjadinya kebakaran hutan sekala besar pada tahun 1997-98, yang menghancurkan berkilo-kilometer habitat bersarang yang potensial dan hampir pasti menghambat persarangan di daerah yang terbakar.

9. Sebuah sarang Buaya Senyulong ditemukan di tepi sungai Simpang Melaka, sarang buaya yang pertama kali ditemukan selama kegitan survei. Sarang ini terletak di hutan rawa gambut primer, pada bagian gambut yang menonjol (gundukan) dekat bagian permukaan air tertinggi. Sarang berisi 13 butir telur utuh dengan total berat 2,2 kg. Habitat bersarang di rawa gambut ini mirip dengan lokasi-lokasi bersarang yang tercatat di tempat lain. Ketersediaan gundukan gambut sebagai mikrohabitat bersarang yang kritis bagi Buaya Senyulong menjadi faktor kunci yang mempengaruhi rendahnya kerapatan sarang di kawasan ini dan juga di tempat lain (seperti Sungai Merang) yang memiliki areal luas yang menunjukkan kelestarian habitat bersarang.

Danau Simpang Datuk (Propinsi Jambi)

10. Danau Simpang Datuk terletak di sisa hutan rawa gambut di daerah pertanian dekat Taman Nasional Berbak. Penduduk setempat mengamati Buaya Senyulong berukuran kecil dekat danau ini, dan teramati adanya jejak/lintasan buaya di bagian sisi danau yang tertutup vegetasi, menunjukkan keberadaan suatu populasi berbiak yang kecil di daerah ini. Danau ini hanya dikunjungi sesekali oleh penduduk setempat dan beberapa bentuk tanah menunjukkan masih adanya habitat bersarang yang masih bertahan.

Taman Nasional Way Kambas (Propinsi Lampung)

11. Survei senter (*spotlight*) telah dilakukan pada tiga bagian sungai di bagian selatan kawasan: Sungai Way Kambas, Way Kanan, dan Way Negara Batin. Satu individu *C. porosus* (9-10 kaki) dan satu mata merah tercatat, di Sungai Way Kambas. Mata merah ditemukan di habitat yang asin dekat dengan laut dan kemungkinan adalah seekor *C. porosus.*

12. Berdasarkan hasil survei, pengkajian habitat dan diskusi dengan staf taman nasional yang telah lama bertugas, Buaya Senyulong tidak ada atau jarang ditemukan di kawasan ini. Temuan buaya oleh staf taman nasional berada di bagian sungai yang payau atau asin dan kemungkinan adalah buaya muara; para staf mengenal jenis ini namun tidak dengan Buaya Senyulong. Habitat di taman nasional ini menunjukkan umumnya tidak cocok untuk Buaya Senyulong. Sebagian besar sungai asin atau payau hingga jauh ke bagian hulu, dan di satu bagian sungai (Way Negara Batin), bagian hulu berpasir dengan hutan yang kering, cukup berbeda dengan tipe habitat Buaya Senyulong yang pernah ditemukan sebelumnya. Survei-survei tetap harus dilakukan di bagian hulu sungai atau di bagian utara taman nasional, namun adanya populasi berbiak Buaya Senyulong tampak kecil kemungkinannya. Taman nasional ini dipertimbangkan sebagai daerah yang kurang menjadi prioritas untuk konservasi Buaya Senyulong.

13. Taman Nasional Way Kambas mungkin mendukung keberadaan populasi *C. porosus* yang signifikan secara regional. Berlimpahnya habitat yang potensial untuk bersarang untuk jenis ini terdapat di kawasan ini, dan ditemukannya keberadaan individu kecil dan besar selama survei berlangsung dan oleh staf taman nasional menunjukkan adanya keberhasilan berbiak. Populasi yang relatif besar dan meningkat ada disini. Jenis ini di Sumatera secara intensif diburu mulai dari tahun 1950-an hingga 1970-an (Bezuijen *et al.* 1997), dan populasi yang terlindungi seperti di sini memiliki nilai konservasi yang tinggi untuk pemulihan populasi regional di Sumatera.

Pelatihan

14. Seperti pada tahun-tahun sebelumnya, pelatihan di lapangan diberikan kepada personil lembaga setempat yang ikut dalam kegiatan survei ini. Pelatihan termasuk tehnik survei senter dan pengisian data, konsep konservasi buaya dan ekologi rawa gambut. Sejak tahun 1995, jumlah instansi yang ikut dalam survei terus meningkat. Pada tahun 2002, anggota tim termasuk staf kehutanan dari Balai Konservasi Sumber Daya Alam Sumatera Selatan dan Jambi, polhut dari Taman Nasional Berbak dan Way Kambas, dan staf dari dua LSM konservasi setempat, Wetlands International-Indonesia Program dan Wahana Bumi Hijau.

ANJURAN-ANJURAN (RECOMMENDATIONS)

Sungai Merang dan Taman Nasional Berbak

Bezuijen *et al.* (2001a) menjelaskan 12 rekomedasi untuk konservasi dan pengelolaan Buaya Senyulong dan hutan rawa gambut di Sungai Merang dan Taman Nasional Berbak. Termasuk di dalamnya mempersiapkan suatu 'Rencana Konservasi dan Pengelolaan' dan secepatnya mengendalikan penebangan liar di Sungai Merang, dan mengimplementasikan suatu program pemantauan Buaya Senyulong di Sungai Merang dan Taman Nasional Berbak. Rekomendasi yang dicapai pada tahun 2002 adalah mengimplementasikan lokakarya/workshop dan melanjutkan pemantauan di kedua lokasi tersebut. Selama Lokakarya Buaya Senyulong tahun 2002, rekomendasi untuk Sungai Merang didiskusikan dan diperbaiki oleh berbagai instansi setempat (Bezuijen *et al.* 2002). Di bawah ini ringkasan dari rekomendasi tersebut.

REKOMENDASI 1

Mendukung dan mengimplementasikan apa yang direkomendasikan dari Lokakarya Buaya Senyulong tahun 2002 untuk Sungai Merang:

1. Merancang suatu daerah Perlindungan Khusus untuk melindungi habitat Buaya Senyulong. Daerah ini harus mencakup Km 40-65 bagian hulu dan satu kilometer setiap sisi sungai.

2. Mengelompokkan system hutan rawa Sungai Merang-Kepahiyang sebagai 'unit perencanaan pengelolaan terpadu'.

3. Mengadakan suatu operasi untuk menghentikan penebangan liar secepat mungkin.

4. Meninjau ulang dan mengatur kegiatan sawmill-liar di dekat sungai secepat mungkin.

5. Mengidentifikasi potensi sumber mata pencaharian lain/alternatif (selain penebang kayu) bersama penduduk setempat.

6. Menetapkan batasan jumlah masyarakat luar yang berusaha bermukim di Sungai Merang.

7. Mengundang dan mendorong sektor swasta untuk ikut terlibat dalam aktivitas-aktivitas pengelolaan.

8. Meninjau ulang dan merubah system kepemilikan lelang tahunan dengan tujuan: pemanfaatan sumber daya alam secara berkelanjutan; meyakinkan penduduk setempat akan dasar-dasar yang menguntungkan dari sistem ini; dan, melindungi habitat berarang Buaya Senyulong.

9. Melakukan suatu pengkajian nilai-nilai biologis dan ekonomis dari sungai ini.

10. Mengembangkan peraturan daerah di Kabupaten Musi Banyuasin yang mendukung saran-saran disebutkan di atas.

REKOMENDASI 2

Segera mungkin mengatur dan mengadakan suatu kunjungan lapangan ke Sungai Merang oleh para pejabat senior Pemerintah Daerah Kabupaten Musi Banyuasin. Hal ini akan meningkatkan penghargaan setempat terhadap pentingnya sungai ini serta memungkinkan pembicaraan lebih lanjut untuk mendapatkan dukungan dari pemerintah setempat. Hal ini juga memelihara dorongan untuk melakukan aksi dan komunikasi yang teratur antara lembaga internasional, nasional dan daerah.

REKOMENDASI 3

Mengusahakan suatu program untuk mendorong penduduk setempat maupun penduduk dari luar Sungai Merang untuk tidak memelihara/menyimpan Buaya Senyulong.

REKOMENDASI 4

Mendapatkan dana skala menengah-besar untuk mempersiapkan serta mengimplementasikan ke-10 aktivitas yang terangkum dalam Rekomendasi 1. Aktivitas konservasi yang telah dilakukan pada tahun 2001-02 didukung oleh dana berjangka pendek, yang berskala kecil. Kegiatan-kegiatan proyek di masa mendatang membutuhkan dana yang berkelanjutan serta adanya staf untuk meneruskan/melaksanakan rekomendasi-rekomendasi tersebut.

Danau Simpang Datuk

REKOMENDASI 5

Melakukan suatu survei untuk memperjelas status konservasi Buaya Senyulong di daerah ini. Survei harus dilakukan pada saat musim berbiak (Juni-September) yang memungkinkan pencarian sarang. Survei senter tidak memungkinkan mengingat begitu rapatnya badan sungai ditutupi oleh rerumputan. Metode survei dapat termasuk pemantauan titik-titik perhentian dan lintasannya, pengumpanan dan perangkap/penangkapan. Jika keberadaan populasi berbiak ditemukan, pertimbangan harus diberikan untuk merancang suatu kawasan lindung, yang harus menjamin berlangsungnya pemanfaatan sumber daya alam oleh penduduk setempat. Sebagian kecil dari daerah ini, yang kadang-kadang dikunjungi oleh penduduk, pada kesempatan yang sama dapat menjadi perlindungan yang efektif bagi Buaya Senyulong serta meningkatkan penghargaan penduduk terhadap jenis ini.

Taman Nasional Way Kambas

REKOMENDASI 6

Taman nasional ini memiliki prioritas yang rendah untuk konservasi Buaya Senyulong, namun dapat mendukung populasi penting Buaya Muara. Survei-survei buaya yang akan datang diharapkan dipusatkan pada badan sungai dibagian utara taman nasional inidan daerah dekat perbatasan di bagian barat (yang tidak tersurvei) untuk memperjelas keberadaan Buaya Senyulong di taman nasional ini. Pengulangan survei di Way Kambas, Way Kanan dan Way Negara Batin Rivers akan memungkinkan pengulangan pemantauan populasi Buaya Muara.

General

REKOMENDASI 7

Hasil diskusi dengan pejabat senior di Departemen Kehutanan dan personil IUCN Crocodile Specialist Group pada 2002 telah menunjukkan adanya perhatian nasional maupun internasional untuk menangkarkan Buaya Senyulong. Hal ini akan meningkatkan pengetahuan tentang penangkaran jenis yang kurang dipahami ini, usaha konservasi selanjutnya dan menciptakan kesempatan-kesempatan baru untuk melatih lembaga-lembaga pemerintah serta lembaga non-pemerintah dalam konservasi buaya. Dianjurkan bahwa potensi pembentukan suatu program penangkaran di Indonesia dan daerah lain untuk dibahas oleh lembaga nasional dan internasional yang terkait, termasuk WMI, IUCN-CSG, Departemen Kehutanan Indonesia (Dirjen PHKA) serta Lembaga Ilmu Pengetahuan Indonesia (LIPI).

1. INTRODUCTION

This report documents the fourth year (2002) of False Gharial (*Tomistoma schlegelii*) surveys undertaken by Wildlife Management International Pty Limited (WMI) and the Indonesian Ministry of Forestry (PHKA) in southeast Sumatra, Indonesia, between 1995 and 2002. Surveys in 2002 were undertaken from August-September in four locations: the Merang River (South Sumatra Province), Berbak National Park and Simpang Datuk Lake (Jambi Province) and Way Kambas National Park (Lampung Province). This was the fourth year of surveys in the Merang River (previous surveys in 1995, 1996 and 2001) and third year of surveys in Berbak National Park (previous surveys in 1996 and 2001). Simpang Datuk Lake and Way Kambas National Park were previously unsurveyed for any crocodile species. Surveys were conducted in coordination with two False Gharial Workshops, held in South Sumatra Province in September 2002 (Bezuijen *et al.* 2002).

