



A REVIEW OF THE STATUS AND DISTRIBUTION OF LARGE WATERBIRDS IN THE TONLE SAP BIOSPHERE RESERVE

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The illustration of water level variation in the Tonle Sap floodplain was reproduced with permission of Frederic Goes (oSmoSe). Artwork in the species accounts courtesy of *A Field Guide to the Birds of South-East Asia* by Craig Robson, published by New Holland Publishers. Allan Michaud designed the cover of this report. All photographs used in the cover design are Allan's except for the pictures of White-shouldered Ibis (Bird Quest), Painted Stork (Sun Visal), Spot-billed Pelican (Robert van Zalinge) and Sarus Cranes, which was taken by Eleanor Briggs.

Acronyms

AWC	Asian Waterfowl Census
BCA	Biodiversity Conservation Area
FA	Forestry Administration
FiA	Fisheries Administration (formerly Department of Fisheries)
GIS	Geographical Information System
GPS	Global Positioning System
ICF	International Crane Foundation
IFBA	Integrated Farming and Biodiversity Area
IUCN	International Union for the Conservation of Nature
MAFF	Ministry of Agriculture, Forestry and Fisheries
MIST	Management Information System
MoE	Ministry of Environment
TSBR	Tonle Sap Biosphere Reserve
TSBRS	Tonle Sap Biosphere Reserve Secretariat
TSCP	Tonle Sap Conservation Project
TSEMP	Tonle Sap Environmental Management Project
UEA	University of East Anglia
UNESCO	United Nations Educational, Scientific and Cultural Organization
WCS	Wildlife Conservation Society
WPO	Wildlife Protection Office

EXECUTIVE SUMMARY

This report reviews the seasonal status and distribution of large waterbirds in and around the Tonle Sap Biosphere Reserve (TSBR). It examines records from past ornithological surveys, as well as patrols, monitoring activities and other field trips by conservation staff. The species reviewed are: Lesser Adjutant *Leptoptilos javanicus*, Greater Adjutant *Leptoptilos dubius*, Painted Stork *Mycteria leucocephala*, Milky Stork *Mycteria cinerea*, Asian Openbill *Anastomus oscitans*, Black-headed Ibis *Threskiornis melanocephalus*, Spot-billed Pelican *Pelecanus philippensis*, Oriental Darter *Anhinga melanogaster*, Black-necked Stork *Ephippiorhynchus asiaticus*, Woolly-necked Stork *Ciconia episcopus*, White-shouldered Ibis *Pseudibis davisoni* and Sarus Crane *Grus antigone*.

There were several reasons for conducting this review:

- 1) To get a better understanding of seasonality of occurrence and abundance
- 2) To identify areas with regular non-breeding aggregations or other key sites
- 3) To identify breeding season aggregations that may indicate as yet undiscovered colonies.
- 4) To compare bird distributions with the present coverage of protected zones in the TSBR
- 5) To identify gaps in data coverage and further survey or monitoring needs.

Large waterbird distribution patterns fall in two main groups – those for which the TSBR is a major breeding area and those for which it appears to be mainly a non-breeding area. The authors propose four simple hypotheses to explain seasonal patterns of the distribution of birds for which the TSBR is a major breeding area:

- (1) most individuals in the TSBR are found close to colonies during January-June (except for Oriental Darters that breed from September-January), with a smaller number of non-breeders roaming more widely
- (2) as each respective breeding season ends, adults and juveniles leave the colonies. They first either move in large numbers to favoured late dry season feeding sites before dispersing or disperse in small groups directly from the colony site
- (3) as the rains begin and the floods rise, feeding conditions change dramatically and birds must move to the edges of the floodplain or beyond to find suitable sites
- (4) as the floods subside, birds move back into the floodplain in preparation for breeding, and may temporarily congregate in large numbers

Overall it was observed that records of many of the birds breeding in Prek Toal such as Oriental Darter, Spot-billed Pelican, Black-headed Ibis, Greater Adjutant and Milky Stork fitted the first hypothesis. There are few records away from the only known colonies at Prek Toal during the breeding season, and these are mostly of small groups. For some other species (e.g. Asian Openbill and Painted Stork) there are significant numbers of breeding season records continuously observed away from known colonies, as well as occasional records of large flocks. The latter may either represent flocks that have dispersed due to colony disturbance, perhaps even from as yet undiscovered colonies, or represent a temporary influx of birds from other regions in Cambodia. The smaller congregations observed are likely to be non-breeders.

Large post-breeding flocks have been witnessed in the TSBR for several species, in particular Greater Adjutant, Spot-billed Pelican and Black-headed Ibis. These congregations are typically in the north-west and south-east extremities of the floodplain, but have also been observed around Boeung Tonle Chhmar in the past. Post-breeding flocks in the north-west have been seen in grasslands in Preah Net Preah district and also outside the floodplain in Monkul Borei district and Ang Trapeang Thmor (all in Banteay Meanchey province). In the south-east, the delta area and the grasslands between the Stung Sen and Stung Chinit rivers in Kampong Thom and Kampong Chhnang provinces are places where large post-breeding aggregations have been observed. Oriental Darter seem to aggregate post- and pre-breeding in the area around Prek Toal. There are very few records of large post-breeding flocks of Painted Storks and Asian Openbills. Late dry season flocks of Lesser and Greater Adjutants are also seen, but their timing suggests that at least some may be coming from colonies outside the TSBR, perhaps in Preah Vihear.

Few birds have been observed to stay around the Tonle Sap the whole year. With far fewer surveys being conducted in the wet (flood) season it is difficult to get a good understanding of bird numbers, but it is believed that most large waterbirds leave the floodplain then. Some species such as Greater and Lesser Adjutant, Asian Openbill, pelicans and darters have been observed to continue to use (mostly outer) areas of the floodplain well into the period of rising flood waters in August-October, but to a lesser degree than they do in the dry season.

For Painted Stork, Asian Openbill and Black-headed Ibis it seems that a large portion of the population that breeds in Prek Toal moves to Ang Trapeang Thmor in the early wet season as there is a strong link in the timing of departure and arrival between the two sites. Particularly with Asian Openbills and Black-headed Ibises a large number of birds seem to move to Ang Trapeang Thmor post-breeding. Black-headed Ibises appear to stay here the entire wet season. For the two adjutant species the percentage found in Ang Trapeang Thmor in the wet season relative to Prek Toal is much smaller (approximately 5-10%) and this may also include individuals from other colonies outside the TSBR. Spot-billed Pelicans also gather at Ang Trapeang Thmor in large groups, just after the breeding season, but with maximum numbers found in the area from November – February, possibly consisting largely of non-breeding birds.

The first groups of returning waterbirds are usually seen to arrive in the floodplain in November-December. Pre-breeding flocks are not observed in all species, and not always near to the colonies.

Four large waterbirds appear to use the TSBR mainly as non-breeding area (White-shouldered Ibis, Black-necked Stork, Woolly-necked Stork and Sarus Crane). The first three are known or suspected to breed in very small numbers but it is believed that the Tonle Sap floodplain is suboptimal breeding habitat. All of these species have mostly been observed in the outer, drier zone of the floodplain, especially in the grasslands of Kampong Thom and eastern Siem Reap and they leave around the start of the rainy season or earlier. There seems to be a resident group of Sarus Cranes in the Stoung and Chikraeng IFBAs in the dry season and other records are mostly from the early dry season when groups have been observed foraging in the recently inundated grassland zone. Most cranes move to Ang Trapeang Thmor in the later stages of the dry season before dispersing to forests in the north and possibly the north-east to breed. White-shouldered Ibis have been infrequently recorded from grassland areas during the later stages of the dry season in the south-east of the floodplain.

This review has identified several key areas for large waterbirds in and near the TSBR. Conservation areas have been established recently at many of these sites, but protection at each site will need to be enhanced. Some remain unprotected.

Dei Roneath. Continuing evidence of breeding colonies.

Prey Kobs and much of the floodplain from the delta north to the Stung Sen. Seems to be an important feeding and flocking area in the very late dry season; the area has records or reports of large post-breeding aggregations of Lesser Adjutant, Greater Adjutant and Spot-billed Pelican and there are also unconfirmed reports of colonies.

Outer north-western floodplain (including Preah Net Preah and Mongkol Borei). Some importance as a staging ground with large pre- and post-breeding season flocks of several species recorded.

The review has also emphasized the huge importance of Ang Trapeang Thmor as a wet season feeding area for birds that breed in Prek Toal, particularly for Painted Stork, Asian Openbill and Black-headed Ibis. Ang Trapeang Thmor is also a very important site for pelicans and Sarus Cranes. There is now a colony of breeding Painted Storks at Ang Trapeang Thmor and several pairs of Spot-billed Pelican have now begun breeding here as well.

There are few recent significant records of large waterbirds at Boeung Tonle Chhmar, which may be partly due to limited survey effort. The area was at least formerly a key waterbird site and merits increased conservation and survey effort.

As data on waterbird numbers, seasonality of occurrence and breeding attempts currently are scarce from not only the newly established Biodiversity Conservation Areas but even from the Boeung Tonle Chhmar and Stung Sen Core Areas a system of data collection is needed. Such a system could be based on the MIST ("Management Information SysTem") database program, which enables protected area staff to collect data while on patrol. When applied by MoE rangers that are stationed in the TSBR this would perhaps improve the quantity of data that is obtained, stored and analyzed. Preconditions for this to work are that the rangers are trained in data collection and recording procedures, that they have sufficient funds to conduct patrols and that they are regularly supervised. A simple version of the data collection protocol for waterbirds and other wildlife in the TSBR as would be used when applying MIST has been included as an appendix to this report.

The issues reviewed here remain quite poorly understood and it is hoped that an academic research program studying the movement of Tonle Sap's threatened large waterbirds and assessing the level of interchange between populations across and beyond Cambodia will be initiated in the future.

ខ្លឹមសារសង្ខេប

របាយការណ៍នេះពិនិត្យមើលឡើងវិញនូវស្ថានភាពប្រចាំរដូវ និងរបាយសត្វស្លាប់ទឹកធំៗនៅក្នុង និងជុំវិញតំបន់ បំបន្លិយជីវមណ្ឌលបឹងទន្លេសាប (TSBR) ។ របាយការណ៍នេះពិនិត្យមើលទិន្នន័យ នៃការស្ទង់មតិធានាពេលអតីតកាលអំពីបក្សី សាស្ត្រក៏ដូចជា សកម្មភាពពល្យាត តាមដាន និងទស្សនកិច្ចសិក្សារបស់បុគ្គលិក ។ ប្រភេទបក្សីដែលត្រូវពិនិត្យឡើងវិញរួមមាន ដូចជា ត្រដក់តូច ត្រដក់ធំ រនាសពណ៌ រនាសស ចង្កៀលខ្យង ត្រយ៉ងខ្លួនស ទុងប្រផេះ ស្មៅញ អង្កត់ខ្មៅ ឬដំបងក្រញូង សត្វកស ឬត្រី ឬកុកពាក់អំបោះ ត្រយ៉ងចំកំកស និងសត្វក្រៀលជាដើម ។

មានហេតុផលមួយចំនួនសម្រាប់ការធ្វើការពិនិត្យមើលឡើងវិញនេះ ៖

- ១) - ដើម្បីទទួលបានការយល់ដឹងប្រសើរជាងមុននៃការកើតមានឡើង និងភាពសំបូរបែបរតាមរដូវកាលរបស់បក្សី
- ២) - ដើម្បីកំណត់អត្តសញ្ញាណតំបន់ដែលមានការប្រមូលផ្តុំមិនបន្តពូជជាទៀងទាត់ ឬទីតាំងសំខាន់ៗដទៃទៀត
- ៣) - ដើម្បីកំណត់អត្តសញ្ញាណការប្រមូលផ្តុំតាមរដូវបន្តពូជ ដែលអាចបញ្ជាក់អំពីបន្ទាយពងកូនបក្សីដែលគេមិនធ្លាប់ ប្រទះឃើញពីមុនមក
- ៤) - ដើម្បីប្រៀបធៀបរបាយបក្សី ជាមួយនឹងការគ្របដណ្តប់ពេលបច្ចុប្បន្ននៃតំបន់ដែលទទួលបានការការពារនៅក្នុង តំបន់ TSBR
- ៥) - ដើម្បីកំណត់អត្តសញ្ញាណគម្លាតនៃការគ្របដណ្តប់ទិន្នន័យ និងធ្វើការស្ទង់មតិ ឬតម្រូវការការតាមដានបន្ថែមទៀត ។

គំរូរបាយបក្សីទឹកធំៗស្ថិតក្នុងក្រុមសំខាន់ៗចំនួនពីរគឺ ក្រុមដែល TSBR គឺជាតំបន់បន្តពូជដ៏ធំមួយ និងក្រុមដែលតំបន់ TSBR មិនមែនជាតំបន់បន្តពូជ ។ អ្នករៀបរៀងលើកឡើងនូវសម្មតិកម្មធម្មតាចំនួនបួន ដើម្បីពន្យល់គំរូតាមរដូវកាល នៃរបាយបក្សីដែល TSBR គឺជាតំបន់បន្តពូជដ៏សំខាន់ ៖

- (១) - បក្សីភាគច្រើននៅក្នុងតំបន់ TSBR ត្រូវបានរកឃើញជាហ្វូងក្នុងកំឡុងខែមករា-មិថុនា (លើកលែងតែស្មៅញ ដែល បន្តពូជពីខែកញ្ញា-មករា) ដោយមានចំនួនតិចតួចនៃបក្សីត្រាច់ចរក្នុងចម្ងាយឆ្ងាយមិនបន្តពូជ ។
- (២) - ដោយសាររដូវកាលបន្តពូជបញ្ចប់ទៅ បក្សីចាស់ៗ និងក្មេងៗចាកចេញពីហ្វូងរបស់វា ។ ពួកវាជាដំបូងឡើយផ្លាស់ទីក្នុង ចំនួនច្រើនទៅកាន់ទីតាំងសំបូរអាហារនៅចុងរដូវប្រាំងដែលវាពេញចិត្ត មុនពេលបែកខ្ញែកជាក្រុមតូចៗចេញពីទីតាំង បន្ទាយពងកូនរបស់ខ្លួន ។
- (៣) - ដោយសារតែភ្លៀងចាប់ផ្តើមធ្លាក់ ហើយកម្ពស់ទឹកជំនន់កើនឡើងស្ថានភាពចិញ្ចឹមជីវិតប្រែប្រួលយ៉ាងខ្លាំង ហើយបក្សី ជាច្រើនត្រូវផ្លាស់ទីទៅកាន់តំបន់វាលទំនាបលិចទឹកឆ្ងាយៗ ដើម្បីស្វែងរកទីតាំងដែលសមស្របសំរាប់ការរកចំណី ។
- (៤) - ដោយសារទឹកជំនន់ស្រកចុះ បក្សីផ្លាស់ទីត្រឡប់មកកាន់តំបន់វាលទំនាបលិចទឹកដើម្បីរៀបចំបន្តពូជ ហើយអាចមក ប្រមូលផ្តុំជាបណ្តោះអាសន្នក្នុងចំនួនច្រើន ។

ជារួម គេសង្កេតឃើញថា ទិន្នន័យបក្សីបន្តពូជជាច្រើននៅព្រែកទាល់ ដូចជា ស្មៅព្យ ទុងប្រផេះ ត្រយ៉ង់ខ្លួនស ត្រដក់ធំ និងរនាសស សមស្របសម្រាប់សម្ភតិកម្មទីមួយ ។ មានទិន្នន័យតិចតួចពីហ្វូងបក្សីដែលត្រូវគេស្គាល់នៅព្រែកទាល់ ក្នុងកំឡុង ពេលរដូវបន្តពូជ ហើយភាគច្រើនជាក្រុមតូចៗ ។ សម្រាប់ប្រភេទបក្សីដទៃទៀត (ឧទាហរណ៍ : ចង្កៀលខ្យង និងរនាសពណ៌) មានចំនួនគួរឱ្យកត់សម្គាល់នូវទិន្នន័យរដូវបន្តពូជ ដែលត្រូវបានសង្កេតមើលជាបន្តពីបន្ទាយពងកូនដែលគេស្គាល់ ព្រមទាំង ទិន្នន័យម្តងម្កាលនៃហ្វូងបក្សីច្រើន ។ ទិន្នន័យម្តងម្កាលនៃហ្វូងបក្សីច្រើននេះអាចតំណាងឱ្យហ្វូងបក្សី ដែលបានបែកខ្ញែក ដោយ សារតែមានការរំខានក្នុងបន្ទាយពងកូន ឬប្រហែលជាអាចមកពីបន្ទាយដែលគេមិនទាន់ប្រទះឃើញផងក៏ថាបាន ឬតំណាងឱ្យ លំហូរចូលនៃបក្សីជាបណ្តោះអាសន្នពីតំបន់ដទៃទៀតនៅក្នុងប្រទេសកម្ពុជា ។ ការប្រមូលផ្តុំតូចៗដែលត្រូវសង្កេត គឺទំនងជា ប្រភេទបក្សីមិនបន្តពូជ ។

ហ្វូងបក្សីក្រោយពេលបន្តពូជជាច្រើន ត្រូវបានកត់សម្គាល់ឃើញមាននៅក្នុង TSBR ចំពោះប្រភេទបក្សីមួយចំនួន ជាពិសេស ត្រដក់ធំ ទុងប្រផេះ និងត្រយ៉ង់ខ្លួនស ។ ការប្រមូលផ្តុំទាំងនេះតួយ៉ាងមាននៅក្នុងតំបន់ដាច់ស្រយាលនៅភាគពាយ័ព្យ និងអគ្នេយ៍នៃតំបន់វាលទំនាបលិចទឹក ប៉ុន្តែក៏ត្រូវបានគេសង្កេតឃើញមានផងដែរ នៅជុំវិញបឹងទន្លេសាបពេលអតីតកាល ។ ហ្វូងបក្សីក្រោយពេលបន្តពូជនៅភាគពាយ័ព្យ ត្រូវបានគេឃើញនៅតំបន់វាលស្មៅនៅស្រុកព្រះនេតព្រះ និងនៅក្រៅតំបន់វាល ទំនាបលិចទឹកក្នុងស្រុកមង្គលបុរី និងអាងត្រពាំងថ្ម (ស្រុកទាំងអស់នេះស្ថិតក្នុងខេត្តបន្ទាយមានជ័យ) ។ ភាគអគ្នេយ៍នៃតំបន់ ដីសណ្ត និងតំបន់វាលស្មៅរវាងស្ទឹងសែន និងស្ទឹងជិនិត ក្នុងខេត្តកំពង់ធំ និងខេត្តកំពង់ឆ្នាំង គឺជាទីកន្លែងដែលការប្រមូលផ្តុំ ក្រោយពេលបន្តពូជជាច្រើនត្រូវបានសង្កេតឃើញ ។ ស្មៅព្យហាក់បីដូចជាប្រមូលផ្តុំក្រោយ និងមុនពេលបន្តពូជនៅក្នុងតំបន់ជុំវិញ ព្រែកទាល់ ។ មានទិន្នន័យតិចតួចមួយចំនួននៃហ្វូងធំៗរបស់សត្វរនាសពណ៌ និងចង្កៀលខ្យងក្រោយពេលបន្តពូជ ។ ហ្វូងសត្វ ត្រដក់តូច និងធំនៅចុងរដូវប្រាំង ក៏ត្រូវប្រទះឃើញផងដែរ ប៉ុន្តែពេលវេលារបស់ពួកវាត្រូវបានសន្និដ្ឋានថា យ៉ាងហោចណាស់ ហ្វូងបក្សីមួយចំនួនអាចមកពីបន្ទាយពងកូនខាងក្រៅ TSBR ដែលនេះប្រហែលជាមកពីខេត្តព្រះវិហារ ។

គេបានសង្កេតឃើញបក្សីមួយចំនួនតូចរស់នៅជុំវិញបឹងទន្លេសាបពេញមួយឆ្នាំ ដោយមានការអង្កេតតាមជំរកសំខាន់ៗ ជិតៗ បានធ្វើឡើងនៅរដូវវស្សា (រដូវជំនន់) នោះ គេមានការលំបាកក្នុងការស្វែងយល់ឱ្យបានត្រឹមត្រូវអំពីចំនួនបក្សី ប៉ុន្តែគេមាន ជំនឿថា បក្សីទឹកធំៗភាគច្រើនបំផុតចាកចេញពីវាលទំនាបលិចទឹកនៅរដូវវស្សា ។ ប្រភេទបក្សីខ្លះ ដូចជា ត្រដក់ធំ និងត្រដក់ តូច ចង្កៀលខ្យង ទុងប្រផេះ និងស្មៅព្យ ត្រូវបានសង្កេតឃើញថា បន្តប្រើប្រាស់តំបន់វាលទំនាបលិចទឹក (ភាគច្រើននៅតំបន់ ខាងក្រៅ) យ៉ាងសុខសាន្តរហូតដល់រដូវទឹកជំនន់ឡើងខ្លាំង នៅចន្លោះខែសីហា-តុលា ប៉ុន្តែក្នុងកម្រិតមួយទាបជាងរដូវប្រាំង ។

ចំពោះរនាសពណ៌ ចង្កៀលខ្យង ទុងប្រផេះ និងត្រយ៉ង់ខ្លួនស ហាក់ដូចជាបង្ហាញថា មួយភាគធំនៃបក្សីដែលបន្តពូជនៅ ព្រែកទាល់ ផ្លាស់ទីទៅកាន់អាងត្រពាំងថ្មនៅដើមរដូវវស្សា ហើយមានទំនាក់ទំនងយ៉ាងខ្លាំងក្នុងការកំណត់ពេលវេលាចាក ចេញ និងមកដល់វាងទីតាំងទាំងពីរនេះ ។ ចំពោះប្រភេទសត្វទាំងនេះ ជាងពាក់កណ្តាលនៃចំនួនបក្សីដែលបានប៉ាន់ប្រមាណថា បន្តពូជនៅព្រែកទាល់ត្រូវបានរកឃើញនៅអាងត្រពាំងថ្មក្រោយពីពេលបន្តពូជ ។ ចំពោះប្រភេទត្រដក់ទាំងពីរប្រភេទ (ត្រដក់ធំ និងត្រដក់តូច) ភាគរយដែលរកឃើញមាននៅអាងត្រពាំងថ្មនៅរដូវវស្សាធៀបនឹងព្រែកទាល់មានចំនួនតិចជាងច្រើន (ប្រមាណ ជា ៥-១០% ប៉ុណ្ណោះ) ហើយចំនួននេះអាចរាប់បញ្ចូលទាំងបក្សីនីមួយៗ ដែលមកពីបន្ទាយពងកូននៅក្រៅ TSBR ទៀតផង ។

បក្សីក្រុមទីមួយ ជាធម្មតាឃើញវិលត្រឡប់មកកាន់តំបន់លិចទឹកវិញនៅខែវិច្ឆិកា-ធ្នូ ។ ហ្នឹងបក្សីដែលត្រូវមិនបន្ត ពូជមិនបានសង្កេតឃើញមានគ្រប់ប្រភេទបក្សីទាំងអស់នេះទេ ហើយពួកវាក៏មិនមែនស្ថិតនៅក្បែរបន្ទាយពងកូនជានិច្ចឡើយ ។ បក្សីធំៗបួនប្រភេទ ហាក់ដូចជាប្រើប្រាស់ TSBR ជាចម្បង មិនមែនជាតំបន់សម្រាប់បន្តពូជទេ (សត្វកស ឬកុកពាក់អំបោះ អង្កត់ខ្មៅ ឬដំបងក្រញូង ត្រយ៉ងចង្កកស និងក្រៀល) ។ បក្សីបីប្រភេទដំបូង ត្រូវបានគេដឹង ឬសង្ស័យថាបន្តពូជ ជាចំនួនតូច ប៉ុន្តែគេជឿថា តំបន់លិចទឹកបឹងទន្លេសាប គឺជាទីជម្រកបន្តពូជដែលវាពេញចិត្តលំដាប់បន្ទាប់ ។ ប្រភេទបក្សីទាំងអស់នេះភាគ ច្រើនបំផុត សង្កេតឃើញមាននៅតំបន់ខាងក្រៅ ដែលហូតហែងជាងនៅតំបន់លិចទឹក ជាពិសេសនៅតំបន់វាលស្មៅនៃខេត្ត កំពង់ធំ និងភាគបូព៌ានៃខេត្តសៀមរាប ហើយចាកចេញនៅក្នុងកំឡុងដើមរដូវវស្សា ឬនៅមុនពេលនេះ ។ ហាក់ដូចជាមានក្រុម បក្សី ក្រៀលមួយក្រុមរស់នៅតំបន់ស្មោង និងជីវ័ក្រុងនៃតំបន់គ្រប់គ្រងកសិ-ជីវៈចម្រុះ IFBAs នៅរដូវប្រាំង ហើយចំនួន ផ្សេងទៀត ភាគច្រើនរស់នៅពិដើមរដូវប្រាំង នៅពេលដែលក្រុមបក្សីត្រូវសង្កេតឃើញរកចំណីនៅតំបន់វាលស្មៅ ដែលបានជន់ លិចនៅពេលថ្មីនេះ ។ សត្វក្រៀលភាគច្រើនផ្លាស់ទីទៅអាងត្រពាំងថ្ម នៅដំណាក់កាលចុងក្រោយនៃរដូវក្តៅមុនពេលបែក ខ្នែកទៅកាន់តំបន់ព្រៃនៅភាគឧត្តរ ហើយអាចទៅកាន់ទិសស្មៅដើម្បីបន្តពូជ ។ សត្វកស ឬកុកពាក់អំបោះ មិនជាញឹកញាប់ ត្រូវបានសង្កេតឃើញមកពីវាលស្មៅ នៅដំណាក់កាលចុងក្រោយនៃរដូវប្រាំងនៅភាគអគ្នេយ៍នៃវាលទំនាបលិចទឹក ។

ការពិនិត្យមើលឡើងវិញនេះ បានកំណត់ឃើញតំបន់សំខាន់ៗមួយចំនួនសម្រាប់បក្សីទឹកធំៗនៅក្នុង និងនៅក្បែរ TSBR ។ តំបន់អភិរក្សត្រូវបានបង្កើតឡើងនៅពេលថ្មីៗនៅតំបន់ជាច្រើននៃទីតាំងទាំងនេះ ប៉ុន្តែកិច្ចការពារនៅតាមទីតាំង នីមួយៗត្រូវការការពង្រឹងបន្ថែម ។ តំបន់មួយចំនួនពុំទាន់មានកិច្ចការពារនៅឡើយទេ ។

ដំណាច់ : មានភស្តុតាងបញ្ជាក់ជាបន្តថា មានហ្នឹងបក្សីបន្តពូជ ។

ព្រៃកោះ និងភាគច្រើននៃវាលទំនាបលិចទឹក ពិសេសភាគឧត្តរនៃស្ទឹងសែន ។ ហាក់ដូចជាមានតំបន់រកចំណី និង ជួបជុំដ៏សំខាន់នៅចុងរដូវប្រាំង ។ តំបន់នេះមានកំណត់ត្រា និងរបាយការណ៍អំពីការប្រមូលផ្តុំគ្នាក្រោយពេលបន្តពូជដ៏ធំនៃត្រដក់ តូច ត្រដក់ធំ និងទុងប្រផេះ ហើយព្រមទាំងរបាយការណ៍ពុំមានការអះអាងអំពីបន្ទាយពងកូនទៀតផង ។

តំបន់វាលទំនាបលិចទឹកភាគពាយ័ព្យខាងក្រៅ (រួមមានព្រះនេត្រព្រះ និងមង្គលបុរី) ។ ត្រូវបានកត់ត្រាថាមានសារៈ សំខាន់សម្រាប់ជាកន្លែងបន្តពូជ ដែលមានហ្នឹងសត្វបក្សីនៅរដូវមុន និងក្រោយបន្តពូជ ជាច្រើនប្រភេទ ។

ការពិនិត្យមើលឡើងវិញនេះ ក៏បានសង្កត់ធ្ងន់អំពីសារៈសំខាន់ដ៏សម្បើមរបស់អាងត្រពាំងថ្មផងដែរ ។ ជាពិសេស សម្រាប់ រនាសពណ៌ ចង្កៀលខ្យង ទុងប្រផេះ និងត្រយ៉ងខ្លួនស ដែលជាងពាក់កណ្តាលនៃចំនួនសរុបនៃបក្សី ដែលត្រូវបាន ប៉ាន់ប្រមាណថា បន្តពូជនៅព្រៃកោះ ក្រោយមកទៀតត្រូវបានប្រទះឃើញនៅអាងត្រពាំងថ្ម ក្រោយពេលបន្តពូជ ។

មានកំណត់ត្រាសំខាន់ៗនៅពេលថ្មីៗនេះ អំពីបក្សីទឹកធំៗនៅបឹងទន្លេឆ្នារ ដែលមួយផ្នែកអាចបណ្តាលមកពីកិច្ចប្រឹងប្រែងស្រាវជ្រាវអង្កេតនៅមានកម្រិត ។ ដើមឡើយ យ៉ាងហោចណាស់ក៏មានទីតាំងបក្សីទឹកសំខាន់មួយដែរ ហើយសមតែមានការអភិរក្ស និងកិច្ចប្រឹងប្រែងសិក្សាស្រាវជ្រាវឱ្យបានច្រើនថែមទៀត ។

ដោយសារទិន្នន័យអំពីចំនួនបក្សីទឹក ការកើតមានតាមរដូវកាល និងការព្យាយាមបន្តពូជ នៅពេលថ្មីៗពុំសូវទទួលបានពីតំបន់អភិរក្សជីវចម្រុះ ដែលទើបបង្កើតថ្មី និងតំបន់ស្នូលនៃបឹងទន្លេឆ្នារ និងស្ទឹងសែននោះ ត្រូវតែមានប្រព័ន្ធប្រមូលទិន្នន័យមួយ ។ ប្រព័ន្ធដូចពេលនេះអាចផ្អែកទៅតាមកម្មវិធីមូលដ្ឋានទិន្នន័យ (ប្រព័ន្ធគ្រប់គ្រងព័ត៌មានតំបន់ការពារធម្មជាតិ Management Information SysTem-MIST) ដែលផ្តល់លទ្ធភាពឱ្យបុគ្គលិកនៅតំបន់ការពារប្រមូលទិន្នន័យនៅពេលចុះល្បាតនៅពេលអនុវត្តដោយអ្នកល្បាតរបស់ក្រសួងបរិស្ថាន ដែលឈរជើងនៅក្នុង TSBR វាប្រហែលជាអាចបង្កើនគុណភាពទិន្នន័យដែលបានទទួលរក្សាទុក និងវិភាគ ។ លក្ខខណ្ឌដែលត្រូវបំពេញជាមុន ដើម្បីឱ្យការងារនេះមានដំណើរការទៅបាននោះ គឺអ្នកល្បាតត្រូវបានទទួលការបណ្តុះបណ្តាលអំពីរបៀបប្រមូលទិន្នន័យ និងនីតិវិធីកត់ត្រាទិន្នន័យ ។ ហើយពួកគេត្រូវមានវិភាគគ្រប់គ្រាន់ដើម្បីធ្វើការល្បាត និងត្រូវទទួលបានការត្រួតពិនិត្យឱ្យបានទៀងទាត់ ។ ឯកសារមានលក្ខណៈសាមញ្ញស្តីពីពិធីសារនៃការប្រមូលទិន្នន័យសម្រាប់បក្សីទឹក និងសត្វព្រៃនៅក្នុង TSBR អាចយកទៅប្រើប្រាស់បាននៅពេលអនុវត្ត MIST ដែលបានភ្ជាប់ជាឧបសម្ព័ន្ធនៅក្នុងរបាយការណ៍នេះ ។

បញ្ហាដែលបានវាយតម្លៃនៅក្នុងរបាយការណ៍នេះ នៅមិនទាន់មានការយល់ឱ្យបានច្បាស់នៅឡើយទេ ហើយយើងសង្ឃឹមថា កម្មវិធីស្រាវជ្រាវកម្រិតខ្ពស់ ដែលសិក្សាអំពីបំណាស់ទីរបស់បក្សីទឹកធំៗ ដែលទទួលបានការគាំពារកំហែងនៅបឹងទន្លេសាប និងការវាយតម្លៃអំពីការផ្លាស់ប្តូរហ្វូងសត្វនៅទូទាំងប្រទេសកម្ពុជា និងនៅក្រៅកម្ពុជានឹងត្រូវបានផ្តួចផ្តើមឡើងនៅពេលអនាគត ។

INTRODUCTION

Scope of the report

This report reviews the seasonal status and distribution of large waterbirds in the Tonle Sap Great Lake floodplain. It examines records from past ornithological surveys, as well as patrols, monitoring activities and other field trips by conservation staff. The species reviewed are shown in Table 1 below. Most of these birds breed in the floodplain, primarily at the large colonies in the Prek Toal Core Area (Goes 2004,

Clements *et al.* 2007b). Other large waterbirds which have been recorded or reported in the TSBR but are not reviewed here are Black-faced Spoonbill (possible vagrant, no confirmed records), Great White Pelican (vagrant), Greater Flamingo (no records for over 70 years) and Masked Finfoot (sporadic records only in the past as a visitor and breeder in Prek Toal).

Table 1. Species reviewed in this report and IUCN global threat category (BirdLife International, 2008)

Species	Global Threat Category
Lesser Adjutant (<i>Leptoptilos javanicus</i>)	Vulnerable
Greater Adjutant (<i>Leptoptilos dubius</i>)	Endangered
Painted Stork (<i>Mycteria leucocephala</i>)	Near threatened
Milky Stork (<i>Mycteria cinerea</i>)	Vulnerable
Asian Openbill (<i>Anastomus oscitans</i>)	Least Concern
Black-headed Ibis (<i>Threskiornis melanocephalus</i>)	Near threatened
Spot-billed Pelican (<i>Pelecanus philippensis</i>)	Near threatened
Oriental Darter (<i>Anhinga melanogaster</i>)	Near threatened
Black-necked Stork (<i>Ephippiorhynchus asiaticus</i>)	Near threatened
Woolly-necked Stork (<i>Ciconia episcopus</i>)	Least Concern
White-shouldered Ibis (<i>Pseudibis davisoni</i>)	Critically Endangered
Sarus Crane (<i>Grus antigone</i>)	Vulnerable

There were several reasons for conducting this review:

- 1) To get a better understanding of seasonality of occurrence and abundance
- 2) To identify areas with regular non-breeding aggregations or other key sites
- 3) To identify breeding season aggregations that may indicate as yet undiscovered colonies.
- 4) To compare bird distributions with the present coverage of protected zones in the TSBR
- 5) To identify gaps in data coverage and further survey or monitoring needs.

Seasonality

The importance of the Tonle Sap landscape for a wide variety of birds comes from its productivity as a floodplain and the increased accessibility to this immense and

bountiful feeding ground in the dry season. A few months into the wet season (July-August) the waters of the Tonle Sap lake start to rise very rapidly when floodwaters from the Mekong River's huge catchment start to stream into the lake. With these waters come huge quantities of fish larvae and fry that together with the water spread out into the wider floodplain, which then acts as a nursery. Not only fish, but other aquatic organisms proliferate. A well known example is the number of watersnakes, the harvest of which is considered to be the largest in the world (Stuart *et al.* 2001). At its peak at the end of the wet season in October-November the total area of the Tonle Sap Lake can reach as much as 16,000 km², depending on the amount of rainfall in the Mekong basin that year, up from around 3,000 km² in April-May.

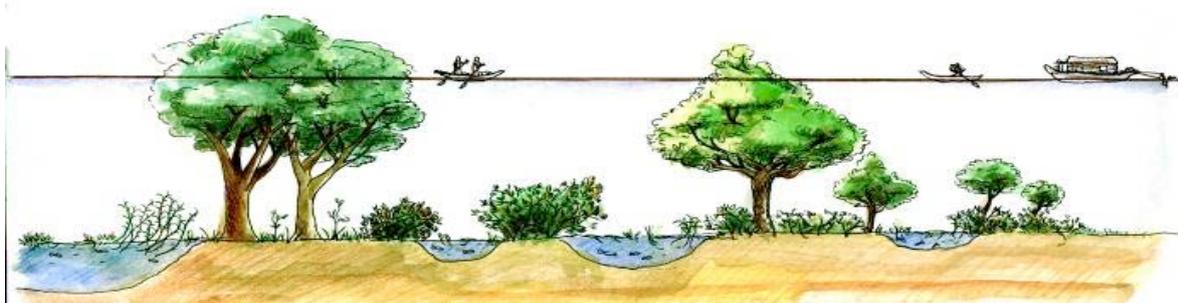


Figure 1. A representation of the variation in water level at the end of the dry and wet seasons in the inner floodplain of the Tonle Sap Lake

As the water recedes again in the dry season fish and many other aquatic organisms are increasingly confined to isolated ponds scattered throughout the floodplain and become easier and easier to catch as water levels drop further. It is this availability of food that brings so many waterbirds, some of which are typically coastal birds (e.g. Milky Stork) whilst others are normally birds of the dry deciduous forests (adjutants, Black-necked and Woolly-necked Stork).

Habitats and Landuse

The floodplain vegetation can be crudely differentiated into irregular concentric bands from the Tonle Sap Lake outwards. The inner floodplain comprises a 5–40 km wide belt of trees (up to 20 m tall) and scrub (up to 5 m in height), normally referred to as flooded forest. This “forest” is estimated to cover about 3,000–3,600 km² of the floodplain at present (Neou Bonheur et al., 2005; Rundel, 2000). The term flooded forest is widely applied to describe the dominant natural floodplain vegetation currently found around the lake, i.e. the mixture of scrub and trees as described above. It stems from the French “forêt inondé” and refers to all seasonally inundated vegetation dominated by woody species (Campbell et al., 2006). A more correct description is “seasonally flooded freshwater swamp forest” (Goes, 2005), but for ease of reading the term flooded forest is maintained in this report.

The vegetation gradually becomes lower in stature with increasing distance from the lakeshore and decreasing duration of flooding (McDonald *et al.* 1997). A mosaic of extensive grasslands with patches of scrub and agriculture occurs next, in areas where the period between floods is longer and the vegetation has been influenced further by disturbing factors such as logging, fire and periods of cultivation. The outermost part of the floodplain is an agricultural belt with deep water rice being grown in the lower areas and other rice varieties being grown where flooding is minimal or intermittent. In total the floodplain consists of 33% flooded forest, 19% grassland, 15% permanent pools scattered throughout the floodplain and 33% agriculture (in the outer zone). The spatial extent of the various habitat types of the floodplain is shown in the species distribution maps.

The main land uses in the inner floodplain are fisheries (both highly commercial and subsistence types) and firewood collection. In the outer floodplain rice cultivation (both larger commercial enterprises and family scale farming) and cattle herding predominate, as well as some subsistence fishing in seasonal and permanent ponds. Recently people have also started establishing tree plantations in the drier areas of the outer floodplain. The long-term viability of such enterprises as well as that of many of the large commercial rice cultivation schemes, in the extreme environment of the Tonle Sap floodplain, is still largely unknown.