1.1 Background

The False Gharial is a freshwater, forest-nesting crocodilian restricted to Sumatra, Borneo and Peninsular Malaysia. Its historic range included Thailand, where it now appears to be extinct. It is a large, mound-nesting crocodile species, with males attaining total lengths of 5-6 m. The species is classified as 'Endangered' by the IUCN, and occurs in peat swamp forest, a globally threatened tropical forest ecosystem that was historically distributed throughout the lowlands of Sumatra, Borneo and Peninsular Malaysia (MacKinnon *et al.* 1996; Whitten *et al.* 1984). The False Gharial is rated a high research and conservation priority by the IUCN Crocodile Specialist Group (CSG) (Ross 1998; Thorbjarnarson 1992) and was the subject of a three-year (1994-96) research program by the CSG, WMI and Indonesian Ministry of Forestry. One key finding of this survey program was the location of two sites in southeast Sumatra with internationally significant False Gharial breeding populations and intact peat swamp forest: the Merang River (South Sumatra Province) and Berbak National Park (Jambi Province) (Fig. 1) (Bezuijen *et al.* 1995a,b, 1997, 1998). Both sites, which were surveyed in 1995-96, support some of the last large, intact remnants of peat swamp forest in western Indonesia (Danielsen & Verheugt 1990).

After 1995-96, no False Gharial surveys were conducted in Sumatra until 2001, when a rapid appraisal of the Merang River and Berbak National Park was considered timely after both the extensive forest fires in southern Sumatra in 1997-98, and the Indonesian economic crisis of 1997 (Bezuijen *et al.* 2001a).

In 2001, significant changes to False Gharial nesting habitat since 1995-96 were documented in both sites. In the Merang River, illegal selective logging had begun in 2001, and was rapidly destroying the peat swamp forest and False Gharial nesting habitat. In contrast to many nearby regions, the swamp forests of the Merang River remained unburnt. In Berbak National Park, many kilometres of riverine swamp forest (potential False Gharial nesting habitat) was destroyed in the 1997-98 forest fires. The rapid appraisal confirmed that, despite these changes, both sites continued to support internationally significant populations of False Gharials (Bezuijen *et al.* 2001a).

1.2 Survey objectives

The objectives of the 2002 False Gharial work program were to:

1. Collect information on False Gharial densities and nesting habitat in the Merang River and Berbak National Park, so that status relative to 1995-96 and 2001 could be assessed, even if management actions to address conservation threats in the Merang River were delayed.

2. Document current human activities and threats to the False Gharial in the Merang River, and compare them to levels reported in 1995-96 and 2001.

3. Implement a False Gharial Workshop in South Sumatra Province that would:

    - enable rapid and effective dissemination of 2001-02 survey results to relevant agencies and stakeholders;

    - raise stakeholder support for conservation and management of the False Gharial and peat swamp forest in the Merang River;

    - formulate specific recommendations, developed by local workshop participants, for management of False Gharial nesting habitat and peat swamp forest in the Merang River, and distribute these to local agencies and stakeholders.

4. Continue training of local forestry officers in crocodile survey and conservation techniques.

5. If funds and time permitted, conduct surveys in new sites to document new information on the status and distribution of the False Gharial in Sumatra.

This report documents the results of False Gharial surveys in 2002. False Gharial workshops are described in Bezuijen *et al.* (2002) and are summarised in Section 7 of this report.

2. METHODS

Survey methods used, and study sites in the Merang River and Berbak National Park, are described in detail by Bezuijen *et al.* (2001a). Only a summary is presented here.

2.1 Study areas

Survey sites are located in a large belt of low-lying, tidal floodplain, termed the 'Eastern Lowlands', which extends from southern to northern Sumatra. These lowlands comprise some 18% (88,000 km^2) of the island, mostly in the provinces of Riau, Jambi and South Sumatra (Claridge 1994; Fig. 1), and consist mainly of alluvial and marine deposits, frequently overlain by a layer of peat that may reach depths of 20 m (Danielsen & Verheugt 1990). Historically, the Eastern Lowlands supported extensive peat swamp and freshwater swamp forests, with riverine forest along river levees and mangrove belts along the coast (Claridge 1994). In the last several decades, large areas have been burnt or cleared and now support a mosaic of primary and secondary swamp forest, scrub, grasslands and croplands.

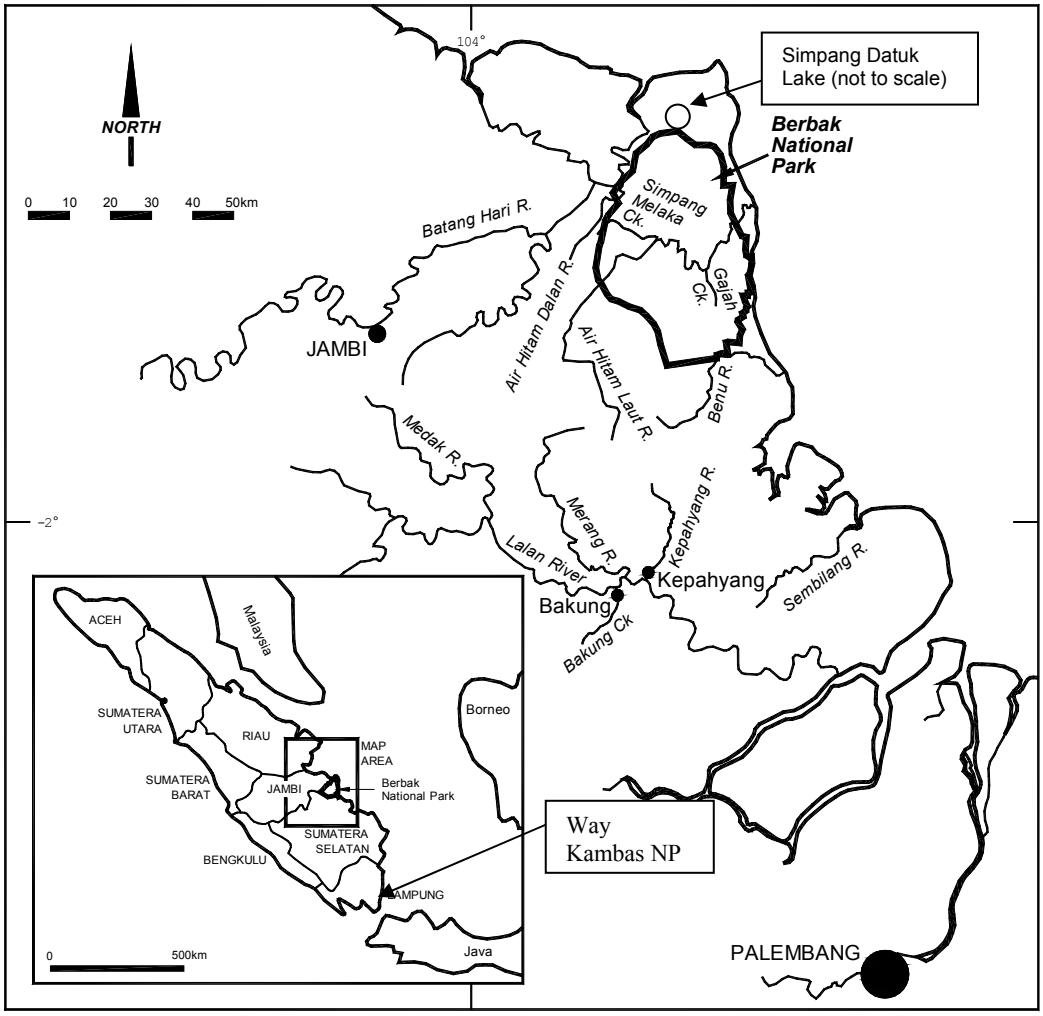

Fig. 1. Localities mentioned in the text.

Large, meandering rivers dominate the lowlands. Tidal range may reach 5 m in some areas, but is highly variable. Tidal influence extends well upstream into totally freshwater areas (Hadi *et al.* 1977). There is usually one tidal cycle per day, but can be two per day during neap tides. Mean annual rainfall in Sumatra is 2200-2500 mm, with peak rainfall from December to March, within a

general wet season lasting 7-9 months (October-April) (Whitten *et al.* 1984). Survey regions are subject to a distinct dry season lasting 3-5 months (May-September), with less than 60 mm rainfall per month. Mean annual ambient temperatures range from 23-31^{0}C and mean annual relative humidity is 85% (Whitten *et al.* 1984).

2.1.1 The Merang River

The Merang River (1^{0}59S, 104^{0}00'E) is a 67 km long, freshwater tributary of the Lalan River, in the northeast of South Sumatra Province (Fig. 1). It is located approximately 30 km from the southern border of Berbak National Park (Section 2.1.2), with which it shares contiguous subsurface peat formations (Danielsen & Verheugt 1990). It is part of a relatively small area in the province that is located on deep peats and which historically supported extensive tracts of peat swamp forest (Danielsen & Verheugt 1990).

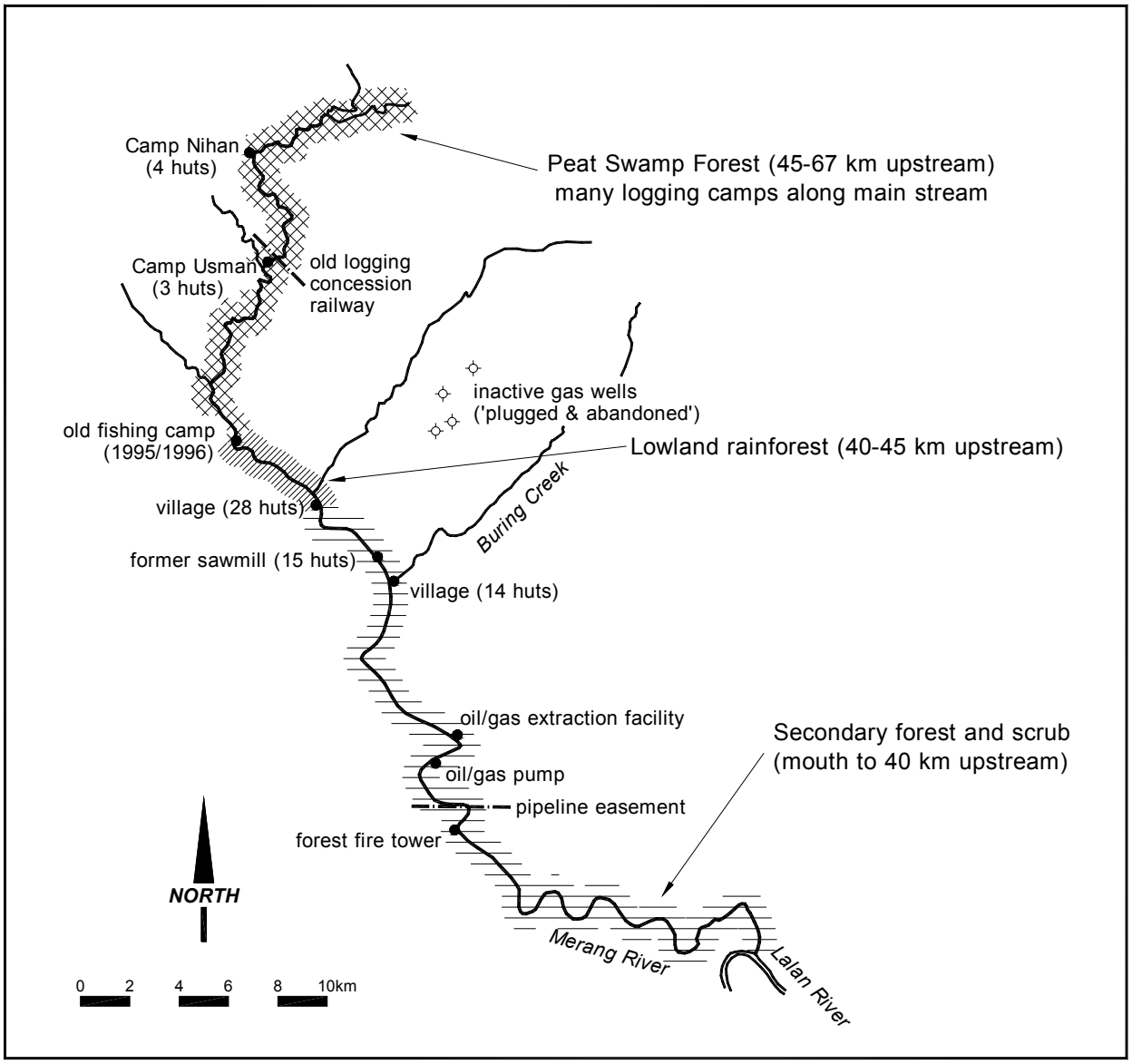

Fig. 2. The Merang River, South Sumatra Province, in 2001 (after Bezuijen *et al.* 2001a). Conditions were relatively unchanged in 2002.