Conservation

In recognition of its unique environmental, economic and cultural significance UNESCO inscribed the Tonle Sap lake into the world network of Biosphere Reserves in October 1997 (Goes, 2005) and in April 2001, a Royal Decree on the establishment of the Tonle Sap Biosphere Reserve (TSBR) was adopted culminating in the zonation of the reserve (Neou Bonheur, 2006). The TSBR (14,812 km²) consists of 3 core areas: Prek Toal (213 km²), Boeung Tonle Chhmar (145 km²), and Stueng Sen (63 km²) where in principle only scientific research and monitoring activities are permitted, a buffer zone (5,393 km²) where human activities and settlements are allowed but activities must be in accordance with conservation objectives, and a transition zone (8,998 km²) for integrated economic development which does not cause a detrimental impact on the other zones (see the map under this section for the location of the different zones). For the Tonle Sap Biosphere Reserve some special exceptions were made by allowing both fisheries (in the form of fishing lots) and ecotourism to be undertaken in the core areas (Goes, 2005). However the natural habitat and resources of the Tonle Sap are being heavily exploited and need careful management. In order to ensure the environment is looked after in key areas without excluding people, further conservation areas adopting integrated management systems have been set up within the TSBR.

In August 2006 four Integrated Farming and Biodiversity Areas (IFBAs) were established in the outer floodplain in Kampong Thom and in January 2007 one more was added in Siem Reap. The IFBAs aim to conserve a portion of the Tonle Sap's grasslands through traditional land management systems implemented by the Forestry Administration with involvement of local communities and under the supervision of two provincial commissions (Kampong Thom and Siem Reap).

Currently this area of the floodplain is under severe pressure from agricultural intensification. The grasslands are not only valuable to the Tonle Sap's large waterbirds, but is also of great importance to local communities who have always used these lands for a diverse mix of livelihood activities, including fishing, cattle herding and farming.

In 2007 five Biodiversity Conservation Areas (BCAs) were set up in the inner floodplain in order to increase participation from all stakeholders in the protection of the environment and natural resources. Within each BCA the Ministry of Environment (MoE) and local residents will work to form a resource management plan and management committee with the purpose of long term sustainable management of forest, agricultural land, water and wildlife which are essential to the livelihoods and culture of local residents. Map 2 shows the boundaries of the conservation areas that have been created within the TSBR and the level of survey attention received by each. The conservation areas are also shown in all the species distribution maps. Map 1 shows the location of important areas for the waterbirds reviewed in this report throughout Cambodia.

Surveys

There is a great deal of data available from the MoE/WCS monitoring team at Prek Toal. The breeding season data have recently been summarised (Clements *et al.* 2007) and the full dataset is held on a wildlife records database by WCS and MoE. This has been used in this report to generate peak breeding-season counts for each species and to extract non-breeding records for more detailed analysis.

In addition, many other sources exist for the lake as a whole (Table 2). This list is probably not comprehensive but the surveys and researchers listed below represent the great majority of the work that we are aware of in the Tonle Sap floodplain besides Prek Toal.

Table 2. Surveys and other sources from the Tonle Sap floodplain from which bird observation records have been used in this report.

Dates	Sites visited	Source
Apr-Jun 1993	Chhnuk Tru (delta of the lake)	Carr, 1993
Mar-Apr 1994	Entire lake	Mundkur <i>et al.</i> , 1995
Jan 1996	Boeung Tonle Chhmar	Edwards, 1999
Feb-May 1996	Prek Toal and Boeung Tonle Chhmar	Parr <i>et al.</i> , 1996
Oct 1997	Sotr Nikum district, Siem Reap	Sam Veasna <i>et al.</i> , 1997
May-Jul 1998	Prek Toal and Boeung Tonle Chhmar	Goes <i>et al.</i> , 1998
Apr 1999	Boeung Tonle Chhmar	Seng Kim Hout <i>et al.</i> , 1999
May 1999	Grasslands in the south-east corner of the Tonle Sap floodplain	Sam Veasna, 1999
Feb-Jul + Oct 2000 and Feb-Jun 2001	Mostly Prek Toal, twice Boeung Tonle Chhmar, once Stueng Sen, also Dei Roneath and a few surveys in other parts of the floodplain on both east and west sides	Goes and Hong Chamnan, 2002
Apr 2000-Jun 2002	Grasslands in Kampong Thom	Pete Davidson, WCS
2001-2005	Incidental records from entire lake and floodplain	Various in Cambodia Bird News
2004-2006	Survey records from grasslands in Chikraeng, Puok and Preah Net Preah districts	BirdLife International, WPO
Feb-Apr 2006	Grasslands in Kampong Thom and Chikraeng district, Siem Reap	Tom Gray, University of East Anglia (UEA)
Mar-May 2006	Bengal Florican survey in grasslands all around the lake	Tom Gray, UEA
Mar 2006	Boeung Tonle Chhmar	Bird <i>et al.</i> , 2006
October 2006	Boeung Tonle Chhmar	Pech Bunnat and van Zalinge, 2006a
Nov 2006	Stueng Sen and Prey Kohs, including Veal Srongai	Pech Bunnat and van Zalinge, 2006b
Nov 2006	Dei Roneath	Long Kheng <i>et al.</i> , 2006
Feb-Jun 2007	Grasslands in Kampong Thom and Chikraeng district, Siem Reap	Tom Gray, UEA
Mar 2007	Au Reang Sor	Harden <i>et al.</i> , 2007
Aug 2007	Stueng Sen	Sorn Pheakdey, 2007a
Sep 2007	Boeung Tonle Chhmar	Sorn Pheakdey, 2007b
Aug-Sep 2007	Tumpich and upland forests in Kampong Thom	Ro Borey, 2007a&b
Feb-Mar 2008	Grasslands in Kampong Thom	Charlotte Packman, UEA
Apr 2007 + Jan-Mar 2008	Crane census in grasslands in Kampong Thom and Siem Reap	Nguyen Phuc Bao Hoa <i>et al.</i> 2007; Evans <i>et al.</i> 2008
Jan 2007-Jun 2008	Patrolling and monitoring activities in IFBAs	WPO, WCS and BirdLife International IFBA project
Jan 2001-2008	Prek Toal, grasslands in south-east corner of the Tonle Sap floodplain	Asian Waterfowl Census
2007-2008	Wetlands on the lakeshore near to Siem Reap town	Howie Nielsen, Sam Veasna Centre

Certain areas of the lake have been surveyed much more regularly than others. The inner floodplain received the most survey attention in the mid to late 1990s. After that conservation and survey work conducted by WCS/MoE focused mainly on Prek Toal which stood out from the rest of the locations as a major breeding area. Boeung Tonle Chhmar has been intermittently surveyed over the years with most surveys

occurring before 2003. There have been very few surveys in other areas in the inner floodplain and only Stung Sen and Dei Roneath have had repeat surveys conducted.

In the outer floodplain the grasslands in the south-eastern part of the floodplain, especially Kampong Thom, are a key habitat for the Bengal Florican (Critically Endangered). WCS (since 1999) and

BirdLife in Indochina (since 2004) together with the WPO have worked there on various projects, as have several academic researchers. This work has also resulted in numerous records of other species of large waterbird, mainly from the dry season. A series of systematic dry season florican surveys was conducted in 2006 in most large grassland blocks around the lake. The florican data are being published elsewhere (e.g. Gray *et al.*, in press); the datasheets also contain incidental records of large waterbirds which are analysed here. In addition, some surveys have been conducted in areas nearby, but outside of the floodplain, and these have also recorded large waterbirds.

Extensive aerial surveys of large waterbirds were conducted in September 2001 (Barzen 2004). They covered the northern quarter of Cambodia and excluded the Tonle Sap floodplain, but nonetheless provide a valuable insight into the possible location of birds that leave the TSBR during the flood season

Most of the data in this report therefore comes from areas that were identified as being priority areas for conservation. This naturally biases the data which should be kept in mind when reading this report and looking at the distribution maps. The prioritization of certain areas for conservation was mostly related to breeding, i.e. nesting colonies at Prek Toal, breeding sites for Bengal Florican in the south-eastern grasslands and therefore does not relate to feeding sites and places important for non- or post-breeding birds. This study therefore acknowledges that available data are incomplete. In such a vast area as the floodplain of the Tonle Sap it is possible, even likely, that there are important areas for large waterbirds which have not yet been recognised. This is especially true for non-breeding sites, since these vary so much through the course of each year depending on water levels.

There is also a seasonal bias. As explained above most of the effort in the grasslands of the outer floodplain has been focused on the dry season as this is the period in which Bengal Floricans occur. However this is also true for the rest of the floodplain. As can be seen from the dates of surveys shown in Table 2, most surveys have been conducted in the dry season. It appears that the dry season is the most important time in terms of number of birds present in the floodplain, but the bias in surveys means far fewer records from the wet season, making it more difficult to assess the distribution of birds in this period.

Since almost every survey records at least one of the species reviewed here, a crude impression of survey distribution around the lake can be obtained by mapping all bird records used in this study (Map 2). Here it can be seen that the distribution of surveys in the floodplain was more uniform in the period before 2003, with records coming from around the inner and outer floodplains. However, after 2003 the focus in the inner floodplain was quite specifically on Prek Toal, the grasslands in the outer floodplain were however being surveyed more uniformly, yet there was little if any systematic recording elsewhere. It is also clear that far less attention has been given to the western floodplain than the floodplain in the east.

Structure of the species accounts

Each species account starts with the common name, scientific name and the most popular Khmer name(s). Thereafter a brief description of the species is given, the habitats used described and the global distribution summarized based on information derived from BirdLife International species factsheets (BirdLife International, 2008) and the standard field guide to South-East Asia (Robson, 2002). The description of the Cambodian range of the species is derived from the upcoming “Annotated Checklist of the Birds of Cambodia” (Goes, in, prep.) unless otherwise stated. The sections on global and Cambodian distribution are followed by

details on the conservation status of the species with the latest information on global population estimates and IUCN threat categories as given in the BirdLife International factsheets (BirdLife International, 2008). The national status of the species under Cambodian law is also given (Anonymous, 2007). This document enacted by the Minister of Agriculture, Forestry and Fisheries distinguishes three categories: Endangered, Rare or Common, which relates to the level of penalties that may be imposed for offenses committed in relation to the species in question.

The section on breeding status of each species summarizes records of breeding. Mostly the records come from Prek Toal in which case the latest information about the size of the nesting colonies from the ongoing waterbird monitoring program is used (Clements *et al.* 2007b). Most records from other locations come from surveys conducted in 2000 and 2001 around the lake (Goes and Hong Chamnan, 2002), but all sources for breeding records are mentioned in the text. Nesting periods given follow those described for Prek Toal (Clements *et al.*, 2007b) or the Northern Plains of Preah Vihear (Clements *et al.*, 2007a).

The main section is that on distribution and movements and is a review of seasonality and numbers of birds seen around the Tonle Sap floodplain based on observational records derived from various sources as listed above in Table 2. The sources are all professional staff or researchers working on bird conservation. A species distribution map showing all records is linked to each account. The maps also show main land cover types and the already established conservation areas around the lake as well as boundaries of the various zones of the TSBR. In each account a summary table of records is given, usually taking peak counts or total number of records from each month. The data are given for the period up to and including 2003 (<03) and from 2004 onwards (>03) to allow for the change in distribution of survey effort between the two survey periods (see above).

Following the analysis of distribution the main threats are listed and the overall status, distribution and conservation of the species being reviewed is discussed. Often here population estimates and seasonality of occurrence at other sites is also referred to in order to briefly synthesize what is currently known about the species in Cambodia.

SPECIES ACCOUNTS

Lesser Adjutant

Leptoptilos javanicus

ត្រូដក់ តូច Trodok toich

Description

A member of the stork family, Ciconiidae. Very large, 120 -130 cm in height and with a wingspan of over two meters. Diet is varied, feeding on frogs, reptiles, fish, crustaceans, large insects as well as young mammals and birds that it is able to catch. It is also a scavenger, eating and actively searching for carrion.

Habitat used

Mostly wetlands: natural pools and lakes in or near open forests, freshwater swamp forest, marshes, mangroves, mudflats.

Global Range

Main populations centered on Assam state in north-eastern India, Cambodia and the Greater Sundas (mostly Sumatra). Smaller breeding populations occur in other parts of the Indian subcontinent and south-east Asia.

Cambodian Range

Widely but sparsely distributed. Known from deciduous forests in northern and north-eastern Cambodia, the floodplain of the Tonle Sap Lake and from coastal areas. A single record exists from the Bassac marshes.

Conservation Status

Global population estimated as being around 6,500-8,000 and declining
Globally Vulnerable
Classified as a Rare species under Cambodian Law

Breeding status in TSBR

Prek Toal: 253 breeding pairs estimated in 2007 (Clements *et al.*, 2007b). This is the



largest known colony in mainland South-East Asia (Goes, 2005).

Dei Roneath: On 27 March 2008 a report came in of four Lesser Adjutant chicks being confiscated from Dei Roneath village, which had been collected from a colony nearby (Sun Visal, pers. comm.). This shows that despite persecution some birds still try to breed in this area. A colony of adjutants was identified in this area 1992 and observed during an aerial survey in 1994, (Mundkur *et al.*, 1995). Two unconfirmed colony locations were reported by local people in 2000 (Goes and Hong Chamnan, 2002a).

Prey Kohs: Nesting has been reported recently by local residents, but so has egg collection (Pech Bunnat and van Zalinge, 2006b). A colony was reported from here in 2000 and 2001-2002 (although then named as being in Stung Sen) but no direct observations and no further records.

Boeung Tonle Chhmar: Although colonies have been reported by local people in the past (Mundkur *et al.*, 1995, Goes and Hong Chamnan, 2002a), there are no recent records of breeding birds, although birds were present during the last ornithological survey during the breeding season, in 2006 (Bird *et al.*, 2006).

Nesting period

Nesting at Prek Toal is from January to June. However, birds start to arrive at colonies in November-December. Breeding in Preah Vihear province takes place between September and February (Clements *et al.*, 2007a).

Distribution and seasonal movements

There are so many records of Lesser Adjutant that they are shown in two maps, for two periods, each with different patterns of survey effort. Most records of Lesser Adjutants around Tonle Sap are from the breeding season there, which coincides with low water level periods (January-June). Lesser Adjutants search for food in the numerous ponds scattered throughout the floodplain in the dry season, typically singly

or in small groups. This includes pools in flooded forest and in grassland. Most breeding season records (especially after 2003) come from Prek Toal, from the outer floodplain in the south-eastern corner of the Tonle Sap (particularly Kampong Thom province) and from Boeung Tonle Chhmar. Table 3 shows the pattern of counts from the south-eastern floodplain. In a recent breeding season survey of Boeung Tonle Chhmar and Moat Khla in March 2006 Lesser Adjutants were found to be common with several encounters daily ranging from single birds to a maximum of nine (Bird *et al.*, 2006). Surveys from before 2003 report totals of 2-23 birds (Mundkur *et al.* 1995, Parr *et al.*, 1996, Goes *et al.*, 1998, Seng Kim Hout *et al.*, 1999).

Table 3. Overview of monthly variation in the south-eastern part of the Tonle Sap floodplain in: lake water levels, nesting period and maximum group sizes observed on survey trips (pooled for all locations and years)

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Water level	Mid□		Low□			Low□		Mid□	High□	Peak□	Peak□	High□	
Nesting in PT	Yes						No						
Max. count	<03	9	10	168	150	87	2	0	2	0	2	2	20
	>03	7	6	9	32	0	18	21	3	12	2	12	2

Records collected between 1999 and 2002 showed that large groups of Lesser Adjutants numbering between 80-200 birds would come to feed for a month or two at a time in the southern Tonle Sap grasslands from March-May (see also Map 3). This activity seemed to be centered mostly on inner floodplain grassland/scrubland, especially in an area called Veal Srongai and adjacent lands to the east and south-east (between Kampong Svay and Baray Districts, Kampong Thom Province). Such large congregations were not observed elsewhere and have not been observed recently around the lake other than at Prek Toal. Possible reasons for the change are analysed in the discussion, below. The south-eastern floodplain remains important for Lesser Adjutant and they are still frequently encountered in this area, but in smaller groups.

Lesser Adjutants do not appear to show the pattern of large flocks forming in June-July which is shown by Greater Adjutant.

No adjutants have been reported from Prek Toal or Boeung Tonle Chhmar in the period of highest water levels from September-October as these sites are located in the inner floodplain, which becomes fully submerged with only the tops of trees remaining above water. In these months some Lesser Adjutants have been recorded from outer areas of the floodplain where the waters are shallower, confirming that some birds use the Tonle Sap the whole year round. However, it is possible that many birds leave the floodplain in the wet season in search of better feeding grounds elsewhere. Barzen (2004) recorded 381 during aerial surveys, very widely distributed

at small and medium-sized forest wetlands across northern Cambodia outside the TSBR.

The floodplain on the western side of the lake still has rarely been surveyed and so we know very little about this area except for the recurrent evidence of a breeding colony at Dei Roneath.

Threats

Egg collection at unprotected colonies is still a major threat to population recovery for this species, but hunting away from colonies may be equally significant. Large waterbirds are especially vulnerable when they visit areas near villages. Night hunting whereby villagers come out with torches and nets (especially during/following rain spells when the birds are unable to fly well) has been documented for adjutants (Goes *et al.*, 2001b).

Conversion of the lake's outer floodplain to agriculture is also a very significant threat with an incredibly rapid growth in dry season farming witnessed over the last five years. The dry season also is the time that Lesser Adjutants flock to this part of the Tonle Sap floodplain.

Comments

The distribution of Lesser Adjutant around the Tonle Sap is still poorly understood away from Prek Toal. A working hypothesis (which also may be considered for other breeding waterbirds treated in this report) is that:

- (i) most birds around the lake are found close to breeding colonies during January-June, with a few non-breeders roaming more widely
- (ii) as each respective breeding season ends, adults and juveniles will either first move in large numbers to other favoured late dry season feeding sites before dispersing or will disperse in small groups directly from the colony site
- (iii) as the rains begin and the floods rise, feeding conditions change dramatically and birds must move to the edges of the

floodplain or beyond to find suitable sites

- (iv) as the flood subside, birds move back into the floodplain in preparation for breeding

At each stage of this cycle information is patchy and the hypothesis unconfirmed, except around Prek Toal. For example, not all breeding colonies are known and so it is difficult to relate them to breeding-season observations. As noted, there is at times a colony at Dei Roneath, but there are still few observations from the area. Furthermore, the distribution and frequency of breeding season records suggests that there may be small colonies in the south-eastern floodplain, possibly in or near Boeung Tonle Chhmar or Prey Kohs where colonies have been reported. The possibility that other (smaller) colonies of Lesser Adjutant exist around the lake besides those of Prek Toal has also been considered very likely by past researchers (Goes and Hong Chamnan, 2002a).

There are records suggestive of large-scale post-breeding dispersal, in particular the former regular appearance of large groups towards the end of the dry season in the south-eastern corner of the floodplain. Survey effort has changed markedly in that area so it is not clear whether this influx still occurs regularly, but it is possible that the noticeable decrease can be credited to the rapid expansion of dry season rice farming in this area. The past influx observed was probably too early for these all to be post-breeding birds dispersing from Prek Toal as these large groups were observed from March-May, so it may be that these were birds dispersing from northern forests, especially from Preah Vihear. A second possibility is that these were unseasonal flocks due to human disruption of breeding colonies. However they could not all be birds from Prek Toal¹ but there may well

¹ When the highest single count in the south-east was made (168 birds in March 2002), there had been no reports of large disturbances of colonies in Prek Toal and it was also estimated that there were only 30-40 pairs at the site (Goes and Hong Chamnan, 2002a; Davidson, 2005).

have been other undiscovered colonies in existence during that time.

Records from monthly counts in Ang Trapeang Thmor, a wetland area bordering dry deciduous forests in Banteay Meanchey, shows that there are almost no Lesser Adjutants in this area in the dry season with numbers declining usually in January, but sometimes December or February. Birds return in the months of May-July. This strongly suggests that these birds breed in Prek Toal where the seasonality of occurrence is the exact opposite. However the maximum count in Ang Trapeang Thmor in 2008 was only 28 Lesser Adjutants (Lou Vanny, 2008) which is only around 5% of the number breeding in Prek Toal.

The hypothesis is a useful way to organise the data we now have, but it can only be validated by increasing data collection on bird movements and preferably by initiating a long term research program that can bring insights into movement patterns of birds and assess the level of interchange between different breeding populations, i.e. those from Prek Toal and those from Preah Vihear.

Although the intricacies of movement patterns around the TSBR and beyond are as yet unknown, this evaluation of records

collected from the TSBR has highlighted the continued importance of several areas besides Prek Toal for Lesser Adjutant: the south-eastern corner of the lake around Veal Srongai IFBA, Baray IFBA and Prey Kohs BCA, an area where there are numerous records and where there may be some breeding birds, and Dei Roneath where although there have been few surveys and consequently few records there has been persistent evidence of breeding. Boeung Tonle Chhmar had Lesser Adjutant colonies in the past, but these seem to have disappeared with no reports of breeding activity for more than five years.

The number of Lesser Adjutants breeding in Prek Toal has increased significantly from around 40 pairs estimated to breed in 2001 to 253 in 2007 (Clements et al. 2007). This increase could be due to several factors. A major part is that protection is resulting in most of the birds returning each year and some of the birds born in Prek Toal returning to breed when they become sexually mature (after four or more years). However, arrival of birds abandoning frequently disturbed colonies elsewhere may have also played a role. The increase in breeding numbers has not yet been reflected in an increase in non-breeding season records at monitored sites, but such a link does not necessarily have to exist.

Greater Adjutant

Leptoptilos dubius

ត្រូដក់ ធំ Trodok thom

Description

A member of the stork family, Ciconiidae. Very large, 145 -150 cm in height and with a wingspan of around two and a half meters. Diet is varied, feeding on frogs, reptiles, fish, crustaceans, large insects, as well as young mammals and birds it is able to catch. It is also a scavenger, eating and actively searching for carrion.

Habitat used

Mostly wetlands: natural pools and lakes in or near open forests, freshwater swamp forest, marshes, mangroves, mudflats.

Global Range

Records of breeding limited to Assam (India) and Cambodia. Ranges widely in the non-breeding season (e.g. also Bangladesh, Myanmar, Thailand).

Cambodian Range

Known from the floodplain of the Tonle Sap Lake and deciduous forests in northern, and north-eastern Cambodia. Only two records from coastal areas. Breeding has been recorded in Prek Toal and deciduous forests in Preah Vihear.

Conservation Status

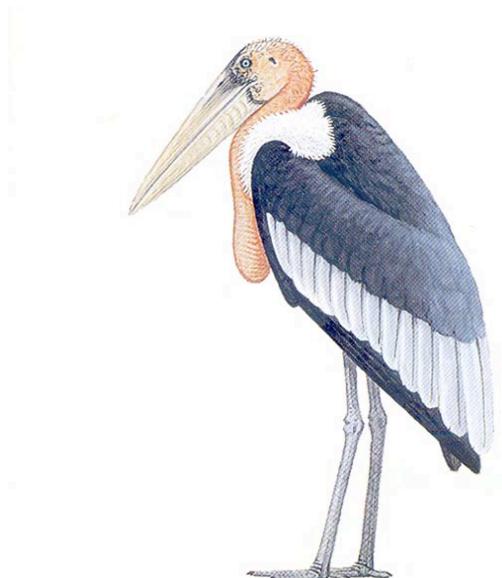
Global population estimated at 800-1,000 and declining

Globally Endangered

Classified as an Endangered species under Cambodian Law

Breeding status in TSBR

Prek Toal: 77 breeding pairs estimated in 2007 (Clements *et al.* 2007b). This is the second largest colony in the world (BirdLife International, 2008).



Dei Roneath: A colony of both species of adjutants was observed in this area during an aerial survey in 1994 (Mundkur *et al.*, 1995) and locations of two unconfirmed adjutant colonies were reported by local people in 2000 (Goes and Hong Chamnan, 2002). Chicks of Lesser Adjutant were confiscated as recently as March 2008 from this area (Sun Visal, pers. comm.).

Prey Kohs: Nesting by what is thought to be Lesser Adjutants has been reported recently by local residents (Pech Bunnat and van Zalinge, 2006b), but the colony could potentially also include Greater Adjutants. A colony of adjutants was reported from this area in 2000 and 2001-2002 (although then named as being in Stung Sen) but there were no direct observations and no further records.

Boeung Tonle Chhmar: Although colonies of Greater Adjutant have been reported by local people in the past from around Boeung Tonle Chhmar (Mundkur *et al.*, 1995, Goes and Hong Chamnan, 2002), there are no recent records of breeding birds. The last ornithological survey in Boeung Tonle Chhmar during the breeding season was in 2006 (Bird *et al.*, 2006).

Nesting period

Nesting in Prek Toal is from January to June. However, birds start to arrive at colonies in November-December. Note that breeding in the Northern Plains forests of Preah Vihear takes place between September and May, a different but overlapping period (Clements *et al.*, 2007a).

Distribution and seasonal movements

Map 5 shows that the Greater Adjutant is a rare bird with few records of sightings by researchers during 1994-2008 away from Prek Toal. Like with many other waterbirds Greater Adjutants like to search for food in the numerous ponds scattered throughout the floodplain in the dry season, typically singly or in small groups. They appear to

use the flooded forests the most, but may also be encountered in scrub and grasslands with scrub. Most records are from Prek Toal in the breeding season. There is a scatter of breeding season records away from Prek Toal. For example, a group of 15-20 Greater Adjutants were seen in Dei Roneath in a mixed colony of Greater and Lesser Adjutants in April 1994 and one other sighting of 2 birds in April 2000.

From the map it can be seen that large congregations of Greater Adjutants have been observed outside Prek Toal at times, particularly in the south-east of the floodplain and mainly at the very end of the breeding season or in the non-breeding season. Maximum group sizes observed in each month are shown in the table below.

Table 4. Overview of monthly variation in the south-eastern part of the Tonle Sap floodplain in: lake water levels, nesting period and maximum group sizes observed on survey trips (pooled for all locations and years)

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Water level	Mid□		Low□			Low□		Mid□	High□	Peak□	Peak□	High□
Nesting in PT	Yes						No					
Max. count	1		1	3	34	84	81		32			61

Peak records of large groups of Greater Adjutants in the south-east are particularly from the months of June-July: in July 1998 a group of 70 birds was observed in Boeung Tonle Chhmar; then 84 in June 2000 in the same area; 81 in July 2001 near the Stung Chinit and again 54 in July 2003 from this vicinity. There are also records of large groups outside this period from the same area. In May 1999 34 were seen in grasslands below the Stung Sen river, a group of 32 was seen in the Stung Chinit area in September 2004 and a group of 61 birds was observed below the Stung Sen in December 2001.

There are observations of smaller, yet still significant, groups outside the floodplain in the wet season. A group of 6 and then 5 was seen in different areas on the same day in August in upland open forests north of the Stung Chinit. Also in August a group of nine was seen in Monkul Borey, north-west of Prek Toal. The presence of small groups

of Greater Adjutant in the outer floodplain adjacent to Prek Toal in August-September has also been confirmed by staff of the Prek Toal colony monitoring and protection program (Sun Visal, pers. comm.). Barzen (2004) recorded only 21 during extensive aerial surveys across northern Cambodia in September 2001; in contrast to Lesser Adjutant most of the birds were in one large group near to Ang Trapeang Thmor.

Threats

Collection of eggs and chicks from nesting colonies is a major threat to the continued survival of populations of Greater Adjutant around the lake. Nest collection may have resulted in the disappearance of colonies in Boeung Tonle Chhmar and may be on the verge of doing so in Dei Roneath if it hasn't done so already.

Hunting is also believed to have a disastrous impact on populations of Greater Adjutant and is especially a threat in the wet season

when birds move out of the flooded forest and congregate in large flocks. In June 2000, a group of 84 Greater Adjutants was observed feeding in grasslands in the outer floodplain. Subsequent heavy rain grounded the birds in the late afternoon preventing them from returning to their roosts nearer to the lake. That night a group of around 15 men from nearby villages came with spotlights and nets, catching one bird after the other, clubbing some to death immediately and keeping others alive. It was believed that around 80-90% of the flock was taken in that single night (Goes *et al.*, 2001b).

Conversion of the lake's floodplain in to agriculture is a very large threat for all waterbirds, with an incredibly rapid growth in dry season farming witnessed over the last five years. The dry season also is the time that Greater Adjutants flock to the floodplains of the Tonle Sap. Note that although five IFBAs have been set up in the south-eastern floodplain to improve conservation of grassland-dependent species, some of the key wetlands for Greater Adjutants are not covered as they fall in the flooded forest zone.

Comments

From 1999-2004 large groups of Greater Adjutants were seen almost yearly in grasslands of the outer south-eastern floodplain between May and July. It is unclear whether they stopped coming to this area after 2004 as survey work here has become much less intensive since then. A large flock was also seen in Boeung Tonle Chhmar in July 1998, but it is not known whether this is a regular occurrence. It is believed that these groups were post-breeding flocks as the timing coincides with the earliest time that completed breeders and fledged young would move away from Prek Toal (Davidson, 2005). There is also the possibility that some or all are post-breeding dispersers from the colonies in Preah Vihear.

A large group was also observed in the south-eastern floodplain as late as September indicating that some birds probably were staying long into the rainy season in this area. The decline in observations between September and December may indicate that they temporarily move further out, and this seems likely given the high water levels, but fewer surveys have been conducted in the wet season so it is not confirmed. It is unknown where the Greater Adjutants might go if they leave this area but the hypothesis is that many of them form small, widely dispersed groups outside the Tonle Sap floodplain. In support of this there have been a few sightings from upland forest areas nearby within Kampong Thom and around Mongkol Borey. The pattern of records from Ang Trapeang Thmor is also consistent. Monthly counts show that there are almost no Greater Adjutants in this area from the beginning of the dry season through to the early wet season, with numbers starting to rise typically in July and increasing sharply in September-November/December, with highly variable peak counts (e.g. up to 60 in 2001 but only 15 in 2008) (WCS/WPO unpublished data; Lou Vanny, 2008).

The high numbers seen previously in the south-east represent significant portions of the known population at the time, but non-breeding counts in recent years represent only a small proportion of the total population. If one considers that the (rough) estimate for the number of adult breeding birds in Prek Toal was 60 with each nesting pair of adults normally raising 2-3 chicks (Sun Visal, pers. comm.), then this would mean that the potential number of Greater Adjutants dispersing from Prek Toal was around 120-150 birds in 2001. Therefore the sighting of 81 birds in 2001 would have represented roughly half of the Prek Toal population. In the Northern Plains of Preah Vihear it is currently estimated that about 55 breeding pairs occur (Clements *et al.*, 2007a), but there is no past data on numbers.

Painted Stork

Mycteria leucocephala

រតាសពណ៌ Roniel por

Description

A member of the Ciconiidae family (storks). Large, 95 -100 cm in height. Diet is varied, feeding on frogs, reptiles, fish, crustaceans and large insects.

Habitat used

Freshwater swamp forest, marshes, lakes and ponds. Occasionally in inundated rice fields.

Global Range

Main breeding populations centered on India, Sri Lanka, and Cambodia.

Cambodian Range

Mainly occurs in the Mekong – Tonle Sap floodplains with main concentrations around the Tonle Sap and particularly Prek Toal in the breeding season. Small flocks scatter throughout the lowlands in the non-breeding season with a few records from along the Mekong in Kratie and coastal regions in the southwest. Further records of birds from the wet season are from rice fields in central and southern Cambodia plus a few from cultivated areas in the margins of dry deciduous forest (in Oddar Meanchey, Banteay Meanchey, Siem Reap, Kampong Thom and once in Preah Vihear) and the species is abundant at Ang Trapeang Thmor, particularly in the wet season. Large flocks have been observed each year in the Mekong Delta at Boeung Prek Lapouv (Takeo) in the early dry season, but these are likely to be non-breeding birds.

Conservation Status

Global population estimated at around 25,000 and declining



Globally Near Threatened

Classified as a Rare species under Cambodian Law

Breeding status in TSBR

Prek Toal: 3,121 breeding pairs estimated in 2007 (Clements *et al.*, 2007b). This is the largest colony in South-East Asia (Goes, 2005; Campbell *et al.*, 2006).

Boeung Tonle Chhmar: A mixed-species roost, including Painted Storks was observed by rangers in 2005, but there was no evidence of breeding (Pech Bunnat and van Zalinge, 2006a).

Nesting period

Nesting at Prek Toal is from January to June. Birds start arriving in December.

Distribution and seasonal movements

From Maps 6 and 7 it can be seen that Painted Storks are more commonly recorded in the eastern than the western floodplain (although this may be partly due to differences in survey effort). The abundance of Painted Storks in the TSBR is strongly influenced by water level and most birds appear to leave the floodplain when water levels rise considerably, in August-November (see Table 5 below).

Table 5. Overview of monthly variation in the Tonle Sap floodplain in: lake water levels, nesting period and maximum group sizes observed on survey trips from places other than Prek Toal or from the non-breeding season in Prek Toal (pooled for all locations and years)

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Water level	Mid□	Low□			Low□			Mid□	High□	Peak□	Peak□	High□
Nesting in PT	Yes						No					
Max. count	<03	150	260	1500	360	467		53				60
	>03	230	90	350	30				1	1	1	515

Large groups of Painted Stork have been observed regularly in the area near Prek Toal. Most of these sightings were probably of birds from the Prek Toal colony foraging nearby. A group of 515 birds from Preah Net Preah north-west of Prek Toal on the 1st of December 2004 may have represented a staging point for the arrival of a part of that year's breeding population.

In the area around Boeung Tonle Chhmar, including the IFBAs to the north in the outer floodplain, feeding groups of up to one hundred birds regularly occur in the dry season. In Boeung Tonle Chhmar itself larger groups have been observed towards the end of the dry season. A group of 360 birds seen in May 2002 and another of 467 in July 1998 were perhaps post-breeding flocks that had come from Prek Toal. However, a group of 1,500 encountered on 8 April 1999 is much more likely to have been the result of disturbance at, followed by abandonment of, the Prek Toal colony. It is unclear why there are no records from Boeung Tonle Chhmar itself after 2003, this may be due to decreased survey effort but could also be a real shift in distribution.

Painted Storks regularly occur in the south-east of the floodplain, especially the outer edges. Without the presence of any known colony nearby it is thought that these birds are non-breeders. The largest groups tend to be at the beginning of the dry season when the ponds are larger and more food is available. Groups of 50+ birds are encountered as late as August, but after that records decline dramatically.

Barzen (2004) recorded only 143 during extensive aerial surveys across northern

Cambodia in September 2001. Effort was concentrated on small/medium-sized wetlands in deciduous forest but this huge area of habitat clearly holds few Painted Storks in the rainy season as there were only four records. Most birds (119) were in and around Ang Trapeang Thmor.

Threats

Collection of eggs and chicks from the colonies in Prek Toal was a major threat, but has reduced greatly after initiation of protection and monitoring activities. It may still be a problem however at other sites where Painted Storks could be attempting to breed. Raiding of colonies and other hunting activities may be a major factor behind the near-threatened status of this species as it otherwise is quite tolerant of human activity and can survive in human dominated landscapes, wild populations being known to roost in zoos and birds observed at airports in Thailand for instance. They also have been known to use wet-season rice fields, which may make them vulnerable to the effects of strongly poisonous herbicides, pesticides and other chemicals.

Comments

It is unknown if there are any important staging sites for post-breeding birds before they migrate to wet season habitats. Boeung Tonle Chhmar had seen large numbers of Painted Stork towards the end of the dry season in the past, but there has been very few data from Boeung Tonle Chhmar recently. An ornithological survey conducted in March 2006 in Boeung Tonle Chhmar did not find any Painted Storks within the core area (Bird *et al.*, 2006), but

would have been too early to find evidence of post-breeding feeding flocks.

Painted Storks are considered to be less tolerant of deep water than Asian Openbills and Lesser Adjutants (Davidson, 2005) so it is expected that fewer Painted Storks stay in the outer floodplain in the rainy season. As mentioned in the section on wider distribution in Cambodia, Painted Storks disperse widely in to the countryside in the wet season. They may also disperse into Thailand where recent attempts at breeding have been observed (Bird Conservation Society of Thailand in Clements *et al.* 2007). Large numbers of Painted Storks gradually move to Ang Trapeang Thmor in the wet season with a total of 2,834 counted in September 2007 climbing from 524 in May and 130 in April. Birds generally stay until December, although more and more are staying the whole year round. The numbers at Ang Trapeang Thmor have been increasing each year with a maximum daily count of 2,834 birds in 2007 up from a maximum of 180 in 2001 (Lou Vanny

2008). This represents near to half the number estimated to breed in Prek Toal.

It is notable that although in the TSBR Painted Storks are only known to breed in Prek Toal, they are widespread in the floodplain in flocks of up to 230 birds throughout the breeding season. This might imply the existence of other colonies, but with over 6,000 birds estimated to breed at Prek Toal, it may be plausible to assume that these other flocks are simply the nomadic non-breeding portion of the population (immatures, failed breeders etc), especially as Painted Storks take several years to reach breeding age.

The Painted Stork population is large and buoyant, and a satellite colony was established in Ang Trapeang Thmor with 64 breeding pairs in 2007 and 154 pairs in 2008 (Lou Vanny, 2008). Other attempts to start colonies can be expected, although there is no known history of breeding at any of the Core or Conservation Areas in the TSBR so it is hard to predict where this might occur.

Milky Stork

Mycteria cinerea

រំនាវ ក្រហម ក្រហម ក្រហម Roniel sor

Description

A member of the Ciconiidae family (storks). Large, 92-97 cm in height. Diet is varied, feeding on crustaceans, amphibians, fish, reptiles and large insects.

Habitat used

Mostly mangroves and tidal mudflats, also freshwater swamp forest.

Global Range

Population centered on Sumatra, Indonesia. Small populations also still occur in Cambodia and Malaysia.

Cambodian Range

Small populations restricted to the Tonle Sap floodplain and coastal wetlands. One record from northern Siem Reap province, but single birds more regularly encountered in Ang Trapeang Thmor, always in association with Painted Stork. Most coastal records are from Prek Teuk Sap mudflats, in Ream NP. Other coastal areas where singles or pairs of Milky Stork have been recorded are in Kompong Smach (Sihanoukville) and Sre Ambel (Koh Kong).

Conservation Status

Global population estimated at around 5,000 and declining
Globally Vulnerable
Classified as a Rare species under Cambodian Law

Breeding status in TSBR

Prek Toal: 10 breeding pairs estimated in 2007 (Clements *et al.*, 2007). This is the largest known breeding population in mainland South-East Asia. Ang Trapeang Thmor and Prek Toal are the only freshwater breeding sites in the world. In 2007 one and in 2008 two Milky Storks have



interbred with Painted Storks at Ang Trapeang Thmor (Lou Vanny, 2008).

Nesting period

Nesting in Prek Toal is from January to June.

Distribution and seasonal movements

Sightings are mostly from Prek Toal. Singles have been observed in the south-eastern corner of the Tonle Sap with one record from the delta near Chhnuk Tru, May 1993 and three separate records from the floodplain in Kampong Thom in March 2000, February 2002 and January 2007. Barzen (2004) had only one record (a little east of Ang Trapeang Thmor) during extensive aerial surveys in September 2001.

Threats

Egg and chick collection and disturbance of nest sites are the main known threats to this species in the TSBR but it is potentially vulnerable to hunting and habitat loss away from the colonies.

Comments

There are very few records of Milky Stork from the Tonle Sap and it is believed to occur in very low numbers. Records have been highly seasonal, from December to July. Breeding is only known from Prek Toal. However, records from January-March and May in the south-east of the Tonle Sap show that their occurrence is not

completely restricted to Prek Toal during the breeding season.