For the purpose of conducting and reporting crocodile survey results, the Merang River was divided into the 'lower reaches' and 'upper reaches', reflecting differences in habitats and survey conditions (Fig. 2). The 'lower reaches' (river mouth to 45 km upstream) are tidally influenced and support secondary forest and scrub modified by fire and logging. Soils are dry, firm and clay-like, and there are relatively few sidecreeks. The 'upper reaches' (45-67 km upstream) are not tidally influenced, and support unburnt peat swamp forest. Soils are waterlogged, acidic, peaty and overlain by a deep leaf litter layer. Unlike the lower reaches, the forest floor and river banks are not flat and continuous, but are a mosaic of raised peat platforms (mounds) and small waterways. Sidecreeks in the upper reaches are numerous and extend up to several hundred metres from the mainstream. The quality and intactness of the peat swamp forest in the upper reaches has degraded rapidly since 2001 due to intensive illegal logging, but the lower reaches have remained relatively unchanged since 1995 (Bezuijen *et al.* 2001a).

Most people live in small, scattered settlements in the lower reaches and there are no permanent settlements in the upper reaches. The human population in 2001-02 was relatively small (<2000 people) and most of the river is uninhabited, with <10 permanent/semi-permanent clusters of huts in the river, and low numbers of single huts scattered in the lower reaches (Fig. 2). However, obvious changes have occurred since 1995, including an increase in the human population and a steady movement of people upstream (Section 3.2.4). The number of seasonally-occupied huts (huts only occupied for part of year, for example during the dry season) in the upper reaches has increased since 1995-96. The lower reaches are navigable by large motorised boats, but only small motorised boats and canoes can be used in the upper reaches.

2.1.2 Berbak National Park

Berbak National Park encompasses the largest protected area of peat swamp and freshwater swamp forest in the Asia-Pacific region (more than 160,000 ha), and is Indonesia's first Ramsar site (Davie & Sumardja 1997; Anon 2000). The park overlies deep (>10 m) peat domes, and supports internationally significant populations of many threatened fauna species. The major waterways in the park are the Air Hitam Dalam River, Air Hitam Laut River and Simpang Melaka Creek. All are freshwater, acidic, 'blackwater' rivers and (based on 1:250,000 topographic maps) are at least 30, 70 and 20 km long respectively. The lower reaches of these waterways are tidally influenced. All three rivers were surveyed in 2001, but only the Air Hitam Laut River and Simpang Melaka Creek were surveyed in 2002.

The Air Hitam Laut River (1^{0}19'15.0"S, 104^{0}26'18.4"E) and Simpang Melaka Creek (1^{0}22'21.9"S, 104^{0}20'57.7"E) (Fig. 1) are located within primary peat swamp and freshwater swamp forest. In the Air Hitam Laut River, which drains to the sea, river banks are dominated by nipah palm (*Nypah fructicans*) until 16 km upstream, and then pandanus (*Pandanus tectorius*). From 20 km onwards, the banks are partly obscured by thick stands of *Hanguana malayana*, a large floating macrophyte, which blocks progress by speedboat 31-32 km upstream. Simpang Melaka Creek drains into the Air Hitam Laut River 22 km upstream. From the mouth to 3 km upstream, the creek retains primary peat swamp forest. In both waterways, large areas of riverine forest were destroyed by forest fires in 1997-98, and little regrowth was present in 2001. Burnt areas extended from 27 km upstream in the Air Hitam Laut River and from 3 km upstream in Simpang Melaka Creek (Bezuijen *et al.* 2001a). Unburnt soils along both waterways are peaty and relatively dry in the dry season, and banks are mostly flat (as compared to the waterlogged soils and raised peat platforms in the Merang River). A village is present at the mouth of the Air Hitam Laut River, which in 1997 supported approximately 2300 people (Anon 2000). From the mouth to 31 km upstream the river is navigable by speedboat. Simpang Melaka Creek is only navigable by canoe.

2.1.3 Simpang Datuk Lake

Simpang Datuk Lake is located near the northern boundary of Berbak National Park in Jambi Province (Fig. 1), and is described in Section 5.

2.1.4 Way Kambas National Park

Way Kambas National Park is located in the southeast of Lampung Province ($4^0$37'-$5^0$16'S, $105^0$55'E, Fig. 1) and encompasses 130,000 ha of lowland forests. The north, west and south park boundaries border an agricultural region with more than half a million residents (Franklin *et al.* 1999). The east boundary borders the Java Sea. A small headquarters is located 13 km inside the park. The park historically supported lowland tropical rainforest, freshwater and peat swamp forest, mangroves and coastal vegetation, but extensive logging from 1968-71 and forest fires between 1972 and 1997 have created a mosaic of early successional forests of the above types, and large areas of *Imperata* grassland (BTNWK 2000). Dry lowland forest is the largest forest type in the park. The park is well known for populations of three critically endangered species, the Sumatran Tiger (*Panthera tigris sumatrae*), Sumatran Rhinoceros (*Diceroyhinus sumatrensis*) and White-winged Duck (*Cairina scutulata*) (BTNWK 2000; Drilling 2001; Franklin *et al.* 1999). Numerous waterways occur in the park, which mostly drain to the sea.

Surveys were conducted in the south of the park, in the Way Kambas River (mouth to 20.5 km upstream), Way Negara Batin River (mouth to 7.6 km upstream) and Way Kanan River (the right fork of the Way Kambas River, from the Way Negara Batin River to 8.5 km upstream). These waterways are relatively large (20-50 m wide downstream), tidally-influenced, and are saline or brackish until far upstream. Mature secondary lowland rainforest (10-25 m high) dominates these waterways, although large areas in all waterways were burnt in 1997-98 and support post-fire grassland, shrub and sapling regrowth, and *Melaleuca* swamps. The Way Kambas River drains to the sea and supports mangrove, 'nipah' *Nypah fructicans* and 'nibung' *Oncopserma* spp. near the coast. In the Way Kanan River, tall secondary forest is extensive, and thick vegetation hinders upstream passage by canoe 8.5 km upstream. Habitats along waterways far upstream were not recorded, but c. 20 km upstream in the Way Negara Batin River (where an access track crosses the waterway), the river is only 5-7 m wide, sandy and semi-dry in the dry season. Banks along each waterway are relatively flat, and muddy or dry (unlike the waterlogged peat soils and raised peat platforms in the Merang River). The Way Ajhang Creek (a small tributary of the Way Kambas River near the Way Negara Batin River) was visited briefly but not surveyed. The lower reaches were burnt in 1997 and support a mosaic of seasonally inundated swamp, *Melaleuca* stands, post-fire shrub regrowth (3-5 m high), grassland and small areas of secondary forest.

2.2 Spotlight surveys

False Gharial densities (number of individuals per kilometre of river) were assessed by spotlight surveys. Spotlight surveys do not measure absolute abundance, but provide an index of relative density which allows changes in population size and structure to be quantified over time (Bayliss 1987; Messel *et al.* 1981). Surveys were conducted from a speedboat or canoe, depending on the navigability of the river, and were restricted to the dry season. They began 1-2 hr after dark and the spotlight (12V / 100 W bulb on a 6" sealed-beam face) was powered from a 12V truck battery. In canoe surveys, in narrower parts of waterways, 6V *Dolphin* torches were used. When possible, surveys in tidal areas were initiated at low tide, when more crocodiles are visible at the water's edge (Messel *et al.* 1981). However, the short time available in each river necessitated that some surveys were conducted on rising or even high tides. Survey start and finish locations and crocodile sightings were recorded with a Garmin 12 CX global positioning system. Crocodiles were identified to species

or recorded as ‘eyeshine’ if only the eye reflection was seen. Estimated size (length) was recorded in foot categories (1-2 ft, 2-3 ft etc) where possible.

Crocodile densities were derived for each river and, in the Merang River, for the upper and lower reaches separately, which support different habitats. To account for repeat sightings of individuals within sections of river surveyed more than once, False Gharial sightings on repeat surveys were ignored for individual survey sections, unless these individuals were at least one size class apart (Bezuijen *et al.* 1997).

2.3 Nests and nesting habitat

Surveys were timed to coincide with the False Gharial nesting season (approximately June-September). Nest searches were conducted in the upper reaches of the Merang River and in Berbak National Park. Logging personnel and fishermen were interviewed for local reports of crocodile nesting. Peat swamp forest nesting habitat in the Merang River from 45-61 km upstream was quantified in 30 m diameter habitat quadrats, with over 20 structural and floristic attributes recorded, including land use, vegetation structure and soil (Bezuijen *et al.* 2001). This provided training in concepts of peat swamp ecology to local counterparts, and enabled some quantitative data on the impacts of logging to be obtained. Seven quadrats were measured and will be added to an existing database for later analysis.

2.4 False Gharial capture and morphometrics

No False Gharials were captured during surveys, but five individuals that were being kept in captivity (ranging from 141 - 179 cm total length) were measured. Morphometric data from these individuals will be entered into the existing morphormetrics database (Bezuijen *et al.* 1995a) for later analysis.

2.5 Interviews with local people

Informal interviews were conducted with logging personnel, local fishermen and park officials. As in previous years, interviews were an important source of information on False Gharials, changes in human activity and changes in resource use patterns.

2.6 Training local counterparts

As with previous surveys, training of local counterparts was a key project aim. Personnel from a range of local agencies accompanied the surveys. The team to the Merang River comprised staff from the South Sumatra Department of Conservation of Natural Resources (BKSDA) (R. Kadarisman and Dadang), Forestry Bureau (*Dinas Kehutanan*) (Mr Marpaung), WI-IP (Yanto) and Wahana Bumi Hijau, a local NGO (Adiosyafri). The team to Berbak National Park and Simpang Datuk Lake comprised staff from BKSDA (Jambi Province) (Mr Nasrullah and Mr Ginting), Berbak National Park Unit (Mr Sismanto and Mr A. Rachman) and WI-IP (F. Hasudungan). Training was given in crocodile spotlight survey techniques, navigation and data sheet entry, crocodile and nest measurement techniques and in peat swamp ecology generally. Personnel that accompanied surveys were provided with certificates describing their involvement (Appendix 5).

3. THE MERANG RIVER

3.1 The False Gharial

3.1.1 Distribution and abundance in 2002

Five spotlight surveys were conducted (9-14 August 2002), from the mouth to 61 km upstream (Appendix 1). In contrast to previous years, the upper reaches (45-67 km upstream) were incompletely surveyed due to extremely low water levels that prevented canoe access beyond 61 km. Water levels in 2002 were the lowest yet seen. For the first time during surveys, all sidecreeks in the peat swamp forest were dry. The upper reaches were surveyed from 45-56 km and 59.4-61 km upstream: a total of 12.6 km, compared to the total 22 km of upper reaches surveyed in previous years.

A total of three False Gharials were seen (excluding possible repeat sightings and assuming all eyeshines were False Gharials): two in the upper reaches (52.5 and 55.2 km upstream) (density 0.16 individuals/km) and one in the lower reaches (43 km upstream) (density 0.02/km) (Table 1). Eyeshines in the upper reaches were assumed to be False Gharials, the only crocodile species that has been recorded in this area during surveys or by local people (Bezuijen *et al.* 1995b, 1997, 2001a).

Table 1. *Tomistoma schlegelii* survey results (excluding repeat sightings) in the Merang River, South Sumatra Province, 9-14 August 2002. km 0 - river mouth. ES - Eyeshine.

River	Location (km readings)	Total km surveyed	Size classes (ft) 1-2	2-3	3-4	4-5	>6	ES	Total	Density (crocs/km)	
Merang (lower)	0-45	45	-	1	-	-	-	-	1	0.02	(over 45 km)
Merang (upper)	45-61	12.6	-	-	-	-	-	2	2	0.16	(over 12.6 km)

Spotlighting effort was unequal between the lower and upper reaches (Section 2.2), although only two '5 km river sections' in the upper reaches were surveyed more than once (Table 2).

Table 2. Spotlighting effort (mouth to 61 km upstream) and crocodile density for 5 km sections in the Merang River, South Sumatra Province, 9-14 August 2002. ES - Eyeshine. Method for excluding repeat sightings is in Section 2.2.

Survey sections (km)	No. times whole or partly surveyed	Total *T. schlegelii* (all surveys)	No. excluded (possible repeat sightings)	Final tally	Density crocs/km
0-40	1	0	-	0	0
40-45	1	1 (TS 2-3 ft)	0	1	0.2
45-50	1	0	0	0	0
50-55	2	2 (ES x2)	1	1	0.4
55-60	2	1 (ES x1)	0	1	0.2
60-65	1	0	-	0	0
65-67	0	0	-	-	-
Density lower reaches km 0-45 (1 croc/45 km)					**0.02**
Density upper reaches km 45-56 & 59.4-61 (2 crocs/12.6 km)					**0.16**

Two local people (Mr Usman, a logger and Mr Suaemi, a fisherman) reported they 'frequently' saw False Gharials in the forested upper reaches in 2002, similar to interview results with local people in 2001 (Bezuijen *et al.* 2001a). In the lower reaches, illegal loggers near the river mouth had not seen any crocodiles, but had only been present for one month. In 2002, no new sightings of large

crocodiles were reported by local people, in contrast to 2001, when three sightings of False Gharials >3 m total length were reported (Bezuijen *et al.* 2001).

Five captive False Gharials were observed during the survey. It was claimed all had been trapped unintentionally during fishing activities, by non-local logging personnel, and were being kept as 'curiosity' items with no apparent commercial purpose. Three were caught in July 2002, 46 km upstream, on baited fish-hooks set for large fish, and were being held in fishboxes at a small village 40 km upstream. Two were caught in August 2002, 54.5 km upstream, in baited fish traps, and were being kept at a logging camp 55 km upstream (by Mr Usman). Individuals ranged from 141.3-179.2 cm total length. None were individuals that had been captured and scute-marked during previous surveys in 1995-96 (Bezuijen *et al.* 1995b, 1997).

3.1.2 Nesting

No False Gharial nests were located during surveys, or were reported by local people. As noted in 2001, the lack of nest sightings by local people, despite relatively high numbers of people in the peat swamp forest, is unusual and may reflect a decline in nesting activity compared to 1995-96. It could also be related to the exceptionally dry season, which is known to reduce the extent of nesting in other wild crocodilian populations. However, the lack of nest sightings in 2001-02 also corresponds with the start of extensive illegal logging since 2001, which has caused extensive physical damage to False Gharial nesting habitat (including former documented nest sites) (Bezuijen *et al.* 2001a) and which has removed the relative tranquillity that characterises this habitat in the absence of logging.

3.1.3 Changes since 1995

Survey data from the Merang River are summarised in Table 3. Data for the lower reaches includes a part survey of the river in 1990 by J. Cox (unpubl. data).

Table 3. Summary of *Tomistoma schlegelii* survey data for the 'lower' and 'upper' reaches of the Merang River, South Sumatra Province (excluding repeat sightings). 1990 results are for km 0-23. ES – Eyeshine.

Year	Size classes (ft)					ES	Total	Density	Source
	1-2	2-3	3-4	4-5	5-6			(crocs/km)	
Lower reaches (0-45 km)									
1990	1 False Gharial seen, no size given						1	0.04	J.Cox (unpubl. data)
1995	-	2	-	2	-	3	7	0.16	Bezuijen *et al.* (1995b)
1996	-	1	-	-	-	1	2	0.04	Bezuijen *et al.* (1997)
2001	-	-	-	1	-	-	1	0.02	Bezuijen *et al.* (2001a)
2002	-	1	-	-	-	-	1	0.02	
Upper reaches (45-67 km upstream)									
1995	-	2	-	-	-	5	7	0.34	Bezuijen *et al.* (1995b)
1996	-	2	2	-	1	5	10	0.49	Bezuijen *et al.* (1997)
2001	1	9	3	-	-	1	14	0.64	Bezuijen *et al.* (2001a)
2002	-	-	-	-	-	2	2	0.16	

Bezuijen *et al.* (2001a) described changes in False Gharial status between 1995 and 2001, and these assessments can now be updated with the 2002 survey data:

- False Gharial populations within the Merang River appear to be declining in both the lower and upper reaches (Table 3). A rapid and steep decline in density has occurred in the upper reaches between 2001 and 2002. A more gradual decline has occurred in the lower reaches since 1996 (Table 3). False Gharial distribution in the lower reaches may also have declined. In 1995-96,

False Gharials were recorded from the mouth to 45 km upstream (ie throughout the lower reaches), whereas in 2001-02 they were only recorded >35 km upstream.

- A decline in False Gharial density in the upper reaches is of particular concern, because the upper reaches have always supported higher densities than the lower reaches, and until recently have retained critical peat swamp nesting habitat. Most recruitment in the river probably originates from nesting in the upper reaches (little or no nesting appears to have occurred in the lower reaches for many years, due to a lack of suitable habitats and increasing human activity). This observed decline is likely to be an accurate reflection of a reduction in absolute numbers, because due to extremely low water levels, survey conditions in 2002 were excellent. In all previous surveys, sidecreeks in the upper reaches contained water, and mainstream surveys possibly missed individuals in sidecreeks. With all sidecreeks dry in 2002, it is reasonable to assume most False Gharials would have been in the mainstream, where low water levels gave an unusually high probability of sighting during the surveys.

- The rapid decline of small and large False Gharials in the upper reaches since 2001 coincides with the start of illegal logging, which has resulted in a large influx of non-local people and extensive damage to nesting habitat since 2001. The decline appears to be due to collection or removal of False Gharials by non-local people. According to logging personnel, from 2001-02 at least 18 False Gharials were inadvertently trapped in fishnets/traps and were being kept (including at least one potential breeding individual >4 m total length): more than the number recorded during surveys in this period (17). Loggers stated that False Gharials were kept as 'curiosity items'. A second, large (>4 m) False Gharial was caught and killed (out of fear) by loggers in 2001 (Bezuijen *et al.* 2001a). The total number of False Gharials collected or lost in recent years is probably higher, as other individuals may have been collected or drowned in fishnets from 1997-2000, before logging began (False Gharials are susceptible to drowning in fishnets, Bezuijen *et al.* 2001b; Frazier 2000). The collection or death of large, sexually mature False Gharials may cause disproportionately high impacts to the population, if few breeding individuals are present in the river. Collection and other forms of removal appear to be causing a rapid and immediate decline in False Gharials in the upper reaches. In the longer-term, continued illegal logging is likely to suppress nesting due to loss of nesting habitat and increased human disturbance of nest sites.

- False Gharial populations in the lower reaches may have been in decline for many years, due to historic clearance of nesting habitats and increasing human activity in the lower reaches. Since 2001, any dispersal of False Gharials from the upper to lower reaches may also have been impacted due to logging in the upper reaches. As development in the lower and upper reaches increase, this decline will probably continue.

- The decline in False Gharial populations in the upper and lower reaches is unlikely to stop unless the pressures of collection, and of habitat loss by logging, are controlled. Continuing loss of False Gharials and nesting habitat may result in local extinction. It is unlikely to be replaced rapidly by recruitment from nearby rivers, because most nearby rivers have been logged or burnt and False Gharial populations are small or absent (Bezuijen *et al.* 1995b, 1997).

3.2 Human activities in 2002

Changes in human activities since 1995 are described in Bezuijen *et al.* (2001a). These factors were largely unchanged in 2002. Illegal logging continued to be the largest commercial activity in the river and the greatest threat to its conservation values.

3.2.1 Illegal logging

Most illegal logging since 2001 has occurred in the peat swamp forest 45-67 km upstream. At the time of surveys (August 2002), logging had been occurring in this section for 20 months. Logging was expanding west of the mainstream, toward the swamp forest between the Merang and Medak Rivers (Fig. 1). Within the lower reaches, most illegal logging since 2001 has occurred in a zone of tall secondary forest 40-45 km upstream, which was still being logged in 2002. A new, small (10 person) log camp was observed near the river mouth in 2002. New information on the largest organised logging operation in the upper reaches was obtained from the field manager of this operation (Mr Usman pers. comm., 14th August 2002) and is summarised below.

- *Extent of logging.* This logging operation is located 54-55 km upstream. Logging extends one kilometre along the river and 'as far inland as can be logged' (base camp is 55 km upstream, Fig. 2). The operation includes a field manager (Mr Usman), a regional leader (the owner of Kepahyang Sawmill at Kepahyang Village, Fig. 1), a province leader (in Palembang) and a national leader (in Jakarta). Logging has moved from the mainstream to 2-3 km west of the mainstream. Foot surveys 'up to 7 km' west of the river revealed 'tall, good quality' forest and 'large timber stocks'. Good timber stocks occur west of the river because this region was last logged 20 years previously (by the former legal concession) and supports good regrowth.

- The operation will continue at least another three years in the Merang River. Log canals extending into the forest are being dug to float logs out. [Canals are 1-2 m wide, 1 m deep, and extend kilometres into the forest, pers. obs.]. The company employs 43 logging personnel in the river, of which 16 construct log canals. Employees live in seven camps throughout the logging areas. Nine chainsaws are used for logging.

- *Timber value at local sawmills.* Most illegal timbers are hardwoods (Dipterocarpaceae) and are sold to two sawmills at Kepahyang and Bakung Villages (Fig. 1). The Kepahyang sawmill is legally licensed to purchase and process timber, but buys illegal timber. In August 2002, sawmill prices for illegal timber were: 'Ramin' - 120,000 Rp/cubic metre (US$13.5, exchange rate August 2002 US$1 = 8900 Rp); 'Meranti' (*Shorea* spp.) - 140,000 Rp/cubic metre (US$15.7); '*Jelutung*' (wild latex *Dyera costulata*) - 170,000 Rp/cubic metre (US$19) for logs >30 cm diameter [*Jelutung* occurs in the Merang River but was heavily logged in the 1980s and commercial harvesting is no longer viable]; '*Rajuk*' [a general grouping of less valuable timbers from different species, including 'Durian', 'Hijuk' and 'Ketiau'] - 120,000 Rp/cubic metre (US$13.5). Prices fluctuate between groups and years.

- *Salary of logging personnel.* Workers earn 1,000,000 Rp (US$112)/person/month. This is a fixed salary for a fixed volume of timber, usually 200 cubic metres, irrespective of time taken to harvest the timber. A team of 4 workers may take 2-3 months to harvest, prepare and transport this volume to the sawmill: 4 weeks logging, 2 weeks assembling log rafts and 2 weeks transport (log rafts are floated downstream then pulled by motorised boat to the sawmill). The 'company' also supplies food and equipment to workers. The Kepahyang sawmill owner lends money to Mr Usman for logistical expenses.

- Mr Usman earns a net income of 15-30,000,000 Rp/month (US$1,685-3,370). The sawmill owner earns up to 80,000,000 Rp per harvesting season (US$8989). There may be up to five harvesting seasons per year (ie five periods when timber is delivered to the sawmill): total annual gross income (before expenses) of the owner may be 300-400,000,000 Rp/year (US$33,708-44,944). Mr Usman did not know how much the bosses in Palembang or Jakarta earn.