In Ang Trapeang Thmor single Milky Storks are seen to arrive at the beginning of the wet season in June and occur up until the early dry season in December-January. The maximum count for Milky Storks in one day

at Ang Trapeang Thmor has been four individual birds (WCS/WPO unpublished data). It is unclear where the remainder of the birds from Prek Toal move to but they may join the coastal population. The timing of the peak count on the coast (41 birds at Ream in July 2002) is consistent with that.

Asian Openbill *Anastomus oscitans*

ចង្កៀលខ្យង Tchongkiel kchong

Description

A member of the Ciconiidae family (storks). Large, 70-80 cm in height. Specializes in feeding on snails. The beak of this bird is especially adapted to efficiently break open a snail's shell.

Habitat used

Freshwater marshes, but also artificial wetlands such as rice fields, irrigation channels.

Global Range

Extensive distribution, occurring from India east through mainland South-East Asia.

Cambodian Range

Widespread, but mainly found along the Tonle Sap and lower Mekong floodplain, down to Boeung Prek Lapouv in Takeo. A few records along the upper Mekong between Kratie and Stung Treng. Single records only from western Siem Pang and northern Monduliri. More numerous in the west, especially around Ang Trapeang Thmor in Banteay Meanchey and scattered flocks have been recorded from Oddar Meanchey. Apparently mostly absent from coastal wetlands, apart from one record from mudflats in the south-west.

Conservation Status

The global population is estimated broadly at 130,000 individuals.

Globally of Least Concern

Classified as a Common species under Cambodian Law

Breeding status in TSBR

Prek Toal: 7,682 breeding pairs estimated by the waterbird colony monitoring program in 2007, up from approximately 600 in 2001 (Clements *et al.*, 2007b).



Dei Roneath: A mixed colony including Asian Openbill was reported by local people in 2000 (Goes and Hong Chamnan, 2002a).

Boeung Tonle Chhmar: A colony was reported from Moat Khla by local people in the past (Goes and Hong Chamnan, 2002a).

Nesting period

Nesting at Prek Toal is from February to June.

Distribution and seasonal movements

From Map 8 it can be seen that Asian Openbills are regularly encountered and often in large numbers from all around the Tonle Sap Lake, but the biggest groups have especially been seen in the inner floodplain and during the dry season. However, Asian Openbills do occur in the TSBR in relatively large numbers for much of the year, as can also be seen in Table 6 below, if compared with other large waterbirds treated in this report.

In the wet season when water levels rise they are often found in flooded fields in the outer agricultural zone of the floodplain or beyond. For example, in August 2003 a total of around 1,300 Openbills were seen in rice fields in Mongkol Borei, Banteay Meanchey (Hong Chamnan and Ro Borey, 2003). A flock of 600-700 birds was seen at the end of the breeding season in grasslands in the south-eastern corner of the lake after which the flock broke up into smaller groups of

around 200 birds which were seen feeding in rice fields on later dates (Goes and Hong Chamnan, 2001b).

Large groups have also been seen during the breeding season away from known colonies

at Moat Khla (1,000 birds in April 2002), Chhnuk Tru (300 in March 1994 and 600 in June 1993) and Kampong Thom grasslands (280 in May 1999).

Table 6. Overview of monthly variation in the Tonle Sap floodplain in: lake water levels, nesting period and maximum group sizes observed on survey trips away from Prek Toal or in the non-breeding season (pooled for all locations and years)

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Water level	Mid□		Low□			Low□		Mid□	High□	Peak□	Peak□	High□
Nesting in PT	No		Yes						No			
Max. count	<03		300	1000	280	600	300		145			200
	>03	451	69	5	20	75	219	1300			50	186

Barzen (2004) recorded about 1300 during extensive aerial surveys across northern Cambodia in September 2001. Effort was concentrated on small/medium-sized wetlands in deciduous forest but this huge area of habitat clearly holds few openbills in the rainy season as most records were clustered in and around Ang Trapeang Thmor. The population of Asian Openbill in Ang Trapeang Thmor shoots up from a few hundred to several thousand at the start of the wet season with 650 birds in May and 22,400 birds in June 2008 (WCS/WPO unpublished data) indicating that this is a major post-breeding site.

Threats

The main threat stems from egg and chick collection and disturbance of colonies during the nesting period. If this can be prevented numbers can quickly rebound as has happened in Prek Toal. Hunting away from the colonies is probably small scale and opportunistic. Highly intensive agriculture using strongly poisonous herbicides, pesticides and other chemicals might potentially be a cause for population declines directly and indirectly through disappearance of the food base.

Comments

Asian Openbills converge upon Prek Toal in December-January with >15,000 breeding birds estimated. After breeding when water levels start to rise it seems that large groups disperse both towards the north-west and to areas such as Moat

Khla/Boeung Tonle Chhmar, the Kampong Thom grasslands and the delta around Chhnuk Tru in the southeast, whereafter they split up again in to smaller groups still numbering over a hundred birds. It is possible that these groups will continue to split in to even smaller ones during the course of the wet season. Birds have been recorded throughout the year from the floodplain so it is likely that a considerable number stay close to the Tonle Sap lake, spread out in the mostly agricultural outer zone. Others presumably disperse further. Some appear to move to the Mekong River and its floodplain. Others may go north-west as shown by the isolated record of 1,300 in August in Mongkol Borei district, Banteay Meanchey province and the regular records from Ang Trapeang Thmor

At Ang Trapeang Thmor numbers increase sharply from June and numbers stay high until September, where after numbers slowly start dropping again to less than one hundred in January (WCS/WPO unpublished data). This pattern is largely the exact opposite of that of Prek Toal indicating that this is a major post-breeding site for birds that breed in Prek Toal. This is furthermore supported by the similar scale of increase in numbers observed at Ang Trapeang Thmor from maximum counts of about 1,800 in 2001 to an estimated 22,000 in 2008 (Lou Vanny, 2008). It is not known how much interchange of individuals or overlap in feeding areas there is with the large colonies in central Thailand.

Black-headed Ibis

Threskiornis melanocephalus

ត្រួយ ងង្គុន ស Troyong kloun sor

Description

A member of the Threskiornithidae family (ibises). Large, 75 cm in height. Feeds on fish, frogs, and insects.

Habitat used

Freshwater marshes, lakes, rivers, flooded grasslands, paddy fields, mudflats and coastal lagoons.

Global Range

Extensive distribution, mostly in the Indian subcontinent and South-East Asia (including Greater Sundas). Small population in China and Japan.

Cambodian Range

Population centered on the Tonle Sap Lake (dry season, breeding) and Ang Trapeang Thmor (wet season, non-breeding). Outlying records in the marshes of the “Four-arms Plain” south from Phnom Penh (wet season) and Boeung Prek Lapouv in Takeo (dry season), the latter possibly belonging to a Vietnamese population rather than the Tonle Sap one. Only one record from the southwest: two birds in lowland ricefields of Sre Ambel (Koh Kong) in November 2003.

Conservation Status

The population is spread over a large area and estimated at 20,100 individuals
Globally Near-threatened
Classified as a Rare species under Cambodian Law

Breeding status in TSBR

Prek Toal: Minimum of 200 breeding pairs estimated in 2001 (Goes, 2001a). The total size is difficult to estimate as this species often nests hidden in low, but inaccessible



shrubby. No other colonies have been reported elsewhere. Flocks of 1740 birds seen in Ang Trapeang Thmor in 2007/08 (Lou Vanny, 2008) may suggest that the breeding population is now significantly higher, but such high numbers have not been counted at Prek Toal.

Nesting period

Approximately January to June at Prek Toal.

Distribution and seasonal movements

From Map 10 it can be seen that large groups of Black-headed Ibis have been recorded in the south-eastern outer floodplain and in the north-west portion of the floodplain and just beyond. These groups mainly appear just after the nesting period and probably represent post-breeding flocks congregating in a feeding area before splitting into smaller groups that disperse to wet season habitats. Observations of post-breeding flocks include a group of 171 birds seen on 27 June 2000 and another group of 241 on 30 June 2002 in grasslands between the Stung Sen and the Stung Chinit. Local people also have reported that Black-headed Ibis visit the delta region in Prey Kohs BCA (Veal Pok) from July-August (Pech Bunnat and van Zalinge, 2006b). Interestingly there are also two records of post-breeding flocks from the same time period but on opposite sides of the floodplain, one from the south-east of 123 birds on 31 July 2003 and another from Mongkol Borei, north-west of

Prek Toal of 211 birds on 17 August 2003. This seems to indicate that post-breeding birds disperse in at least two directions.

Barzen (2004) recorded only 5 during extensive aerial surveys across northern Cambodia in September 2001. Effort was concentrated on small/medium-sized wetlands in deciduous forest but this huge area of habitat apparently holds few if any Black-headed Ibis in the rainy season as there was only one record, at Ang Trapeang Thmor.

Returning birds have also been witnessed in December with a large group of 289 birds seen in Preah Net Preah district, Banteay Meanchey province and a smaller group of 40 birds in the south-east. Only small groups have been encountered in September and there are no records for October-November. It is likely therefore that most birds leave the floodplain during September-November, probably due to peak flood levels preventing birds from feeding.

Table 7. Overview of monthly variation in the Tonle Sap floodplain for: lake water levels, nesting period and maximum group sizes observed on survey trips away from Prek Toal or in the non-breeding season (pooled for all locations and years)

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Water level	Mid□		Low□			Low□		Mid□	High□	Peak□	Peak□	High□
Nesting in PT	Yes						No					
Max. count	<03	10	8	25	9	50	241	8				40
	>03	53	15					123	211	6		289

During the breeding season small groups are sometimes encountered away from Prek Toal, usually of fewer than 10 birds together, sometimes up to 25. These are most likely non-breeding groups moving around the floodplain. A group of 50 birds was seen at Boeung Tonle Chhmar in May 2002 which may have been non-breeders or birds from a disturbed colony.

Threats

The main threat stems from egg and chick collection and disturbance of colonies during the nesting period. Hunting is probably small scale and opportunistic.

Comments

The post-breeding dispersal of Black-headed Ibis from Prek Toal is relatively clear. Large groups have been seen to aggregate in the north-west and south-east of the floodplain before dispersing to wet season habitats. The north-west groups

presumably travel to Ang Trapeang Thmor in Banteay Meanchey province where numbers are seen to increase significantly from June-July each year, with the birds staying until November-December. The lack of a good estimate of numbers of Black-headed Ibis breeding in Prek Toal makes it difficult to say much about the exact degree of correlation between the two populations, but high numbers are observed at Ang Trapeang Thmor where the ibises are more visible (see Cambodian Range, above). The final destination of the south-eastern groups has not been properly identified, but includes perhaps floodplains around the “Four-arms Plain” near Phnom Penh. A very few birds may stay in the outer floodplain of the Tonle Sap for the whole year.

There is little indication that there are currently any other breeding populations in Cambodia besides that at Prek Toal.

Spot-billed Pelican

Pelecanus philippensis

ឡុងប្រពែង៖ Toung prophes

Description

A member of the pelican family, Pelecanidae. Large size, 127-140 cm. Diet is restricted almost exclusively to fish.

Habitat used

Large inland waterbodies, especially shallow lakes, large rivers. Also lagoons and estuaries in coastal regions (but this has not been observed in Cambodia).

Global Range

Breeding populations are only known from India, Sri Lanka and Cambodia.

Cambodian Range

Population centered on the Mekong – Tonle Sap floodplain. In the wet season some birds disperse around the country and in the wider region and some stay around the lake. Large groups of Pelicans regularly pass through Ang Trapeang Thmor at the beginning of the wet and dry seasons. Small wet-season parties are annual sights at the marshes of the “Four-Arms” Plains near Phnom Penh, as well as in Takeo, Kandal and Prey Veng provinces. There is also a recent record on the upper Mekong (south of Stung Treng) of two birds in June 2004. Apparently absent from the southwest.

Conservation Status

Global population estimated as being around 13,000-18,000 and declining
Globally Near-threatened
Classified as a Common species under Cambodian Law

Breeding status in TSBR

Prek Toal: 2,592 breeding pairs estimated by the waterbird colony monitoring program in 2007 (Clements *et al.*, 2007b).



This is one of the largest colonies in the world (Goes, 2005, BirdLife International, 2008).

Nesting period

Nesting takes place from December to June at Prek Toal.

Distribution and seasonal movements

From Map 11 it can be seen that Spot-billed Pelicans concentrate in the inner floodplain and sightings in the outer region are usually of small groups. These are probably mostly records of non-breeding birds that feed in small ponds or the edge of flood waters. One exception was a record of 176 Pelicans from December 2004 in the north-western corner of the floodplain near Prek Toal (in Preah Net Preah district). These may have been birds returning to the Prek Toal colony or birds from the colony feeding nearby.

From Table 8 it can be seen that only small groups have been observed away from Prek Toal during the breeding season. The one exception is a large group (1,800 birds in April 1994) seen at the mouth of the delta – this was in all likelihood birds that had flown there following disturbance at the Prek Toal colony. Small groups have been observed in Prek Toal in July, August, October and November and it is believed that some pelicans stay in the TSBR the whole year round.

Small groups also occur regularly almost throughout the year at Boeung Tonle Chhmar. There was a much larger flock of 993 birds in July 1998 (with 630 counted

just west of this area in the same month), which is likely to have been a post-breeding feeding concentration.

A substantial portion of the population of pelicans that breed at Prek Toal are thought to leave the TSBR from August to November. However, villagers' reports suggest that Chhnuk Tru may be a regular feeding site since local residents report an

abundance of Pelicans in August (post-breeding flocks) with smaller numbers staying on until November (Pech Bunnat and van Zalinge, 2006b). None was recorded by Barzen (2004) during extensive aerial surveys across northern Cambodia in September 2001. Effort was concentrated on small/medium-sized wetlands in deciduous forest.

Table 8. Overview of monthly variation in the Tonle Sap floodplain in: lake water levels, nesting period and maximum group sizes observed on survey trips from places other than Prek Toal or also from the non-breeding season in Prek Toal (pooled for all locations and years)

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Water level	Mid□		Low□			Low□		Mid□	High□	Peak□	Peak□	High□
Nesting in PT			Yes						No			Yes
Max. count	<03	5	29	2	1800	1	32	993	17	56		
	>03	2		1						51	43	176

Threats

The main threat stems from egg and chick collection and disturbance of colonies during the nesting period. However, collection has been reduced greatly in Prek Toal by the colony monitoring and protection program and there are probably no other sites with nests. Hooks and lines set near colonies sometimes catch fishing birds such as pelicans.

Comments

Pelicans, like Darters, find most of their food in large water bodies and therefore their distribution is concentrated on the inner floodplain and the lake itself with only small groups feeding in the drier area of the outer floodplain. The population is mostly centered on the colonies in Prek Toal

during the breeding season, but large post-breeding flocks have been recorded towards the south-east in Boeung Tonle Chhmar and reported around the delta and in Prey Kohs BCA.

Pelican numbers at Ang Trapeang Thmor have also been observed to increase slightly from June-September, with a much larger second spike in numbers from November-February at Ang Trapeang Thmor (WCS/WPO unpublished data) in Banteay Meanchey province, indicating that this is also an important seasonal feeding site where they will gather before moving further. Recently, in 2008, two pairs started to breed. The most recent maximum count from Ang Trapeang Thmor is 3,667 birds (Lou Vanny, 2008).

Oriental Darter

Anhinga melanogaster

ស្មោង Smaonh

Description

A member of the darter family, Anhingidae. Large, 85 -97 cm. Diet is almost exclusively fish.

Habitat used

Mostly wetlands: rivers, pools and lakes, freshwater swamp forest, marshes and mangroves.

Global Range

Widespread, but only locally common resident in Indian subcontinent, Indonesia (especially Greater Sundas) and mainland south-east Asia (mostly Cambodia, which is now a major stronghold, and southern Myanmar).

Cambodian Range

Population is centered on the Tonle Sap lake. In recent years, birds are seen in higher numbers and frequency along the lower Mekong – Tonle Sap floodplain and the stretch of the Mekong in the northeast including its main tributaries. A small breeding colony is known to exist on the upper Stung Sen within Kulen Promptep WS (Preah Vihear). Individuals or pairs are occasionally found around Angkor and Ang Trapeang Thmor. There have been no recent records from the southwest.

Conservation Status

Global population estimated at 11,200 and declining over most of its range

Globally Near-threatened

Classified as a Common species under Cambodian Law

Breeding status in TSBR

Prek Toal: 4,053 breeding pairs estimated by the waterbird colony monitoring program in 2007. The current size of the colony is around two-thirds the 2008 global



population estimate (BirdLife International, 2008), indicating how rapidly the colony has grown over the last few years and how significant this colony is.

Dey Roneath: In December 2007 around 100 nests were found in 3 trees approximately 7 km east of Dey Roneat village. These had just been constructed, but the colony had already been disturbed and no Darters were found present. A colony of many nests (>1,000) was reported by local people from the area in 2000.

Prey Kohs: As recently as 2006 local people reported that Darter egg and chick collection still occurs (Pech Bunnat and van Zalinge, 2006b), but the location of the colonies was not obtained.

Boeung Tonle Chhmar: Local people reported around 7 nests in the core area and a large mixed colony of darters and cormorants from Moat Khla in 2000.

Stung Sen: There is mention of a colony of 43 nests in November 2001 in the literature, but no location is given except that it is in the Stung Sen area (Goes, 2001a).

Nesting period

Nesting at Prek Toal is generally from September to January, earlier than most of

the other species reviewed in this report and coinciding with the highest water levels.

Distribution and seasonal movements

Map 12 shows that Oriental Darter sightings are especially numerous around Prek Toal. Here Darters are observed the whole year round in fairly large numbers. However, from Table 9 it can be seen that numbers are especially high just before and after the nesting period (all records shown in

February and August are from Prek Toal; the record of 118 birds is from Boeung Tonle Chhmar in July 1998).

Table 9. Overview of monthly variation in the Tonle Sap floodplain in: lake water levels, Oriental Darter nesting period and maximum counts observed on survey trips away from Prek Toal or outside of breeding season (pooled for all locations and years)

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Water level	Mid□		Low□			Low□		Mid□	High□	Peak□	Peak□	High□
Nesting in PT	Yes				No						Yes	
Max. count	<03	19	217	60	75	50	29	118	200	2	120	
	>03		215	68	35	92	25	77	430		4	

Darters concentrate around large or deep waterbodies where they can dive for fish. Within the inner floodplain moderately large numbers of Oriental Darters have been seen in the non-breeding (dry) season from several areas near the lakeshore: Boeung Tonle Chhmar, Stung Sen and at the mouth of the delta near Chhnuk Tru, but mostly still at Prek Toal. Further away from the lake sightings are generally less frequent and involve smaller groups (often just 1-4).

Threats

The main threat stems from egg and chick collection and disturbance of colonies during the nesting period. If this can be prevented numbers can quickly rebound as has happened in Prek Toal. Hooks and lines set out near the colonies occasionally snare fishing birds such as darters and cormorants.

In Table 9 it can also be seen that very few Darters are encountered away from Prek Toal during the nesting period. Although September-December is the period with the fewest surveys it can still be concluded from the lack of records elsewhere that the bulk of the population is, at this time, breeding in Prek Toal. The record of 120 birds seen in November stands out. This record was actually made in 2001 in an area just west of the Stung Sen core area and this sighting is related to the colony mentioned above.

Comments

Prek Toal now supports a huge proportion of the world's Darter population, and is overwhelmingly the focal site for them within TSBR. They can be found there in large numbers year round, but nonetheless from March-July thousands disperse to feed elsewhere. Moderately large flocks occur at these times at other sites in the inner floodplain with singles or small groups roaming very widely to fish in rivers, ponds or other small wetlands in and beyond the TSBR.