- *Origin and numbers of logging personnel.* Loggers in the Merang River consist of two groups: local people, with permanent homes near the river (usually in the Bakung, Kepahyang or Karangagung Villages, Fig. 1) and non-local people. Most non-local loggers come from Selepan Village (south of Palembang), who apparently travel throughout the province to harvest timber and are locally well-known for their timber skills. Mr Usman estimated that since 2001, c.100 local men, and 2000 non-local men from Selepan Village, had logged the river. [A village 40 km upstream consisted entirely of non-local loggers from Selepan Village, Bezuijen *et al.* 2001a]. Non-local loggers apparently earn slightly less than Mr Usman's workers, although non-local field managers earn more than him as they prepare timber to a more finished state.

3.2.2 Fishing

The peat swamp forest of the Merang River supports important fish breeding habitats and the river is known regionally for its good fish stocks (Bezuijen *et al.* 2001a). Commercial fishing increased from 1995-96 (Bezuijen *et al.* 1997) and apparently, from 1997-2000, then almost stopped in 2001 with the start of illegal logging (Bezuijen *et al.* 2001a). This situation was unchanged in 2002. New information on fishing was obtained from a commercial fisherman working in the upper reaches of the river (Mr Suaemi pers. comm. 12th August 2002):

- *General.* Mr Suaemi lives in Karangagung Village (Fig. 1) and visits the river every 10 days, for 3-4 days, with a team of 3-4 people. He transports his fish downstream for sale. He uses a small motorised boat ('ketek') and canoes for transport, and 'electrofishes' using a metal rod attached to an 8V battery. Optimal fishing periods and time of peak income are March-May, because in this period, water levels in the swamp forest recede and large turtles and fish enter the mainstream from the forest after breeding.

- *Commercial regulations.* Under the conditions of '*lebak lebung*' (annual river ownership, Section 3.2.3), he is obliged to sell his fish to the river 'owner'. He may sell his fish directly to the public, but is taxed 1,000 Rp/ kg (US$0.11) by the owner to do so. He stated it was more profitable for him to pay the tax and sell the fish to the public than to the owner. No tax is applied to snakes and turtles, which represent an opportunistic but beneficial sidecatch.

- *Commercial value of turtles and fish in 2002 sold direct to public.* Soft-shelled turtle (*Trionyx* spp.) is the most commercially valuable animal for sale: 20,000 Rp/kg (US$2.2) for turtles ≤10 kg total fresh weight; 12,000 Rp/kg (US$1.3) for turtles > 10 kg fresh weight (older individuals have less valuable meat). Fish are of less value: 10,000 Rp/kg (US$1.1) for most species. The most commercially valuable fish species is 'ikan toman' (*Channa micropeltes*), for 13,000 Rp/kg (US$1.5). Six other fish species are commercially valuable: 'serandang' (*C. pleuropthalmus*, 'bujuk' (*C. lucius*), 'tembakang' (*Helostoma teminckii*), 'selincah' (*Betta anabatoides*), 'sepatung' (*Pristolepis grootii*) and 'tapa' (*Wallago leerii*). Arowana (*Scleropagus formosus*), a rare fish species valued in the international pet trade, occurs in the Merang River but is rarely seen. Mr Suaemi caught two in 2001-02, and sold one in Kepahayang Village for 12,500 Rp/kg (US$1.4). He noted that he would have received much more had he sold it in Palembang. He claimed that the river 'owner' bought all fish from him at a flat rate of 3,000 Rp/kg (US$0.34) regardless of species.

- *Catch rate and local salary.* Mr Suaemi estimated he catches 50 kg fish/day. [At the time of interview, he had been fishing for two days and one night, and had caught 50 kg of fish]. He estimated his team earns approximately 500,000 Rp (US$56.2)/person/month, or, 6,000,000 Rp (US$674)/person/year. This varies with catch rate and market prices. He stated the best fishing is far upstream, because the forest is more intact than downstream. His catch rate has remained

constant over 2001-02 (despite the illegal logging), although fishing has become more difficult due to abandoned timber in the mainstream, which hinders boat passage.

3.2.3 Resource ownership

The Merang River is legally classified *Hutan Produksi Tetap* (Production Forest) and is under the jurisdiction of the provincial Ministry of Forestry. Fishing is regulated under a traditional, regional system of annual 'river ownership', in which local people bid for exclusive one-year fishing rights to a river or section of river (Bezuijen *et al.* 2001b). Administrative management of the river is under the Head of Baking Village (Fig. 1), Mr Rusdi Senen. In 2002 he auctioned an upstream section of river (27-67 km upstream) to the 2002 'owner' (Mr Barowi) for 32,000,000 Rp (US$3596). Ownership rights ended in December 2002. Information on this upstream section was obtained from Mr Basir (brother of the owner, pers. comm. 15th August 2002):

- Similar to 2001, most income in 2002 was derived by taxing the illegal loggers for their timber as it was transported downstream. The 'owner' taxed loggers 2500-3000 Rp (US$0.28-0.34) per log raft (the same price as in 2001, Bezuijen *et al.* 2001a).

- Little income in 2002 was derived from commercial fishing. Six fishermen had worked for the owner in the 2002 dry season but only one fisherman (Section 3.2.2) was currently working in the upper reaches. From January-August 2002, the owner had only bought 300 kg of fish from commercial fishermen. [This may indicate fishermen are selling their fish elsewhere, as a single fisherman may catch 50 kg/night in the upper reaches, Section 3.2.2]. The 'owner' would buy fresh fish for 8000 Rp (US$0.90)/kg and dry fish for 4000 Rp (US$0.45)/kg [although a commercial fisherman stated the owner bought all fish for 3000 Rp/kg, Section 3.2.2]. More commercial fishing would apparently be conducted in the wet season (late 2002), by use of two large 'jaring' (fish traps) that extend across the river near a village 40 km upstream. [When water levels are high, nets are extended across the mainstream to catch all fish moving with the tide].

3.2.4 Changes since 2001

Increasing human activity since 2001 was evident in the lower and upper reaches. A steady increase in human population, and upstream movement of people, has occurred since 1995, although the human population remains low compared to nearby rivers. Socio-economic changes from 1995-2001 are described in Bezuijen *et al.* (2001a) and are summarised in Table 4. Illegal logging was the largest commercial activity in 2001 and 2002.

Table 4. Some aspects of human population size and resource use between 1995 and 2002 in the Merang River, South Sumatra Province. 1995-96 and 2001 data from Bezuijen *et al.* (2001a). 'Village' arbitrarily defined as any collection of >10 huts. '-' not recorded.

Variable	Lower reaches (0-45 km upstream)				Upper reaches (45-67 km upstream)			
	1995	1996	2001	2002	1995	1996	2001	2002
Population								
Total population	<500	500+	500-1000	500-1000?	20-30	50-60	150	>100
Commercial fishermen	-	-	-	-	7-8	20-30	5	1
Illegal loggers	0	0	>50	>50	0	0	145	>100
Infrastructure								
Legal sawmill	1	1	0	0	0	0	0	0
Villages (>10 huts)	1	1	3	3	0	0	0	0
Huts (perm/seasonal)	15-25	20-25	61	75	0	4	8	8
Illegal logging camps (old/active)	0	0	20	25	0	0	79	80
Oil/gas base station	0	0	1	1	0	0	0	0
Motorised boats	-	-	36	47	1	3	7	3
Dominant commercial activities								
Legal logging								
Illegal logging								
Fishing								
Oil/gas								
Dominant subsistence activities								
Fishing								
Agriculture (medium-large scale)								

In the lower reaches, minor changes since 2001 included closure of a small illegal sawmill at the river mouth and removal of c.15 huts near a former legal sawmill 36 km upstream (apparently by police operations). New developments in 2002 were an agricultural settlement of three huts and a cleared, burnt area of 400 m x 100 m along the river near the river mouth (the first agricultural settlement observed in four survey years), and two hunting parties. One party of four hunters, from Palembang, was using a motorised boat with a tall, portable tower attached to the roof for spotlight hunting. A party of three local hunters was hunting birds. These changes indicate the lower reaches are gradually becoming more populated and visited, possibly as regional knowledge of the availability of natural resources in the river (in contrast to more populated and developed rivers nearby) increases.

In the upper reaches, illegal logging continued to be the largest commercial activity and threat to natural resources in 2002. Illegal logging had been occurring for 20 months (January 2001 – August 2002). The accumulated impact of this logging was more evident than in 2001. No sections of river bank from 40-67 km upstream remained unlogged. Logging was expanding away from the mainstream. A new and significant threat in 2002 to the peat swamp forest was large-scale forest fire (Section 3.3).

3.3 Conservation threats in 2002

Threats to the False Gharial and peat swamp forest in the Merang River in 2002 included collection of False Gharials by logging personnel (Section 3.1.3) and illegal logging (Section 3.2.1). Logging impacts are described in Bezuijen *et al.* (2001a). Three other factors were noted to be potential threats to these values:

- Forest fire. In 2002, a combination of dry conditions, large volumes of discarded timber and small peat fires started by logging personnel, increased the risk of large-scale forest fire in the

peat swamp forest. Unlike most nearby rivers, the peat swamp forest of the Merang River has remained unburnt despite extensive regional forest fires in recent years. Large-scale forest fire would cause long-term damage to the soils, vegetation and hydrology of the peat swamp forest.

- Oil and gas extraction in the peat swamp forest. Two oil companies, Gulf and Pertamina-YPF, are based in the Merang River, but limited exploration / extraction activities to date have resulted in negligible impacts to False Gharial habitats (Bezuijen *et al.* 2001a). Pertamina-YPF may conduct future exploration and extraction activities near the peat swamp forest north-east of the river (Mr Amril Adnan pers. comm.). Without environmental management, these activities could cause disturbance to False Gharial nesting habitats.

- Uncontrolled settlement. The human population in the Merang River is increasing. New settlers arrive each year, and bring new pressures such as agriculture and hunting. It is likely this will continue. Without planning, such colonisation will result in continued, uncontrolled reclamation of habitats.

4. BERBAK NATIONAL PARK

4.1 The False Gharial

4.1.1 Distribution and abundance in 2002

Four crocodile surveys were conducted (21-24 August) in two waterways in Berbak National Park in 2002 (Appendix 1). Surveys were conducted in the Air Hitam Laut River (mouth to 32 km upstream) and Simpang Melaka Creek (mouth to 7.2 km upstream). Excluding repeat sightings, a total of seven crocodiles of two species, the False Gharial and Saltwater Crocodile (*Crocodylus porosus*), were seen during surveys (Table 5). Surveys in 2002 did not include a third river surveyed in 2001, the Air Hitam Dalam River.

Table 5. Crocodile survey results in Berbak National Park, Jambi Province, 21-24 August 2002. AHL – Air Hitam Laut River; SM Creek – Simpang Melaka Creek. Km 0 = river mouth. Sightings are *Tomistoma schlegelii* (TS) unless denoted ES (eyeshine) or CP (*Crocodylus porosus*). Repeat sightings excluded. For density calculations, 'ES' *excluded* for both species in AHL, but *included* in SM Creek, where all ES assumed to be *T. schlegelii*.

River	Location (km readings)	Total km surveyed	Size classes (ft) 1-2	2-3	3-4	4-5	9-10	ES	Total	Dens (all sp.)	Dens (TS)	Dens (CP)
AHL	0-32	40	-	2 (1xTS)	-	-	1(CP)	3	6	0.22	0.03	0.06(over 32 km)
SM Creek	0-7.2	7.2	-	-	-	-	-	1	1	0.14	0.14	0 (over 7.2 km)

The highest crocodile density recorded was in the Air Hitam Laut River (0.22 individuals/km including three eyeshines, Table 5), where eyeshines may be False Gharials or Saltwater Crocodiles. In 2001 and 2002, an 8-9 ft and 9-10 ft Saltwater Crocodile (possibly the same individual) was recorded 26.8 km and 31.2 km upstream respectively (Bezuijen *et al.* 2001a; Appendix 1). Excluding eyeshines, False Gharial density in the Air Hitam Laut River was 0.03/km (one individual in 32 km, Table 5).