Colonies have been reported from the other core areas in the past and although most have apparently been collected to extinction, breeding attempts continue at Dey Roneat. Darters also sometimes breed along the upper Stung Sen in Preah Vihear. Overspill from Prek Toal is likely to lead to more breeding attempts elsewhere, but targeted protection from egg-collection will be needed for colonies to become established.

Black-necked Stork

Ephippiorhynchus asiaticus

អង្កត់ខ្មៅ ឬ ដំបងក្រញ៉ូង Angkot khmao
(Dambon kragnou)

Description

A member of the Ciconiidae family (storks). Very tall, 120 -135 cm in height and with a wingspan of over two meters. Diet is varied, feeding on frogs, reptiles, fish, crustaceans, large insects and rodents.

Habitat used

Freshwater marshes, floodplain grasslands, pools in or near open forests, occasionally mudflats.

Global Range

Main (sub-) populations are centered on India, Cambodia, New Guinea and Australia.

Cambodian Range

Known from deciduous forests in northern and north-eastern Cambodia, the floodplain of the Tonle Sap Lake (especially grasslands) and from coastal areas. A few records from the Areng valley (Koh Kong) in the Cardamom Mountains (Goes in prep.).

Conservation Status

Population in South and South-East Asia estimated as being under 1,000 individuals and declining. The geographically distinct population in New Guinea and Australia may hold between 10-20,000 individuals and is considered stable or even increasing slightly

Globally Near Threatened

Classified as an Endangered species under Cambodian Law

Breeding status in TSBR

Prek Toal: 1 pair nested in 2004 and 2005, raising two chicks each time (Sun Visal,



2005). There have been no more records since then.

Nesting period

Nesting has been observed to be from January to June at Prek Toal. This is also the case in the Northern Plains (Clements *et al.* 2007a)

Distribution and seasonal movement

As can be seen from Map 13 and Table 10 below Black-necked Storks are recorded in the floodplain of the Tonle Sap almost exclusively in the dry season. Observations mostly occur between December-June with sightings seemingly becoming slightly more frequent towards the end of the dry season. Sightings come mainly from the large grasslands found in Kampong Thom province. There are regular records from Prek Toal and past records from Boeung Tonle Chhmar in the flooded forest zone, although here they have mostly been observed on mudflats on the lake shore.

Group sizes are typically 1-3, rarely more, and sightings are infrequent. Black-necked Storks therefore occur at very low densities in the floodplain of the Tonle Sap.

Table 10. Overview of monthly variation in the eastern part of the Tonle Sap floodplain in: lake water levels, nesting period and total number of records (pooled for all locations and years)

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Water level	Mid□	Low□		Low□			Mid□	High□	Peak□	Peak□	High□	
Nesting in PT	Yes					No						
Total Records	4	6	7	9	4	5	1	1				4

The largest group sizes observed (6 birds twice and one group of 4, all from different years) come from the area around Boeung Tonle Chhmar and the IFBAs nearby. The only other place where group sizes of 5 and 4 birds were seen together is from Prek Toal, where there have also been recent records of successful breeding.

Threats

Hunting is undocumented for this species, but is likely to occur on an opportunistic basis. Collection of juveniles for trade has been documented from upland forests, but with so few breeding birds in the TSBR they are unlikely to be a specific target for poachers. Habitat conversion of large areas of the floodplain into intensive agriculture is probably the major immediate threat. Black-necked Storks have been seen foraging in the water reservoirs of dry season rice growing areas, but this is likely only to happen if human disturbance remains low and there is enough natural habitat in the surrounding area, i.e. the storks may use agricultural areas bordering tracts of natural habitat but will not venture deep into an agricultural zone.

Comments

The data strongly suggest that Black-necked Storks are seasonal visitors to the TSBR, occurring from December to August, but especially towards the end of the dry season when many wetlands in the deciduous forests of northern Cambodia have dried up. They then start to leave the Tonle Sap floodplain as waters rise in May and have apparently gone by September, although survey effort has been low in this season and some birds may remain.

Single storks, pairs or small family groups are seen regularly in grasslands, especially in Kampong Thom and along the border with Siem Reap. Black-necked Storks are also encountered in the inner floodplain in the dry season, especially along the lake shore and along river banks, although this apparent preference may partly reflect ease of observation in these habitats. A pair bred successfully at Prek Toal for two seasons and it is therefore possible that more birds breed within the TSBR. They are usually non-colonial breeders so their breeding activity is less conspicuous. The area around Boeung Tonle Chhmar seems to hold relatively large numbers of Black-necked Stork and may be an important dry season feeding site so this area could be searched for evidence of breeding. However, some ornithologists believe that the flooded forests of the Tonle Sap represent a sub-optimal breeding habitat for Black-necked Stork (Frederic Goes, pers. comm.).

Breeding has also been documented in Preah Vihear province. Here also only 2-3 nests have so far been found each year. Therefore any case of breeding holds significance for a species that is so rare in mainland South-East Asia.

Black-necked Storks occur at Ang Trapeang Thmor throughout the year, but peaks occur each year in the early wet season from June-August, coinciding with the seasonal decline in records around the Tonle Sap.

As with other waterbirds the movement patterns of Black-necked Storks remain largely unknown and conservation efforts would be greatly improved by a better understanding of seasonal migrations of and the interchange between populations.

Woolly-necked Stork

Ciconia episcopus

កុកពាក់អំបោះ Kok peah amboh



Description

A member of the Ciconiidae family (storks). Large, 75 - 90 cm in height. Feeds mostly on frogs, reptiles, rodents and large insects.

Habitat used

Marshes, pools and streams in open forest.

Global Range

Extensive distribution, occurring in sub-Saharan Africa, the Indian subcontinent and South-East Asia, including Indonesia and the Philippines.

Cambodian Range

Relatively widespread. Known from deciduous forests in northern and north-eastern Cambodia, the floodplain of the Tonle Sap Lake and from the coastal zone.

Conservation Status

Global spread over a large area and estimated broadly at 30,000-140,000 individuals

Globally of Least Concern

Classified as a Common species under Cambodian Law

Breeding status in TSBR

Prek Toal: 1 pair has bred every year since 2004. In 2002 two chicks were confiscated in Prek Toal, which was the first indication that this species was breeding here (Sun Visal pers. comm.).

Nesting period

January to June in Prek Toal.

Distribution and seasonal movements

Map 14 shows that most records come from the outer eastern floodplain of the Tonle Sap. There have been very few surveys in the outer western floodplain so far. Most of the records in the inner floodplain come from Prek Toal where at least one pair has been breeding since 2004 and groups of up to 6 birds have been seen during the breeding season.

For the rest sightings have largely come from the grasslands in the outer floodplain, especially from December to April. Observations are usually of single birds or of small groups, but larger flocks of >10 birds are also sometimes seen.

Groups of up to 22 birds have been encountered during surveys in the wet season in open forests with grasslands in upland areas north of route 6 in Kampong Thom province.

Table 11. Overview of monthly variation in the eastern part of the Tonle Sap floodplain in: lake water levels, nesting period and maximum group sizes observed on survey trips (pooled for all locations and years)

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Water level	Mid□		Low□			Low□		Mid□	High□	Peak□	Peak□	High□
Nesting in PT	Yes						No					
Max. count	<03	11	6	17	10	5	2	8	2		8	3
	>03	34	15	20	2	5	1	8	1	1	1	18

Threats

Hunting is undocumented for this species, but is likely to occur on an opportunistic basis. Habitat conversion of large areas of the floodplain into intensive agriculture could have a large impact on their continued occurrence here.

Comments

The Tonle Sap grasslands represent a seasonal resource for this species. Although it is a reasonably common species in the dry dipterocarp forests it is much less common in the Tonle Sap floodplain and largely avoids the inner floodplain indicating that this is probably not its favoured habitat. It is surprising that a pair has been nesting in Prek Toal; however, the total breeding population around the lake seems likely to be low.

White-shouldered Ibis

Pseudibis davisoni

ត្រួយ ងងឹ កំ កស Troyong chamkom kor sor



Description

A member of the Threskiornithidae family (ibises). Large, 75-85 cm in height. Feeds by probing in soft substrates for soil organisms.

Habitat used

Occurs near lakes, pools, marshes and slow-flowing rivers in open lowland forest. It also inhabits sparsely wooded, dry or wet grasslands and wide rivers with sand and gravel bars.

Global Range

Population is centered on Cambodia with some in southern Vietnam, extreme southern Laos and Kalimantan (Indonesia).

Cambodian Range

Historically common throughout the country, but severe decline already noticed in the second half of the twentieth century. The decline has continued unabated, while the actual cause remains a mystery. Now an extremely rare resident mainly restricted to the north and northeast, where it seems to favor wetland and disturbed habitats (ponds and paddy fields in the dry deciduous forest), and the riverine system of the upper Mekong, Sesan, Srepok and Sekong. Some birds visit Ang Trapeang Thmor and the Tonle Sap floodplain in Kampong Thom. Breeding has been documented in protected areas in the Northern Plains of Preah Vihear. Some birds may occur in the southwest of the country but the last sighting was of a single bird in Sre Ambel in 1994. Western Siem Pang district (Stung Treng) has recently come to light as the indisputable stronghold with a finding of a staggering 108 birds. This is around half the most optimistic global population estimate for this Critically Endangered species.

Conservation Status

Global population estimated at 50-250 and declining

Globally Critically Endangered

Classified as an Endangered species under Cambodian Law

Breeding status in TSBR

There are no known breeding sites in the TSBR

Nesting period

White-shouldered Ibises nest from late November/early December to late April in the Northern Plains in Preah Vihear (Clements *et al.*, 2007a)

Distribution and seasonal movements

Sightings of singles and pairs have been made occasionally in the south-eastern corner of the floodplain from January to July. Most records (8/13) are from March and April (see Map 15). There is only one record of a group of three birds (July 2002) and quite remarkably, the first ever sighting of White-shouldered Ibises in this area was of a group of 20 birds, observed by Sam Veasna in May 1999.

Threats

Hunting and egg-collection are presumably a threat, as for all large waterbirds, but it is not yet understood why this species has declined so much more than the others. There is a tentative theory that the species has largely been dependant on ungulates and fire to maintain an open grassy understorey in lowland forested landscapes

which also get regular seasonal inundation. The dependence on such low level disturbance makes it vulnerable to both abandonment (reductions in grazing intensity and low level human activity) and intensification of use. Balancing these two trends may be possible under such management regimes as are being promoted in the Integrated Farming and Biodiversity Areas (IFBAs).

Comments

The appearance of White-shouldered Ibis in the south-eastern corner of the floodplain

during the dry season is an annual occurrence and coincides with the breeding season elsewhere in Cambodia, hence there is a chance that they breed in the TSBR. The large flock of 20 birds seen in May 1999 may have been a post-breeding flock, but it is unsure from where. The White-shouldered Ibis is considered to be South-East Asia's most threatened bird species (BirdLife international, 2008) and it is therefore a conservation priority to establish the size of the population that uses this portion of the Tonle Sap and which areas it uses exactly.

Sarus Crane

Grus antigone

ក្រណាម ក្រណាម Kriel

Description

A member of the Gruidae family (cranes). Very large, 152-156 cm in height. Sarus Cranes are omnivorous, feeding on roots and tubers of aquatic plants (particularly Water Chestnut *Eleocharis dulcis*), seeds (including rice), invertebrates and amphibians.

Habitat used

Occurs in freshwater marshes, floodplains and open lowland forests with scattered small pools. Sometimes also in rice fields.

Global Range

There are three-four geographically distinct populations with one centered on northern India, another in northern Australia and one centered on Cambodia. A population in Myanmar may be linked with both the Indian and Cambodian populations (Jones *et al.*, 2005)

Cambodian Range

Distributed across the northern and eastern dry deciduous forest, with isolated pairs breeding near wetlands during the rainy season. Although some birds apparently remain year-round in this habitat, a large proportion of the population leaves after breeding and disperse to the lower Mekong – Tonle Sap floodplain and Ang Trapeang Thmor. A series of recent censuses in the dry season found that at the beginning of the dry season around half of the cranes can be found at the main known dry season sites, with most at Boeung Prek Lapouv and in the grasslands of the south-eastern Tonle Sap floodplain. By the end of the dry season the cranes are mainly congregated at three sites: one site in the Tonle Sap grasslands (Stoung and Chikraeng IFBAs), Kampong Trach in the Mekong Delta and especially Ang Trapeang Thmor in Banteay Meanchey.



The largest coordinated national count was of 664 birds at the end of the 2008 dry season, with 439 of these counted in Ang Trapeang Thmor (Evans *et al.* 2008). There are also several records from the Mekong floodplain south of Phnom Penh and a few from the coastal southwest, in Sre Ambel.

Conservation Status

Global population estimated at 19,300-21,800 and declining. Coordinated counts across major wetlands in Cambodia and Vietnam in the dry season of 2008 found 856 Sarus Cranes (WCS/BirdLife/ICF unpublished data). This is thought to represent the great majority of birds in the region.

Globally Vulnerable

Classified as a Rare species under Cambodian Law

Breeding status in TSBR

There are no known breeding sites in the TSBR.

Nesting period

In Preah Vihear Sarus Cranes nest from June-September (Clements *et al.*, 2007a).

Distribution and seasonal movements

In the TSBR Sarus Cranes have only been observed from floodplain grasslands and agricultural areas bordering on these grasslands. They do not occur in the flooded forest or inner floodplain. From Map 16 it can be seen that Sarus Cranes have not been encountered on the western side of the floodplain. There are fewer large areas of grassland on the western side which may be the reason for the lack of records, but there has also been limited coverage and cranes may yet be found in this area.

Cranes start to arrive in November as waters in the outer floodplain recede. The two largest counts of Sarus Cranes in TSBR come from December. A group of 126 was seen just east of Baray IFBA in 2007 feeding in incompletely-harvested deep water rice fields. Another large group of 74 cranes was

seen in grasslands in the north-west of the floodplain in Preah Net Preah district in 2004. Besides the availability of rice remaining in former deep water rice fields, the exposure of seasonal aquatic plants when waters recede is also likely to be a reason why there are higher numbers of cranes at the beginning of the dry season. As the dry season progresses fewer cranes have been seen to remain in the Tonle Sap floodplain and they appear to roam widely. Only one site has regular records suggestive of a long-staying group – the area comprising Chikraeng and Stoung IFBAs (where groups of up to 41 cranes have been regularly observed until end March with smaller numbers up to May). The area around Baray and Kouk Preah Boeung Trea IFBAs has intermittent records, mostly at the beginning of the dry season.

Table 12. Overview of monthly variation in the eastern part of the Tonle Sap floodplain in: lake water levels and maximum numbers counted from surveys (pooled for all years)

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Water level	Mid□		Low□			Low□		Mid□	High□	Peak□	Peak□	High□
Max. count	68	41	41	22	31		46	2			4	126

The record of 46 cranes in July (2000) is from near the Stung Chinit outside of the Tonle Sap floodplain. There are far fewer records from the period before 2003 than after. The reason for this is largely unknown, but may be, to some degree, related to increased agricultural activity (see discussion below).

Threats

As Sarus Cranes are known to sometimes feed on rice they are especially in danger of persecution from farmers protecting their crops. However, cranes are not birds of the agricultural landscape in Cambodia and intensification would decrease habitat for them. Sarus Cranes can tolerate low intensity farming as some forms of human induced disturbance (grazing, burning, seasonal agriculture, creation of artificial wetlands) can stimulate the growth of several of the short lived species of plants they feed on. The Integrated Farming and

Biodiversity Areas (IFBAs) recently established in the grasslands of the outer floodplain can hopefully conserve areas of the Sarus Crane’s habitat in the Tonle Sap floodplain.

Comments

The Tonle Sap floodplain hosts about 7% of the regional Sarus Crane population through 1-4 months of the dry season and temporarily supports much large numbers. The floodplain of the Tonle Sap also lies between two other important dry season refuges for Sarus Cranes: the Mekong Delta and Ang Trapeang Thmor. It is possible that the grasslands in Kampong Thom are important stopovers for birds passing through.

By protecting not only the flooded forests in the inner floodplain but also the grasslands in the outer floodplain, habitat for Sarus Cranes can be conserved while the

representation of the overall Tonle Sap ecosystem is enriched. Currently the IFBAs have concentrated on Kampong Thom province, but the grasslands of Preah Net Preah are also a priority for establishing conservation measures.

The construction of new reservoirs in the floodplain may inadvertently create good

habitat for cranes, as was the case with Ang Trapeang Thmor. However, although around 100 such projects now exist in the south-eastern floodplain alone, so far only one group of reservoirs has been observed to be used by cranes (around Stoung and Chikraeng IFBAs).

DISCUSSION

This review had five main objectives.

- 1) To get a better understanding of seasonality of occurrence and abundance
- 2) To identify areas with regular non-breeding aggregations or other key sites
- 3) To identify breeding season aggregations that may indicate as yet undiscovered colonies.
- 4) To compare bird distributions with the present coverage of protected zones in the TSBR
- 5) To identify gaps in data coverage and further survey or monitoring needs.

The conclusions are treated in turn below.

Seasonality of occurrence and abundance

Large waterbird distribution patterns fall in two main groups – those for which the TSBR is a major breeding area and those for which it appears to be mainly a non-breeding area.

Breeders

This group includes all species covered by this review except Woolly-necked Stork, Black-necked Stork, White-shouldered Ibis and Sarus Crane. The authors propose four simple hypotheses to explain seasonal patterns of the distribution of birds for which the TSBR is a major breeding area:

- (1) most individuals in the TSBR are found close to colonies during January-June (except for Oriental Darters that breed from September-January), with a smaller number of non-breeders roaming more widely
- (2) as each respective breeding season ends, adults and juveniles leave the colonies. Either they first move in large numbers to favoured late dry season feeding sites before dispersing or they disperse in small groups directly from the colony site

(3) as the rains begin and the floods rise, feeding conditions change dramatically and birds must move to the edges of the floodplain or beyond to find suitable sites

(4) as the floods subside, birds move back into the floodplain in preparation for breeding, and may temporarily congregate in large numbers

Evidence for and against each of these hypotheses is discussed in turn below.

Hypothesis 1. The suggestion that species that breed in the Tonle Sap floodplain are largely concentrated near colonies in the breeding season holds true for most species, in particular Oriental Darter, Spot-billed Pelican, Black-headed Ibis, Greater Adjutant and Milky Stork. For these species there are hardly any large groups seen away from Prek Toal, and those cases where this was observed were from before or in the very first years of nest protection at the colony sites, and so may result from abandonment of colonies within the breeding season.

Other species that are only known to breed at Prek Toal, but which are found more often in large groups away from these colonies in the breeding season are Asian Openbill, Painted Stork and Lesser Adjutant. The populations of these birds are large and so the non-breeding proportion of the population is probably quite a large total number as well, especially for Painted Stork and Lesser Adjutant, which take a few years to reach maturity.

Most records of large groups of Asian Openbills away from Prek Toal in the breeding season come from the period before 2003 and could include cases of birds disturbed from Prek Toal or birds around other suspected breeding colonies (e.g. Dei Roneath and near Boeung Tonle Chhmar). There have been far fewer records of large openbill flocks during the breeding season away from Prek Toal in the period after 2003.

Lesser Adjutants show a similar pattern of numerous records far from Prek Toal in the dry season, but usually of small groups, especially in the period after 2003. Some larger groups were observed away from Prek Toal in the breeding season before 2003. This could have been due to the same factors as mentioned for Asian Openbill, or possibly arrival of post-breeding birds from outside the TSBR where breeding cycles finish earlier (see below).

Medium sized groups (usually <100) of Painted Storks are frequently encountered in the outer floodplain clustered around small waterbodies. Given no evidence of other breeding colonies it is believed that these are groups of non-breeding birds.