Eyeshines in Simpang Melaka Creek were assumed to be False Gharials, because Saltwater Crocodiles have never been recorded in the creek during surveys nor reported by local people (Bezuijen *et al.* 1997, 2001a). Including one eyeshine, False Gharial density in Simpang Melaka Creek was 0.14/km (Table 5). In addition to this single eyeshine, two other False Gharials were recorded: a 4-5 ft individual, seen during the day (6.2 km upstream) and a nesting female (unseen but whose nest was located 0.6 km upstream). A total of 3 False Gharials over 7.2 km yielded a density of 0.42/km in the creek. The 4-5 ft individual was seen in a burnt section of creek; in 2001, four of five spotlighted False Gharials were seen in this burnt section. [A crocodile survey of the creek by Wetlands International on 1st November 2002 recorded one 2-3 ft False Gharial and one eyeshine, a density of 0.26/km over 7.2 km (F. Hasudungan *in litt.* 13th November 2002)].

4.1.2 Nesting

One False Gharial nest, in Simpang Melaka Creek, was recorded during surveys. The nest was located 0.6 km upstream from the creek mouth within unburnt, primary peat swamp forest, and was the first nest documented during surveys. It is apparently the third False Gharial nest recorded in the park. Two nests were seen by park rangers in Simpang Melaka and Simpang Gajah Creeks (Fig. 1) in the 1980s (Bezuijen *et al.* 1997).

The nest was situated on a dry, raised peat platform (or mound) 2.5 m from the high water mark (the creek is freshwater but the lower reaches are tidally influenced) and 10 m from midstream. The nest

site was situated in a small, discrete area of several raised peat platforms and small waterways along the mainstream. On each side of this discrete area, peat platforms were absent. The nest was hidden from the midstream by a 3-5 m wide belt of Pandanus *Pandanus tectorius* along the banks. The peat platform was 6.5 m x 4.2 m and the base of the nest was 1.2 m above the high water mark. The platform supported four *Dipterocarpaceae* trees (20-30 m high and 21-41 cm diameter at chest height), with a 60% canopy cover over the nest, and sparse (<5%) ground cover of saplings and lianas. Vegetation cover around the platform included tall trees, palms and lianas, and a sparse, open ground layer of saplings, lianas and sawsedge *Thoracostachyum*.

The nest measured 1.5 m x 1.2 m x 0.33 m (basal length x width x height) and was composed of peat, a mixture of soil and partly decomposed leaves and wood debris. Distance from top of nest to top egg was 24 cm. The top of the nest consisted of hard, dry peat. A thin 'membrane' of leaf litter/humus separated the dry peat from the nest chamber, which was notably moist. The nest contained 13 eggs. All were in good mechanical condition (no cracking or swell marks) and were opaque. In crocodilians, the degree of egg 'banding' and opaqueness indicates egg age. The length of egg development stages in False Gharials is unknown, but Saltwater Crocodile eggs incubated at 30^{0}C become opaque around 65 days after laying (Webb *et al.* 1987). If egg development rates are similar in False Gharials, these eggs were at least 65 days old and were possibly laid in late June, and could be expected to hatch around late October. More precise age may be determined by measurement of embryo head length, but given the small number of eggs in the nest, none were opened. Nest and egg measurements are described in Appendix 2 and summarised in Table 6. The nesting female was not seen, but fresh slide marks were present near the nest

Table 6. Clutch measurements of a *Tomistoma schlegelii* nest located in primary peat swamp forest, Simpang Melaka Creek, Berbak National Park 22 August 2002. Egg length and width are $\pm$ SD (n, range).

Clutch Size	Mean egg length (mm)	Mean egg width (mm)	Total clutch mass (kg)	Mean egg mass (g)*	Nest temp (^{0}C)	Ambient temp (^{0}C)
13	91.4$\pm$3.2 (n=13, 89.3-101.3)	56.4$\pm$0.8 (n=13, 54.6-57.5)	2.2	169	31.5	28.4

* A course estimate derived by dividing total clutch mass by clutch size.

This nest was revisited by Wetlands International staff on 1st November 2002, five weeks after the nest was documented. The nest had been opened, and three eggshells were scattered around the nest and broken eggs were present within the nest. Two footprints of wild pigs *Sus scrofa* were present around the nest (F. Hasudungan *in litt.* 13th November 2002). Similar signs indicating False Gharial nest predation by wild pigs were also observed in the Merang River in 1995-96 (Bezuijen *et al.* 1995b, 1997).

4.1.3 Changes since 2001

Available survey data for the Air Hitam Laut River and Simpang Melaka Creek are summarised in Table 7.

Table 7. False Gharial (*Tomistoma schlegelii*) survey data for Berbak National Park, Jambi Province. Km 0 = river mouth. ES – Eyeshine. Density with and without ES are given as *Crocodylus porosus* may account for some Eyeshines.

Year	Surveyed (km)	Size classes (ft) 1-2	2-3	3-4	4-5	Other	ES	Total	Density (with ES)	Density (no ES)	Source
Air Hitam Laut River											
1990	0-20.5	7 False Gharials seen, no size given						7	0.34	0.34	J.Cox (unpubl. data)
1996	0-25	-	-	1	-	7-8	2	4	0.16	0.08	Bezuijen *et al.* (1997)
2001	0-31	1	-	-	-	-	3	4	0.13	0.03	Bezuijen *et al.* (2001a)
2002	0-32	-	1	-	-	-	3	4	0.13	0.03	
Simpang Melaka Creek											
1996	0-2	-	1	-	-	-	2	3	1.50	0.50	Bezuijen *et al.* (1997)
2001	0-7.2	2	1	-	-	-	2	5	0.69*	0.40*	Bezuijen *et al.* (2001a)
2002	0-7.2	-	-	-	-	-	1	1	0.14	0	

* the 2001 density given in Bezuijen *et al.* (2001a) is 0.67/km, calculated over a distance of 7.5 km. This distance was corrected to 7.2 km in 2002 with new GPS data, and the 2001 density adjusted accordingly.

Conservation threats to False Gharial populations in the park are discussed in Bezuijen *et al.* (2001a), and include loss or degradation of nesting habitat by forest fire, human activity in nesting areas and egg predation by introduced pigs (*Sus scrofa*). Based on survey data, the following points are apparent.

- Surveys in 2002 recorded a higher density of False Gharials in Simpang Melaka Creek than in the Air Hitam Laut River, as in previous years.

- False Gharial densities in Simpang Melaka Creek have declined since 1996, and an apparently steep decline occurred between 2001 and 2002 (Table 7). There are no obvious reasons for this: survey conditions (weather, survey route, observers) were the same in both years, and there were no physical disturbances (eg fire) to the creek in this period. The decline may be part of a longer trend since 1997, reflecting the impact of large-scale forest fires in 1997-98, which destroyed many kilometres of potential nesting habitat. False Gharial populations in the park have probably been impacted by suppressed nesting and recruitment during and since the fires in all burnt waterways, which by 2002, still only supported sparse regrowth in burnt sections. Future surveys will reveal whether the 'decline' detected between 2001 and 2002 is the part of any longer-term trend.

- False Gharial densities in the Air Hitam Laut River appeared to decline between 1990 and 1996, and then stayed relatively constant between 1996 and 2002 (Table 7). Reasons for any decline before the 1997-98 fires are unclear. Potential factors might include occasional human activities in the lower reaches, or exclusion of False Gharials by Saltwater Crocodiles (Bezuijen *et al.* 2001a). Large Saltwater Crocodiles may prey upon smaller False Gharials, which could also explain why False Gharial numbers are higher in Simpang Melaka Creek (where Saltwater Crocodiles have not been recorded) than in the Air Hitam Laut River. There is little data to support this possibility, except that the presence of at least one large Saltwater Crocodile in the Air Hitam Laut River in 2001-02 corresponds with an absence of False Gharials in the same area where they were recorded in 1996. It is also possible that survey results are simply reflecting natural population fluxes between years.

- The availability of *raised* peat platforms (mounds) as critical nesting microhabitat for the False Gharial may be a key factor influencing the low nest densities in the park and in other sites that otherwise seem to support large areas of apparently suitable nesting habitat (eg the Merang

River). Most documented False Gharial nests have been on these raised peat platforms in peat swamp forest, near waterways (Bezuijen *et al.* 2001b). Peat platforms suitable for nesting appear to be naturally scarce. Many kilometres of searches in apparently optimal peat swamp forest nesting habitat in Berbak National Park and the Merang River since 1995 have located few nests. In 2002, 4.2 km of riverbanks in Berbak National Park were searched, but only one apparently suitable nesting site (ie a raised, flat and unvegetated peat platform near water) was located, and this was the platform on which the single nest was located. In all other areas searched, raised peat platforms were absent. The riverbanks were often steep and overhanging the water, well above the water level at low tide. Within peat swamp forest, raised peat platforms may be critical microhabitat for False Gharials nesting, and the apparent natural scarcity of suitable nest sites may be an important factor contributing to nest densities.

- Predation of False Gharial eggs by introduced wild pigs *Sus scrofa* appears to be an important factor impacting False Gharial survival (Bezuijen *et al.* 2001b). Egg predation by wild pigs in Berbak National Park was confirmed by F. Hasudungan, who observed that the nest documented during surveys in 2002 was predated soon afterward by wild pigs (Section 4.1.2). Five of seven False Gharial nests documented in the Merang River in 1995-96 were predated by wild pigs (Bezuijen *et al.* 1995b, 1997). It is possible that our opening of the nest to check for eggs, increased olfaction cues and made the nest more vulnerable to predation by pigs.

5. SIMPANG DATUK LAKE

Simpang Datuk Lake is located within a small, isolated patch of degraded peat swamp forest, in an agricultural region near the northern border of Berbak National Park, Jambi Province (Fig.1). The site was visited on 25th August 2002, after recent crocodile sightings by local people were reported to park staff and to Wetlands International (Hasudungan and Wardoyo 2002). No spotlight surveys were undertaken during the visit, but a site inspection and interviews with a local resident were conducted.

Peat swamp forest historically occurred throughout this region, but has been extensively cleared and burnt for coconut plantations and irrigated croplands - only small peat swamp remnants occur. The lake is located in a small forest remnant less than 0.5 x 0.5 km (0.25 km^2 or 25 ha), that has been selectively logged (probably several years previously) and partially burnt (in 1997-98). The remnant consists of a sparse canopy cover (25-30 m high) and a shrubby ground and midlayer that is thickly overgrown with *Acrostichum* fern, an invasive weed that colonises fragmented forest. The patch retains distinct peat swamp characteristics of thick, waterlogged peat substrate, anaerobic soils and trees with large buttress roots. The lake is small (100 x 100 m) and artificial, and was formed along a small creek (Simpang Datuk Kanan Creek, which drains away from Berbak National Park) many years previously by fishermen who blocked the creek for fishing (S. Wardoyo pers. comm.). Before the 1997-98 fires, the lake and creek were overgrown with *Hanguana malayana*, a large, floating aquatic plant. After the fires, this was succeeded by a thick floating mat of sedge 2-3 m high, that covers the lake surface. The creekline is thickly overgrown with *H. malayana*. Much remnant forest around the lake was destroyed by fire. The lake is 3 m deep near the edge.

Local information

Local information on crocodile sightings was provided by Mr Bage, a long-term resident who guided the team to the lake. Mr Bage saw False Gharials in the lake and nearby irrigation canals before and after the 1997-98 fires. In January 2002 he saw three '30-40 cm' False Gharials in an irrigation canal near his home, and thought they had entered the canal near the lake. [It is feasible that small first-year False Gharials would be seen in January, as hatching is thought to occur around October]. He also stated that during the 1997-98 fires, the lake partly dried out and was 'full' of small and large False Gharials, '80' of which he had carried to deeper parts of the lake. Mr Bage had never seen Saltwater Crocodiles in the region, and correctly described the differences between each species.