Hypothesis 2. Large flocks in TSBR at the end of the breeding season away from the colonies have been witnessed for several species, particularly Greater Adjutant, Spot-billed Pelican and Black-headed Ibis. These congregations are typically in the north-west and south-east extremities of the floodplain, but have also been observed around Boeung Tonle Chhmar. Post-breeding flocks in the north-west have been seen in grasslands in Preah Net Preah district and also outside the floodplain in Monkul Borei district and at Ang Trapeang Thmor, both in Banteay Meanchey province. In the south-east the delta area and the grasslands between the Stung Sen and Stung Chinit rivers in Kampong Thom and Kampong Chhnang provinces are places where large post-breeding aggregations have been observed. It is generally believed that these aggregations are of birds dispersing from Prek Toal, but for adjutants this is not entirely clear. Late dry season flocks of Lesser and Greater Adjutants are seen, but their timing suggests that at least some may be coming from colonies outside the TSBR, perhaps in Preah Vihear. Lesser Adjutants breed in Preah Vihear from September-February, so the observation of large groups in the south-eastern part of the Tonle Sap floodplain from March to May (at least during 1999-2002) coincided better with the cessation of breeding in this area than with

that of Prek Toal where breeding continues till June. For Greater Adjutant there is a similar suggestion of mixing. Most large aggregations appear in the south-east floodplain on Tonle Sap from June-July. Breeding in Prek Toal generally runs through June, whilst in Preah Vihear birds breed from September-May.

Oriental Darter seem to aggregate post-breeding in the area around Prek Toal where they breed.

There are very few observations of large post-breeding flocks of Painted Storks and Asian Openbills in the TSBR. It may be that these species disperse immediately in small flocks and scatter outside the floodplain, but it is known that the population of Asian Openbill in Ang Trapeang Thmor shoots up from a few hundred to several thousand at the start of the wet season with 650 birds in May and 22,400 birds in June 2008 (WCS/WPO unpublished data) indicating that this is a major post-breeding site. Large numbers of Painted Storks gradually move to Ang Trapeang Thmor with a total of 2,800 counted in September 2007 climbing from 524 in May and 130 in April.

Hypothesis 3. Some species such as Greater and Lesser Adjutant, Asian Openbill, pelicans and darters have been observed to continue to use (mostly outer) areas of the floodplain, but to a lesser degree than in the dry season. With far fewer surveys being conducted in the wet (flood) season it is difficult to get a good understanding of bird numbers, but it is believed (also considering numbers observed elsewhere, e.g. at Ang Trapeang Thmor) that a high proportion of large waterbirds leave the floodplain. Those that remain are highly dispersed and difficult to count. Even species that easily cope with deep water such as Spot-billed Pelican mostly appear to leave the Tonle Sap suggesting that fishing is far less profitable during this period (this is also mirrored by human activity in that the main fishing season – e.g. the operation of Fishing Lots – is in the dry season).

The aerial surveys reported by Barzen (2004) did not detect significant numbers of most of these species in extensive coverage of the deciduous dipterocarp forests from Oddar Meanchey to northern Mondulhiri in September 2001. The two exceptions were Lesser Adjutant, which was numerous and widespread, and Sarus Cranes, which were on their breeding grounds. From a separate report it is estimated that around 55 breeding pairs of Greater Adjutants occur in the Northern Plains of Preah Vihear (Clements *et al.*, 2007a) showing that at least this area holds a substantial population. It was especially noteworthy that openbills, Painted Stork, Black-headed Ibis and pelican were not found commonly using this habitat at this time of year; this confirms indications from terrestrial surveys that they prefer floodplain habitats.

Hypothesis 4. The first significant groups of birds are usually seen returning to the floodplain in November-December. Pre-breeding flocks are not observed in all species, and not always near to the colonies. For nearly all birds some pre-breeding aggregations can also be observed in the north-west and south-east extremities of the floodplain. This is to a lesser degree than the pre-breeding aggregations and is likely influenced by the level of the water, high water preventing the birds from returning directly to the colony. It has been observed in Prek Toal that most birds return approximately one month or less ahead of nesting to mate and construct nests (Sun Visal, pers. comm.). Records around the lake also increase with larger numbers counted from November onwards.

Oriental Darter seem to aggregate pre-breeding mainly in the area around Prek Toal where they breed

Non-breeders

Four large waterbirds appear to use the TSBR mainly as non-breeding area (White-shouldered Ibis, Black-necked Stork, Woolly-necked Stork and Sarus Crane). The first three are known or suspected to breed

in very small numbers but it is believed that the Tonle Sap floodplain is suboptimal breeding habitat. All of these species have mostly been observed in the outer, drier zone of the floodplain, especially in the grasslands of Kampong Thom and eastern Siem Reap and they leave around the start of the rainy season or earlier.

There seems to be a resident group of Sarus Cranes in the Stoung and Chikraeng IFBAs through the dry season but other crane records are mostly from the early dry season when larger groups have been observed foraging in the recently inundated grassland zone. Most cranes apparently move to Ang Trapeang Thmor in the later stages of the dry season before returning to their breeding sites in the northern and eastern plains.

White-shouldered Ibis have been infrequently recorded from grassland areas during the later stages of the dry season in the south-east of the floodplain. Breeding has however not been documented and this area warrants follow up surveys for this species.

Key sites, possibly undiscovered colonies and coverage of protected areas

Although the full intricacies of movement patterns around the TSBR are highly complex and currently only understood in a general way, the evaluation of records collected from the TSBR has highlighted the continued importance of several areas around the lake for large waterbirds. Conservation areas have been established recently at many of these sites, but they need to be protected by the government, including provincial and other local level institutions, communities and any private operations such as fishing lots. Currently conservation efforts also require continued support from international cooperation agencies and donors.

There are continued records of attempts to breed by Lesser Adjutant and Oriental Darter in **Dei Roneath**. This could potentially also include Greater Adjutant, and Asian Openbills have been reported to breed here in the past making recolonization a likely prospect.

There are also reports by local people of nesting by Oriental Darter and Lesser Adjutant in the **Prey Kohs** area. The Prey Kohs BCA includes part of the zone where large post-breeding aggregations of Lesser Adjutant, Greater Adjutant and Spot-billed Pelican have been observed or reported. In fact **the whole south-eastern floodplain from the Stung Sen south**, including the delta region seems to be an important feeding and flocking area in the very late dry season and it is from here that some of the largest numbers of waterbirds have been observed. Further work is needed to identify the key sites within this area.

Another area that appears to be of some importance as a staging ground for dispersing and returning birds is the **outer north-western floodplain**, particularly the inundated grasslands of Preah-Net-Preah and the mixed grassland and agriculture just outside the floodplain in Monkul Borei district (see Map 1).

Mention must be made of **Ang Trapeang Thmor Sarus Crane Reserve**, which lies well outside the TSBR but is of great importance in the annual cycle for many of the large waterbirds. In particular for Painted Storks, Asian Openbills, Spot-billed Pelicans and Black-headed Ibis. It is also a crucial site for Sarus Cranes, some of which probably spend time in the TSBR earlier in the dry season. Some large waterbird species have now started to establish satellite colonies at ATT; this provides a valuable insurance should problems befall the colony at Prek Toal.

Boeung Tonle Chhmar has had frequent records of large numbers of waterbirds and there were colonies present before 2003. There have been few significant records

since 2003 although it is possible that undiscovered breeding sites exist. A better understanding of the reasons behind this change is needed. It is not purely a result of reduced survey effort as verbal reports from rangers indicate that high levels of disturbance are likely to be having impacts on the birdlife.

The success of the breeding colonies at Prek Toal compared with other areas lies in the protection from nest collection afforded here. Collection of eggs and chicks from nests is continuing to decimate colonies throughout the floodplain. If at least the sites where colonies were known to have occurred in the past are properly protected from collectors it is probable that the birds will return to nest and colonies may be able to rebound quickly as has been the case in Prek Toal. It would therefore also be advised to model colony protection at other sites on that of the Prek Toal program.

The best sites to establish colony monitoring and protection program such as in Prek Toal would be in Boeung Tonle Chhmar and Stung Sen core areas and Dei Roneath and Prey Kohs BCAs. In order to protect the colonies, the entire area would need to be surveyed and re-surveyed from November-January to establish where colonies are being formed and if there is any nesting activity. Any nesting colonies then need to be protected around the clock until chicks have fledged.

Further survey requirements

A more accurate assessment of bird movements can only be obtained when more long term data is collected on bird occurrence at various sites across the lake. It is especially important to collect data from the Conservation Areas about seasonality of use, numbers present over time and the establishment of colonies and records of breeding activity. As data on waterbird numbers, seasonality of occurrence and breeding attempts currently are scarce from not only the newly established Conservation Areas but even from the Boeung Tonle

Chhmar and Stung Sen Core Areas a system of data collection is needed. Such a system could be based on the MIST ('Management Information Sys'Tem') database program, which enables protected area staff to collect data while on patrol. When applied by MoE rangers that are stationed in the TSBR this would perhaps improve the quantity of data that is obtained, stored and analyzed.

Preconditions for MIST to work are that the rangers are trained in data collection and recording procedures, that they have sufficient funds to conduct patrols and that they are regularly supervised. A simple version of the data collection protocol for waterbirds and other wildlife in the TSBR as would be used when applying MIST can be seen in Appendix 1. This is only an example of one component of the entire MIST system and should not be considered an alternative to the full MIST data procedure and forms that is being taught to MoE rangers in the Core Area at present. The MIST system already includes these features.

Certain areas that currently are outside the protected area network have some records of large groups of large waterbirds and so would merit further surveys through the year to assess their true importance. These include the inundated grasslands of Preah Net Preah and the agriculture/grassland mosaic of Monkul Borey (outside the floodplain) as well as parts of the south-east floodplain and delta region that are not protected.

Among areas with no significant records to date, the western floodplain has received the least survey attention while areas immediately to the north and south of Dei Roneath have suitable habitat and may still be of importance for large waterbirds. Observers should look for opportunities to visit these areas.

Ideally an academic research program studying the movement of Tonle Sap's threatened large waterbirds and assessing the level of interchange between populations from different regions of the country will follow.

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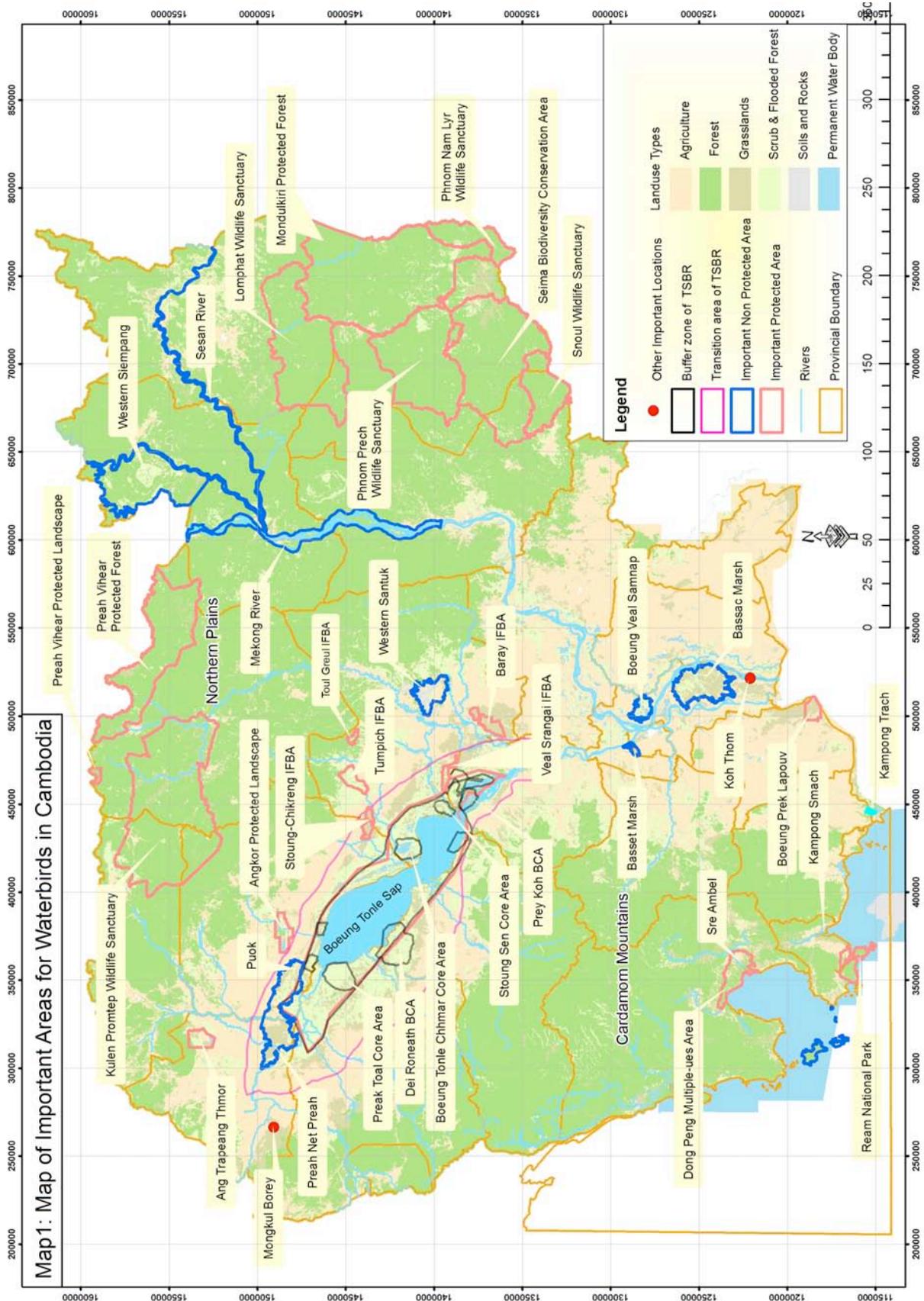
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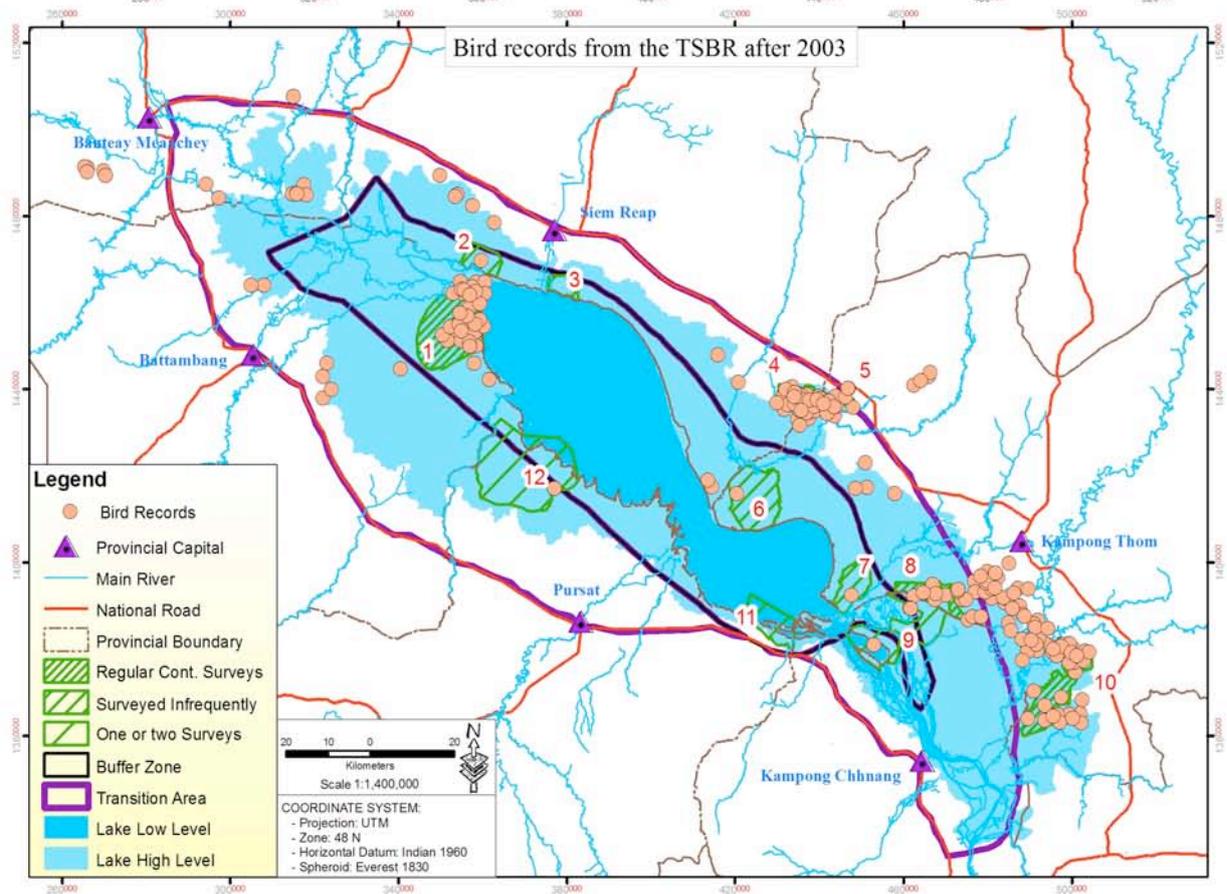
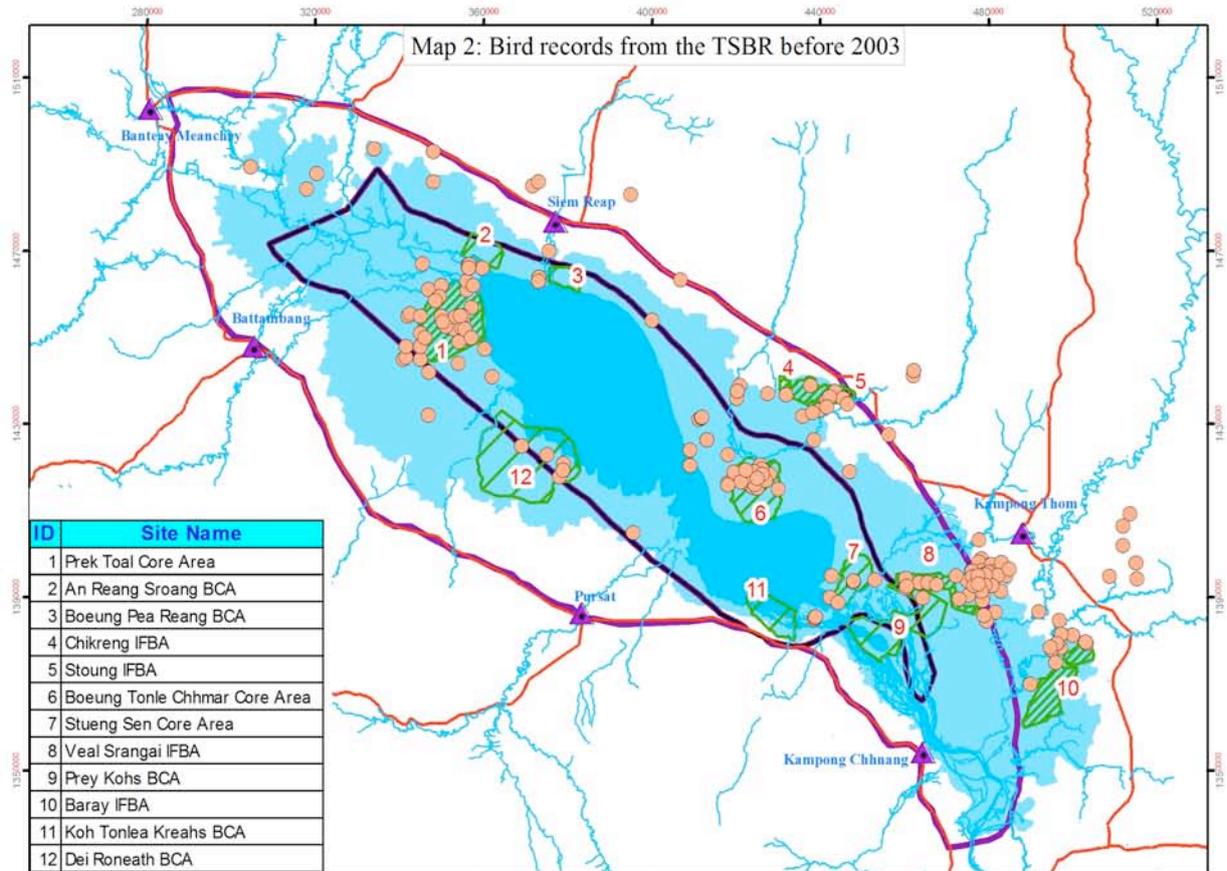
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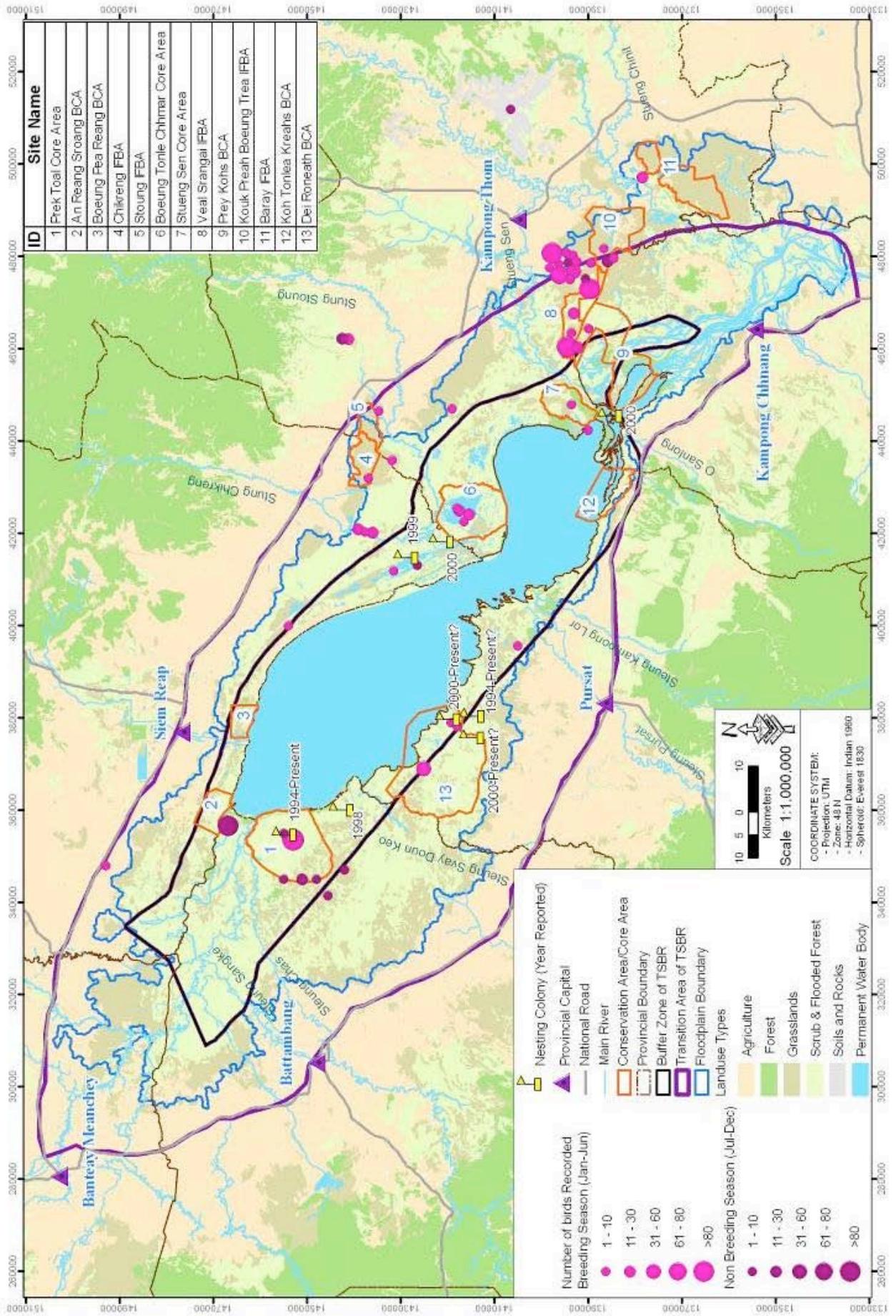
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MAP SECTION