Habitat potential for False Gharials

During the site visit three large (30 x 30 cm) tunnels, and a large slide trail, were observed within the floating sedge mat of the lake and *H. malayana* of the nearby creek. These tunnels were clearly crocodile exit/entry points between the lake and creek (no other regional fauna could make holes of this size in such habitat). These indirect signs, and local information, indicate False Gharials occur in the lake and that nesting has occurred since the 1997-98 fires. A rapid assessment of population size and nesting status would be relatively simple given the small, isolated nature of the site.

6. WAY KAMBAS NATIONAL PARK

6.1 The False Gharial in Lampung Province

Lampung is the closest Sumatran province to Java and is among the most densely populated province in Sumatra. Little information on the status of crocodiles in the province exists. In a four-day visit to the province in 1996, Bezuijen *et al.* (1997) conducted interviews with local fishermen and former crocodile hunters to obtain local information on crocodiles. Thirteen False Gharial sightings by local people were recorded, dating from the 1950s to 1996, with six sightings between 1990 and 1996. Records were from the north (Mesuji River, bordering South Sumatra Province), north-central Lampung (Tulung Bawang River), central Lampung (Pengbuan and Way Terusan Rivers) and central-east Lampung (Way Kambas National Park). The most recent False Gharial nesting record was a nest sighting in Pengbuan River (central Lampung) in 1980. A former crocodile hunter collected False Gharial eggs from nests every year along Tulung Bawang River (north-central Lampung) in the 1960s.

These sightings indicated False Gharials were formerly widely distributed in suitable rivers in the east of this province until recent decades, although it was noted that surviving False Gharial populations were probably subject to increasing pressures from habitat loss and human disturbance. Such pressures are continuing eg intensive illegal logging along waterways in central Lampung (Saroso 2002). Bezuijen *et al.* (1997) noted that Way Kambas National Park was the most likely place in the province to support viable populations of False Gharials, but surveys in 2002 revealed the species is probably scarce or absent in the park (below). There are no other large areas of protected swamp forest remaining in the province, and it seems likely the species may become locally extinct along many rivers as development and loss of habitats continues.

6.2 Way Kambas National Park

6.2.1 Crocodile surveys in 2002

Four crocodile surveys were conducted (19-22 September) in Way Kambas National Park in 2002 (Appendix 1). Surveys were conducted in the: Way Kambas River (mouth to 20.5 km upstream, until the 'fork' with Way Kanan River and Way Negara Batin Rivers); Way Kanan River ('fork' to 8.5 km upstream); and, Way Negara Batin River ('fork' to 7.6 km upstream).

A total of two crocodiles were observed in the surveys and both were in the Way Kambas River: a 9-10 ft Saltwater Crocodile 22.3 km upstream, and an eyeshine (presumed to be a Saltwater Crocodile) 2.2 km upstream, near the sea (Table 8). Both were in tidal, brackish water. High tides and a full moon gave poor survey conditions during all surveys.

Table 8. Crocodile surveys in Way Kambas National Park, Lampung Province, 19-22 September 2002. WKambas – Way Kambas River; WKanan – Way Kanan River; WNBatin – Way Negara Batin River. Km 0 = river mouth. Sightings were of *Crocodylus porosus* (CP) or 'eyeshines' (ES).

River	Location (km readings)	Total km surveyed	Size classes (ft) 1-2	2-3	3-4	4-5	9-10	ES	Total	Dens (all sp.)	Dens (TS)	Dens (CP)
WKambas	1-20.5	19.5	-	-	-	-	-	1*	1	0.05	0	0.05
WKanan	20.5-29	8.5	-	-	-	-	1	-	1	0.12	0	0.12
WNBatin	0-7.6	7.6	-	-	-	-	-	-	0	0	0	0

6.2.2 Status of crocodiles in the park

The occurrence of False Gharials and Saltwater Crocodiles in the park was assessed from survey results, sightings by park staff and habitat assessment. Ten local sightings were recorded, eight during the current survey and two in 1996 (Bezuijen *et al.* 1997) (Table 9).

Table 9. Crocodile sightings by park staff, Way Kambas National Park. CP–*Crocodylus porosus*. TS–*Tomistoma schlegelii*. Local size estimates given in metres. ? – unknown by interviewee.

River	Approximate km upstream	Year of sighting	Species	Size	Source
Way Kanan	22	1996	CP	3-4 m	Mr Mukhlisin
Way Kanan	24	1998	CP	'large'	Mr Mukhlisin
Way Kanan	30	2001	?	?	Mr Dedi
Way Kambas	15-20	1996	TS?	2 m	Ranger in 1996 (Bezuijen *et al.* 1997)
Way Kambas	1	1991-2002	?	?	Mr Dedi
Way Kambas/Kanan	?	1991-2002	?	?	Mr Dedi
Way Kambas/Kanan	?	1991-2002	?	?	Mr Dedi
Way Kambas/Kanan	?	1991-2002	?	?	Mr Dedi
Way Ahjang	?	1996	TS?	3	Ranger in 1996 (Bezuijen *et al.* 1997
Way Ahjang	0.4	1998	CP	1.5 m	Mr Mukhlisin

Interviews in 2002 were conducted with Mr Mukhlisin (Head, park sub-section) and Mr Dedi (ranger), who have worked in the park since 1979 and 1991 respectively. Both regularly travel along major waterways in the park by speedboat or canoe. All crocodile sightings were from three waterways (Table 9), which may reflect the frequency of visitation to these rivers rather than crocodile distribution in the park. These rivers are nearest the park headquarters, easily accessed and most often visited by park staff when transporting visitors around the park. Small waterways far upstream in the park, only navigable by canoe, are less frequently visited. Both officials were familiar with Saltwater Crocodiles but were less familiar with False Gharials.

False Gharials. Despite a preliminary assessment that False Gharials probably occurred in the park (Bezuijen *et al.* 1997), 2002 surveys indicate that False Gharials are in reality probably scarce or absent. The park does not appear to support suitable habitats for this species. At least three major waterways (Way Kambas, Way Kanan, Way Negara Batin Rivers) are saline or brackish until well upstream, as are waterways in the north of the park (park staff pers. comm.). Most False Gharial records are from freshwater habitats (Bezuijen *et al.* 2001b). Remote upstream waterways may support more suitable habitat for this species, although inspection of the upper reaches of the Way Negara Batin River revealed a partly dry, sandy creekbed, in dry lowland forest, quite different from documented False Gharial habitats elsewhere (Bezuijen *et al.* 2001b). Two False Gharial sightings reported by rangers in 1996 (Table 9) were possibly Saltwater Crocodiles. The presence of Saltwater Crocodiles may also reduce the possibility of False Gharials occurring in the park's large waterways.

Saltwater Crocodiles. Saltwater Crocodiles appear to be widely distributed in the park. The presence of small and large Saltwater Crocodiles recorded during surveys and by park staff (Table 9) indicates successful nesting occurs. Many sections of the Way Kanan, Way Kambas and Way Negara Batin Rivers, and Way Ahjang Creek, were observed to support potential nesting and foraging habitat for this species. Park staff noted that waterways in the north of the park support similar habitats, and it is likely that Saltwater Crocodiles occur in these systems too. Saltwater Crocodiles were intensively hunted in Sumatra from the 1950s-70s (Bezuijen *et al.* 1997), and Way Kambas National Park may be an important site, within the protected area estate, within which this species can recover.

7. FALSE GHARIAL WORKSHOPS

Two False Gharial Workshops were held in September 2002 in South Sumatra Province (Bezuijen *et al.* 2002), and the results are summarised below.

Provincial Workshop

The *2002 False Gharial Workshop: Assessment of the Management and Conservation of the Merang River as habitat for the False Gharial* was held in Palembang, capital of South Sumatra Province (2-3 September). The Workshop was implemented on the basis of 2001 recommendations (Bezuijen *et al.* 2001a) to enable discussion of conservation values in the Merang River among stakeholders and government agencies. Thirty-six participants attended, from a range of national, provincial and local government agencies, NGOs, universities and commercial organizations. The Workshop was opened by Ir. Adi Susmianto, Director of the Department of Biodiversity Conservation Republic of Indonesia (PHKA), and was reported in three newspapers (one national and two provincial). The Workshop was conducted in Indonesian language.

Workshop recommendations recognized the need for specific follow-up with Local Government after the Workshop, and included the formation of a small working group that would initiate such follow-up. The working group, which included Local Government delegates, defined specific recommendations for the management of False Gharial habitat (peat swamp forest) and for the control of illegal logging in the Merang River, which could be presented to the Local Government. Key recommendations included the designation of two management zones: a False Gharial conservation zone, extending 45-67 km upstream and 1 km east and west of the river; and, a multiple-use land management zone, encompassing the peat swamp forest system of the Merang-Kepahyang Rivers, that would enable conservation and sustainable use of natural resources by local people.

Workshop proceedings were completed in Palembang one week after the Workshop, and were distributed to workshop participants and Local Government. Workshop participants were also provided with a certificate, which described their attendance (Appendix 5).

Local Government Workshop

This workshop was held to present the results and recommendations of the Provincial Workshop to senior personnel from Local Government. After a preliminary meeting with senior officials (9th September), a half-day Workshop was conducted for 20 senior Local Government delegates, from 10 local government agencies (17th September). The workshop was held in Sekayu, the administrative centre of Local Government, which is 3 hours drive from Palembang, and it was conducted jointly by WMI and Wetlands International (WI-IP). This was considered a crucial workshop to secure Local Government support for future conservation efforts in the river. Most officials were unaware of the conservation values of the river, and much time was spent discussing the threats facing these values, in particular the illegal logging. Interest and support for management of the river's natural resources was discussed.

The Workshop reinforced the need for: a commitment from local Government; international funding; an inventory of natural resources; a rapid appraisal of the river by Local Government; the formation of a small working group for follow-up activities.

The need for a brief visit to the river by senior local officials was highlighted by participants as being particularly important.

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APPENDIX 1. SURVEY DATA

2002 survey data, southeast Sumatra, Indonesia. **Table 1** presents logistic details. **Table 2** presents crocodile sightings. Dates are denoted 'day/month/year'. 'Km' values are the number of kilometres upstream from the river mouth. Latitude/longitude coordinates recorded with a Garmin 12 CX GPS.

Table 1. Spotlight survey details. Spotters: AD=Adios; AR=A. Rachman; ARO=Arodin; MB=Mark Bezuijen; DA=Dadang; FH=Ferry Hasudungan; GI=Ginting; RK=Riza Kadarisman; SIS=Sismanto. Survey vessel (SV): SP= 40 HP speedboat; CA - canoe. Weather: CC - cloud cover (1/8=no cloud; 8/8=overcast); Tide: eb – exposed bank. n/a = not applicable (no tidal influence).

Date	Start location		Finish location		Total km	Survey time	Spotter	SV	Weather				Survey cond	Notes
	Km	GPS coordinate	Km	GPS coordinate					CC	Rain	Moon	Tide		
SOUTH SUMATERA PROVINCE														
Merang River														
9/8/02	40	S01^{0}58'49.2", E104^{0}00'49.4"	0	S02^{0}08'40.7", E104^{0}10'14.9"	40	1945-2130	MB/RK	SP	1	Mod	None	Low	Av	Dry start, later rain + low vis.
11/8/02	55	S01^{0}53'37.9", E103^{0}59'55.3"	56	not recorded	1	2000-2215	AD	CA	1	None	None	n/a	Exc	
11/8/02	55	S01^{0}53'37.9", E103^{0}59'55.3"	50	S01^{0}55'37.3", E103^{0}58'54.5"	5	2000-2340	MB	CA	1	None	None	n/a	Exc	
13/8/02	61	S01^{0}51'07.1", E104^{0}01'12.7"	59.4	S01^{0}51'38.8", E104^{0}00'46.4"	1.6	1830-2100	DA	CA	2	None	1/4 full	n/a	Good	Slow, noisy progress: low water
14/8/02	55	S01^{0}53'37.9", E103^{0}59'55.3"	40	S01^{0}58'49.2", E104^{0}00'49.4"	15	2000-0320	MB/RK	CA	1	None	1/2 full	n/a	Exc	levels
JAMBI PROVINCE														
Simpang Melaka Creek, Berbak National Park														
21/8/02	7.2	S01^{0}22'21.8", E104^{0}20'57.5"	0	S01^{0}23'43.5", E104^{0}22'03.6"	7.2	2045-2345	MB/FH	CA	2	None	Full	High	Poor	
Air Hitam Laut River, Berbak National Park														
23/8/02	30.9	S01^{0}27'20.3", E104^{0}19'59.8"	32	S01^{0}26'39.9", E104^{0}19'19.9"	1.1	1855-2000	MB/GI	CA	1	None	Full	High	Poor	Stopped due to H. malayana
23/8/02	22	S01^{0}23'43.5", E104^{0}22'03.6"	30.9	S01^{0}27'20.3", E104^{0}19'59.8"	8.9	1910-2205	FH/AR	CA	1	None	Full	High	Poor	blocking river
24/8/02	22	S01^{0}23'43.5", E104^{0}22'03.6"	32	S01^{0}26'39.9", E104^{0}19'19.9"	10	0445-0540	MB/FH	SP	1	None	Full	Ebb	Poor	Ebb tide, 0.5 m exposed banks
24/8/02	22	S01^{0}23'43.5", E104^{0}22'03.6"	2	S01^{0}19'17.4", E104^{0}26'17.4"	20	2000-2130	SIS/AR	SP	1	None	Full	High	Poor	
LAMPUNG PROVINCE														
Way Kanan River, Way Kambas National Park														
19/9/02	26	S05^{0}01'40.6", E105^{0}46'34.5"	29	S05^{0}01'23.6", E105^{0}45'48.7"	3	2130-2245	MB/FH	CA	1	None	3/4 full	High	Poor	
20/9/02	20.5	S05^{0}01'33.7", E105^{0}48'04.6"	26	S05^{0}01'40.6", E105^{0}46'34.5"	5.5	2305-2345	FH	SP	1	None	Full	High	Poor	
Way Kambas River, Way Kambas National Park														
20/9/02	1	S05^{0}02'54.2", E105^{0}51'26.2"	20.5	S05^{0}01'33.7", E105^{0}48'04.6"	19.5	1905-2010	MB/FH	SP	2	None	Full	High	Poor	
Way Negara Batin River, Way Kambas National Park														
20/9/02	0	S05^{0}01'33.7", E105^{0}48'04.6"	7.6	S05^{0}04'19.4", E105^{0}46'49.2"	7.6	1920-2150	ARO	SP	1	None	Full	High	Poor	

Table 2. Survey results. Sightings are divided into 'Survey' (seen during spotlight surveys) or 'Other' (incidental observations). All crocodiles = *Tomistoma schlegelii* (TS) unless denoted CP (*Crocodylus porosus*) or ES (eyeshine). SWOE = shallow water on edge; OB = on bank; MS = midstream.

Survey / other	Date	Sightings				Notes
		Size (ft)	Km	GPS coordinate	Position	
SOUTH SUMATERA PROVINCE						
Merang River						*All ES in Merang River probably Tomistoma*
Survey	9/8/02	no crocs	-	-	-	
Survey	11/8/02	ES	55.2	not recorded	SWOE	Medium-sized ES
Survey	11/8/02	ES	52.5	not recorded	SWOE	Large ES. In a large deep pool fringed with H. malayana
Survey	13/8/02	0	-	-	-	
Survey	14/8/02	ES	55.2	not recorded	SWOE	Most likely to be same croc seen on 11/8/02
		ES	43	not recorded	SWOE	In long stretch of Pandanus
JAMBI PROVINCE						
Simpang Melaka Creek, Berbak National Park						
Survey	21/8/02	ES	2.9	S01^{0}23'39.1", E104^{0}21'19.5"	SWOE	
Other	21/8/02	4-5 (TS)	6.2	S01^{0}22'43.9", E104^{0}20'46.6"	OB	Seen 1700 hrs on log next to bank. Burnt section. Dived.
Air Hitam Laut River, Berbak National Park						
Survey	23/8/02	no crocs	-	-	-	
Survey	23/8/02	ES	23.1	not recorded	SWOE	
		ES	26.6	S01^{0}25'37.2", E104^{0}20'47.2"	SWOE	
		ES	27.1	S01^{0}25'54.0", E104^{0}20'45.9"	SWOE	
		ES	29.4	not recorded	SWOE	
Survey	24/8/02	2-3 (TS)	26.6	S01^{0}25'37.2", E104^{0}20'47.2"	SWOE	
		ES	27.1	S01^{0}25'54.0", E104^{0}20'45.9"	MS	
		9-10 (CP)	31.2	S01^{0}27'15.3", E104^{0}19'47.9"	SWOE	
Survey	24/8/02	2-3 (CP)	18.1	S01^{0}22'55.1", E104^{0}23'04.7"	SWOE	
LAMPUNG PROVINCE						
Way Kanan River, Way Kambas National Park						
Survey	19/9/02	no crocs	-	-	-	
Survey	20/9/02	9-10 (CP)	22.3	S05^{0}01'46.2", E105^{0}47'40.9"	OB	Croc on bank, dived at our approach
Way Kambas River, Way Kambas National Park						
Survey	20/9/02	ES	2.2	S05^{0}02'15.8", E105^{0}51'29.4"	SWOE	Croc in saltwater near Nypah. Probably CP.
Way Negara Batin River, Way Kambas National Park						
Survey	20/9/02	no crocs	-	-	-	

APPENDIX 2. NEST DATA

Nest data. Ht – height. Nest measurements are in metres. '% shade over nest' is an estimate of nest exposure to direct sunlight, and is visually estimated by standing over the nest and tracing the east-west course of the sun and estimating, in 3-hour intervals, how much sunlight would fall upon the nest.

Nest location: Simpang Melaka Creek, 0.6 km upstream. GPS: S01^{0}23'28.8", E104^{0}22'00.9"												
Nest dimensions							**% shade over nest (3 hour intervals)**				**Temp (^{0}C) at 0940 hrs**	
Ht of nest above water	**Basal length**	**Basal width**	**Nest ht (base to top)**	**Top of nest to top egg**	**Top of nest to bottom egg**	**Depth of nest chamber**	**0600-0900**	**0900-1200**	**1200-1500**	**1500-1800**	**Nest**	**Ambient**
1.20	1.50	1.20	0.33	0.24	0.29	0.09	80% shaded	70% shaded	40% shaded	70% shaded	31.5	28.4

Egg data. Individual egg weights could not be measured due to lack of a suitable weighing scale. 'Total clutch mass' was calculated by weighing all eggs together and deriving corrected clutch weight. 'Mechanical damage' refers to cracks or water swelling on the eggshell.

Egg length (mm)	**Egg width (mm)**	**Total clutch mass (kg) (corrected)**
89.6	57.1	2.2
89.6	56.3	
92.6	56.2	**Mechanical damage**
90.2	57.5	
90.1	56.7	0
91.1	56.6	
101.3	54.6	
90.1	55.6	
90.9	57.0	
93.2	55.6	
89.4	56.4	
89.3	57.3	
90.2	56.3	
Mean±SD	**Mean±SD**	
91.4±3.2	56.4±0.8	

APPENDIX 3. GPS COORDINATES

Coordinates recorded with a Garmin 12 CX GPS. NP – National Park

Feature	Latitude (South)	Longitude (East)	Km upstream from mouth
Merang River, South Sumatra Province			
New agricultural settlement	02^{0}07'53.2"	104^{0}07'17.8"	9-10
Air Hitam Laut River, Berbak NP, Jambi Province			
Wardens post near mouth of river	01^{0}19'17.4"	104^{0}26'17.4"	2
Fork with Simpang Melaka Creek	01^{0}23'43.5"	104^{0}22'03.6"	22
Fork with Simpang Gajah Creek	01^{0}27'20.3"	104^{0}19'59.8"	30.9
Location of *Hanguana malayana* that blocked river in 2002	01^{0}26'39.9"	104^{0}19'19.9"	32
Simpang Melaka Creek, Berbak NP, Jambi Province			
Mouth of creek – see "fork with SM Creek (above)	as above	as above	as above
Location of False Gharial nest in 2002	01^{0}23'28.6"	104^{0}22'00.9"	0.6
Hut of Mr Sulaeman (furthest upstream point surveyed in 2001 & 2002)	01^{0}22'21.8"	104^{0}20'57.5"	7.2
Simpang Datuk, north of Berbak NP, Jambi Province			
House of Mr Bage (guide to Simpang Datuk)	01^{0}07'56.1"	104^{0}15'44.5"	-
Simpang Datuk (lake location)	01^{0}08'34.0"	104^{0}15'39.6"	-
Way Kambas National Park, Lampung Province			
Way Kambas River: post near river mouth	05^{0}02'54.2"	105^{0}51'26.2"	1
Way Kambas River: Kali Biru Post (hut)	?	?	19
Way Kambas River: fork with Way Negara Batin River	05^{0}01'33.7"	105^{0}48'04.6"	20.5
Way Kanan River: park headquarters	05^{0}01'40.6"	105^{0}46'34.5"	26

APPENDIX 4. PROJECT ITINERARY

24 July	Depart Melbourne to Darwin. Prepare trip (24-27 July).
28 July	Depart Darwin to Jakarta.
29 July	Meet with PHKA. Obtain field permits (29 July – 1 August).
2 Aug	Depart Jakarta to Palembang.
3 Aug	Meet Wetlands International. Initiate Workshop preparations.
5 Aug	Meet BKSDA, BAPPEDA, WI, Dinas Kehutanan, WBH. Continue Workshop preparations.
6-8 Aug	Prepare for field surveys of Merang River & Berbak National Park. Meet Mr Hasan and Johny (PD Budiman).
9 Aug	Depart to Merang River.
9-15 Aug	Survey Merang River.
16 Aug	Return to Palembang. Continue Workshop preparations.
19 Aug	Depart to Jambi Province.
20 Aug	Meet Head BKSDA & Head Berbak National Park. Obtain field permits. Leave to Nipah Panjang. Organise surveys and transport to Berbak.
21 Aug	Depart Nipah Panjang (0500, low tide) to Air Hitam Laut River.
21-24 Aug	Survey Berbak NP.
25 Aug	Depart Berbak NP to Nipah Panjang. Visit Simpang Datuk.
26 Aug	Return to Palembang.
27 Aug-1 Sep	Continue Workshop preparations. Meet Ir. Dulhadi (new Head BKSDA).
2-3 Sep	2002 False Gharial Workshop held in Palembang.
4-8 Sep	Prepare Workshop Proceedings.

9 Sep	Preliminary meeting (WMI, WI) with Kabupaten (local government) Musi Banyusasin in Sekayu (3 hours drive from Palembang). Discuss and organise a 1-day Workshop to be held for local government in Sekayu based on Provincial Workshop results.
10-16 Sep	Print and distribute Workshop Proceedings to all participants. Prepare for local workshop.
17 Sep	One-day Workshop for Kabupaten Musi Banyuasin held in Sekayu (WMI, WI).
18 Sep	M. Bezuijen and F. Hasudungan (WI) depart Palembang to Lampung.
19 Sep	Travel to Way Kambas National Park.
19-22 Sep	Survey Way Kambas National Park.
23 Sep	M. Bezuijen departs Lampung to Jakarta. F. Hasudungan departs to Palembang.
24 Sep	Meet Ir. Adi Susmianto, Ir. Kurnia Rauf, Ibu Faustina Hardjanto and Ir. Kusno (PHKA) and discuss project results.
26-27 Sep	Travel to Bogor. Meet WI, FFI, LIPI. Discuss project results.
28 Sep	Depart Jakarta to Darwin.
4 Oct	Depart Darwin to Melbourne.

SUMMARY OF WORKDAYS IN INDONESIA (M. Bezuijen)

Field surveys	19	Preparing field surveys	3
Obtaining permits	8 (Jakarta/Palembang)	National/Internat travel	4
Workshops (all activities)	28	**Total**	**62 days**

APPENDIX 5. CERTIFICATES

Certificates (following pages) were presented to personnel that participated in field surveys or the 2002 provincial False Gharial Workshop.