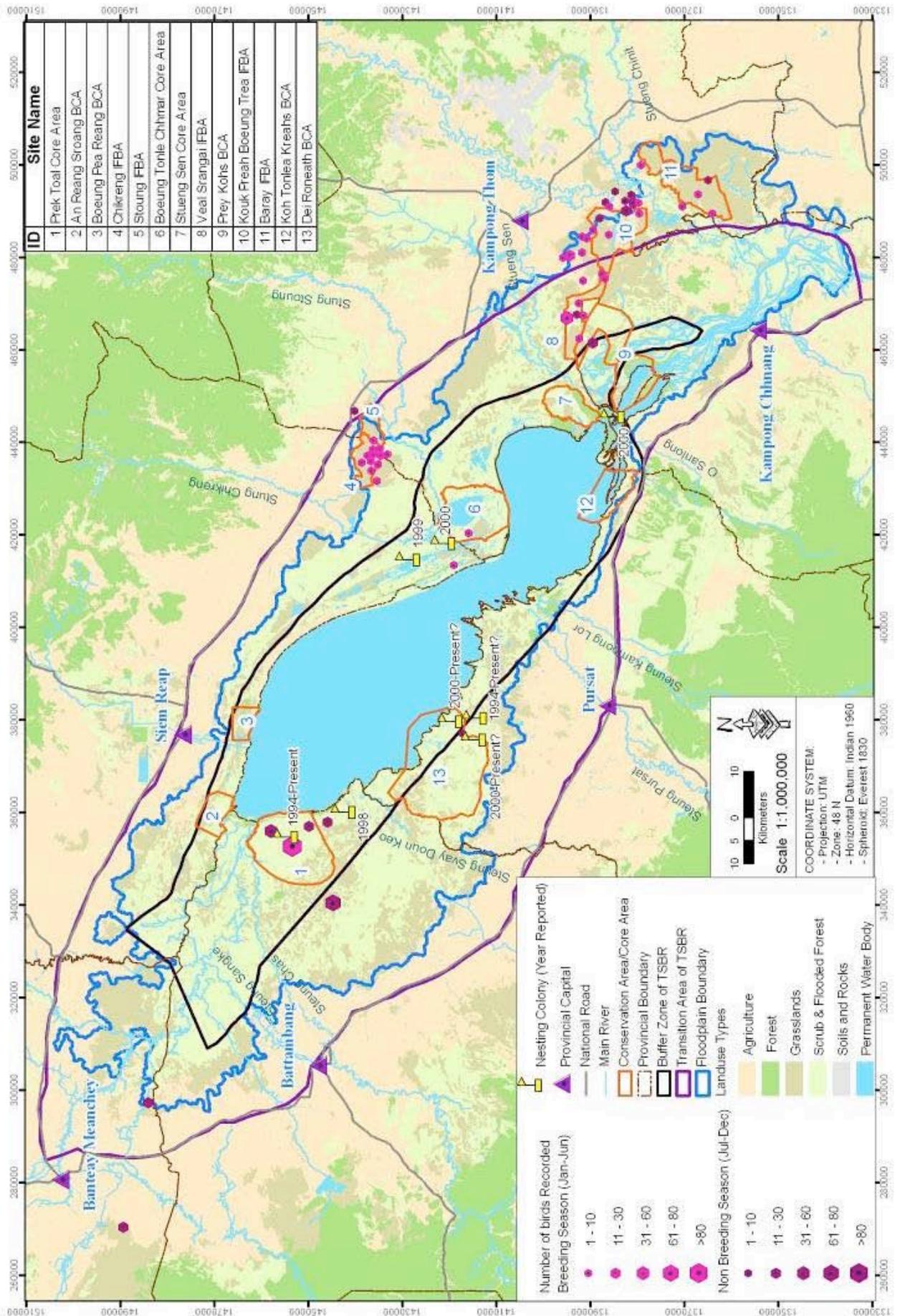




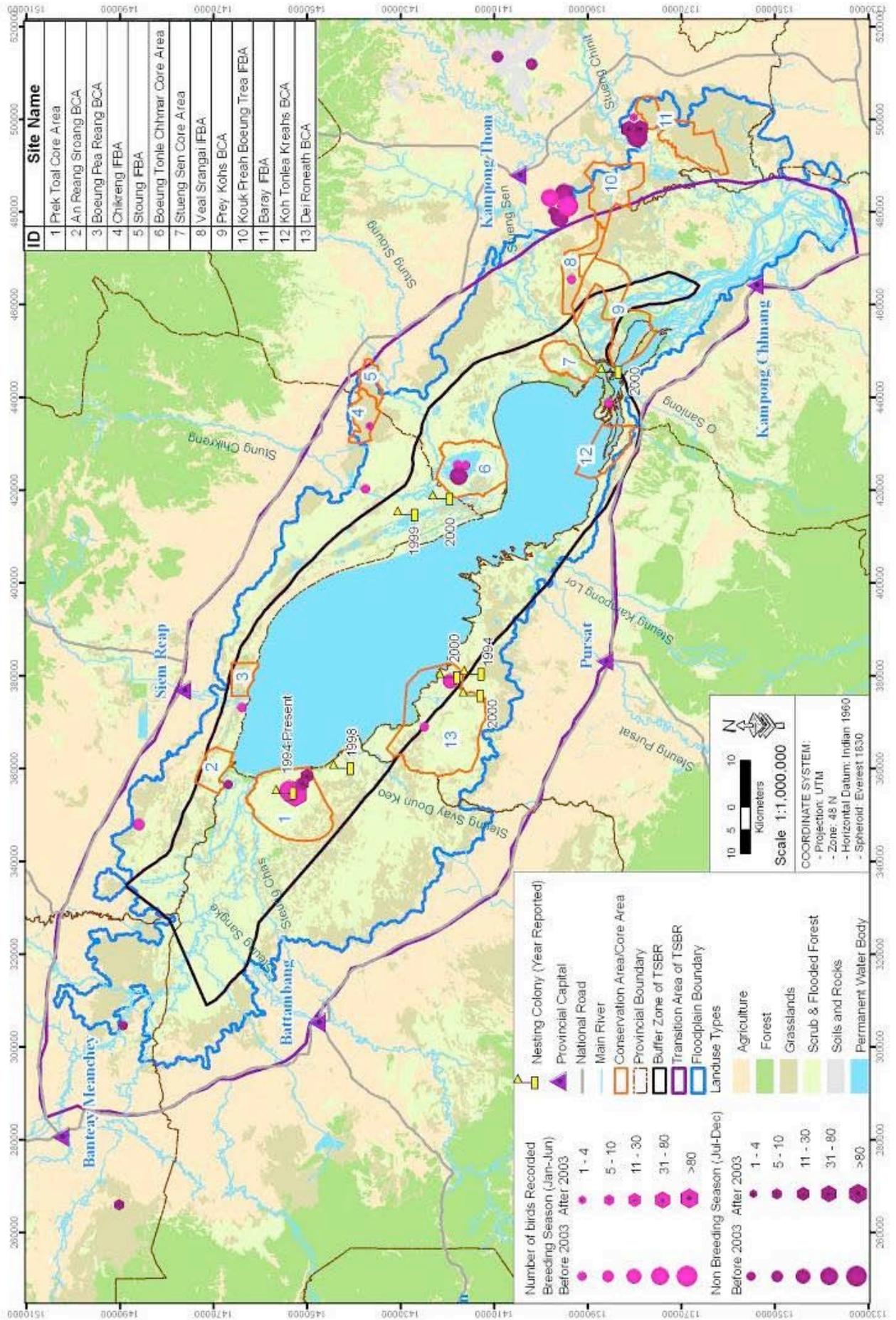
Map 3: Records of Lesser Adjutant in the TSBR before 2003



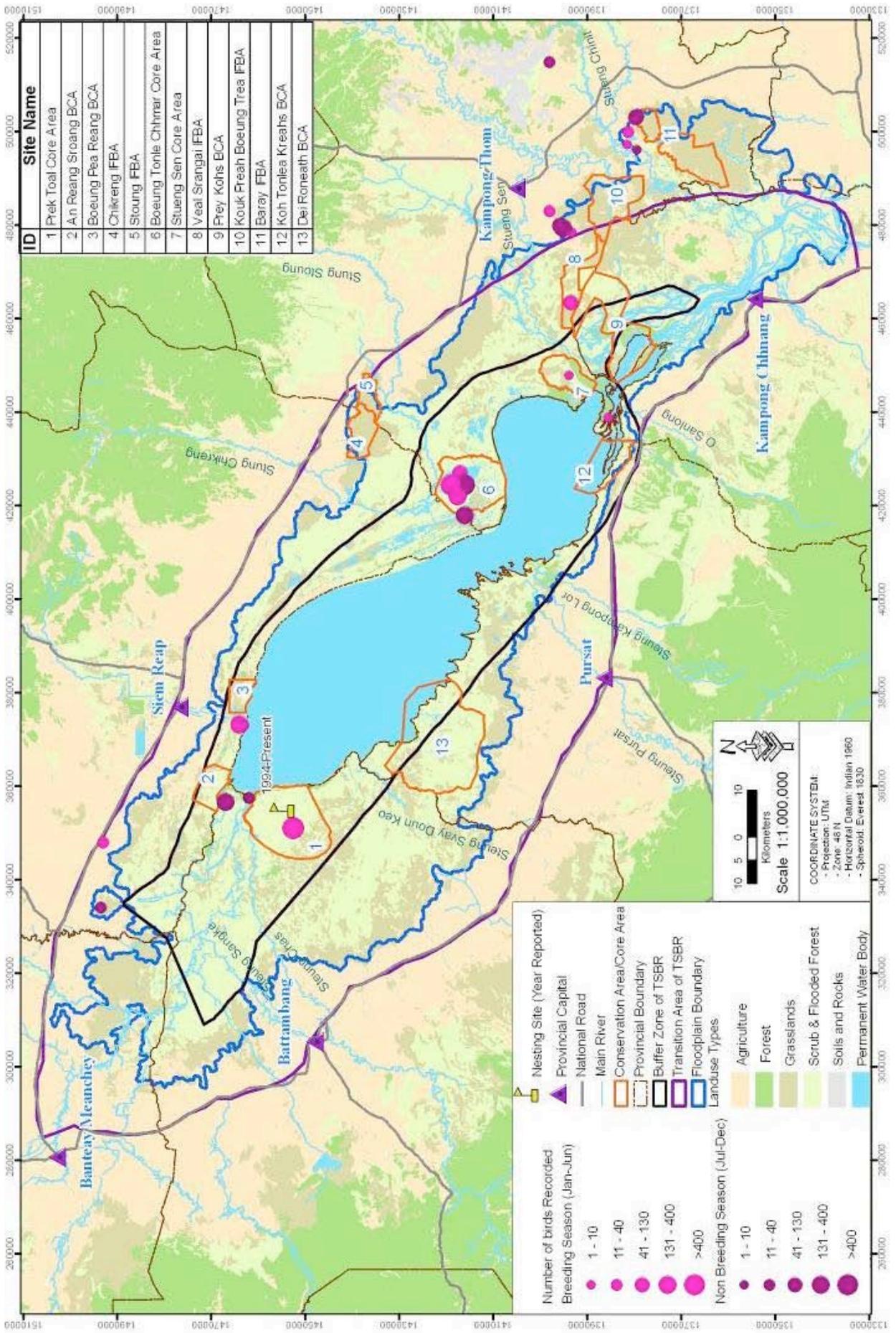
Map 4: Records of Lesser Adjutant in the TSBR after 2003



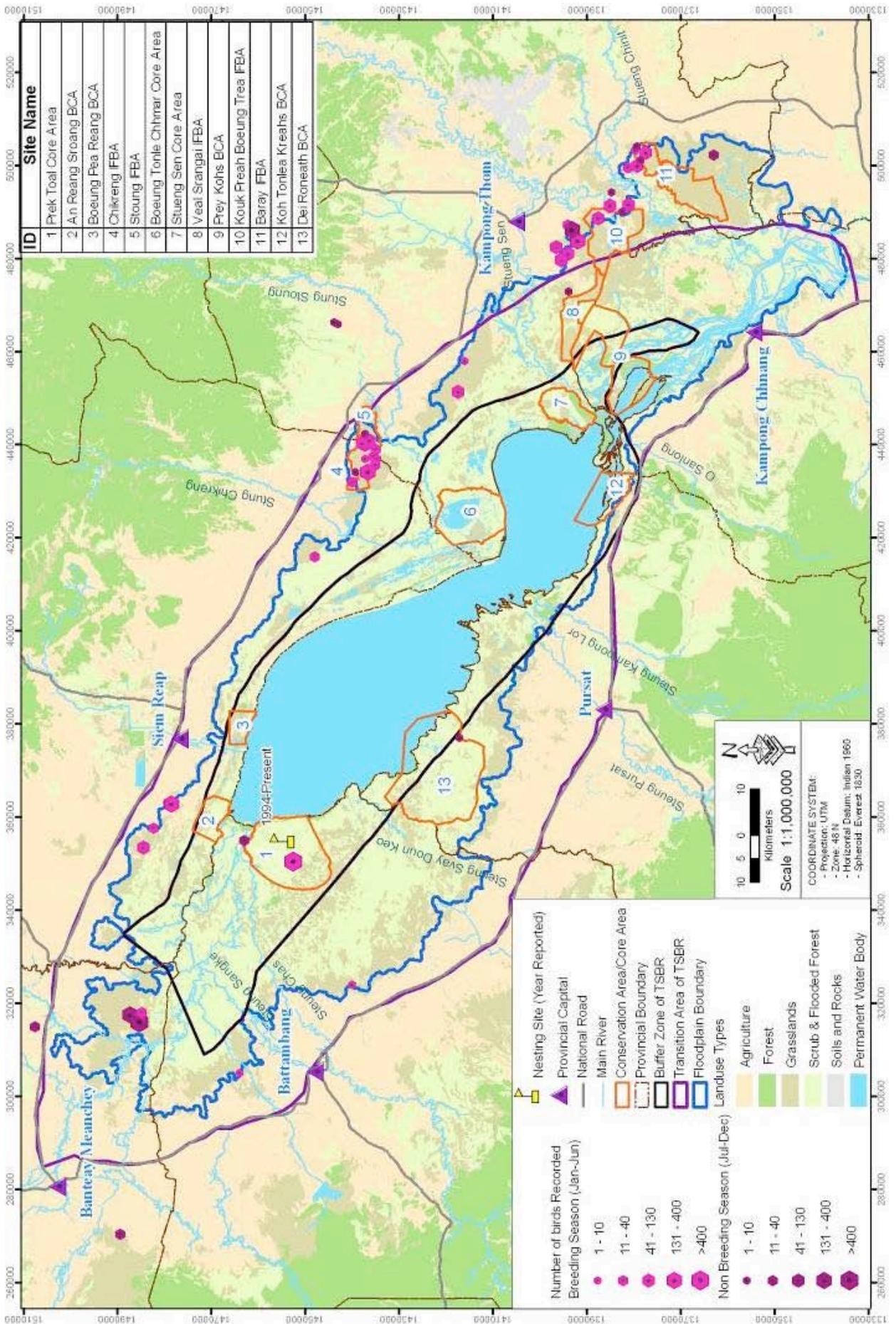
Map 5: Records of Greater Adjutant in the TSBR



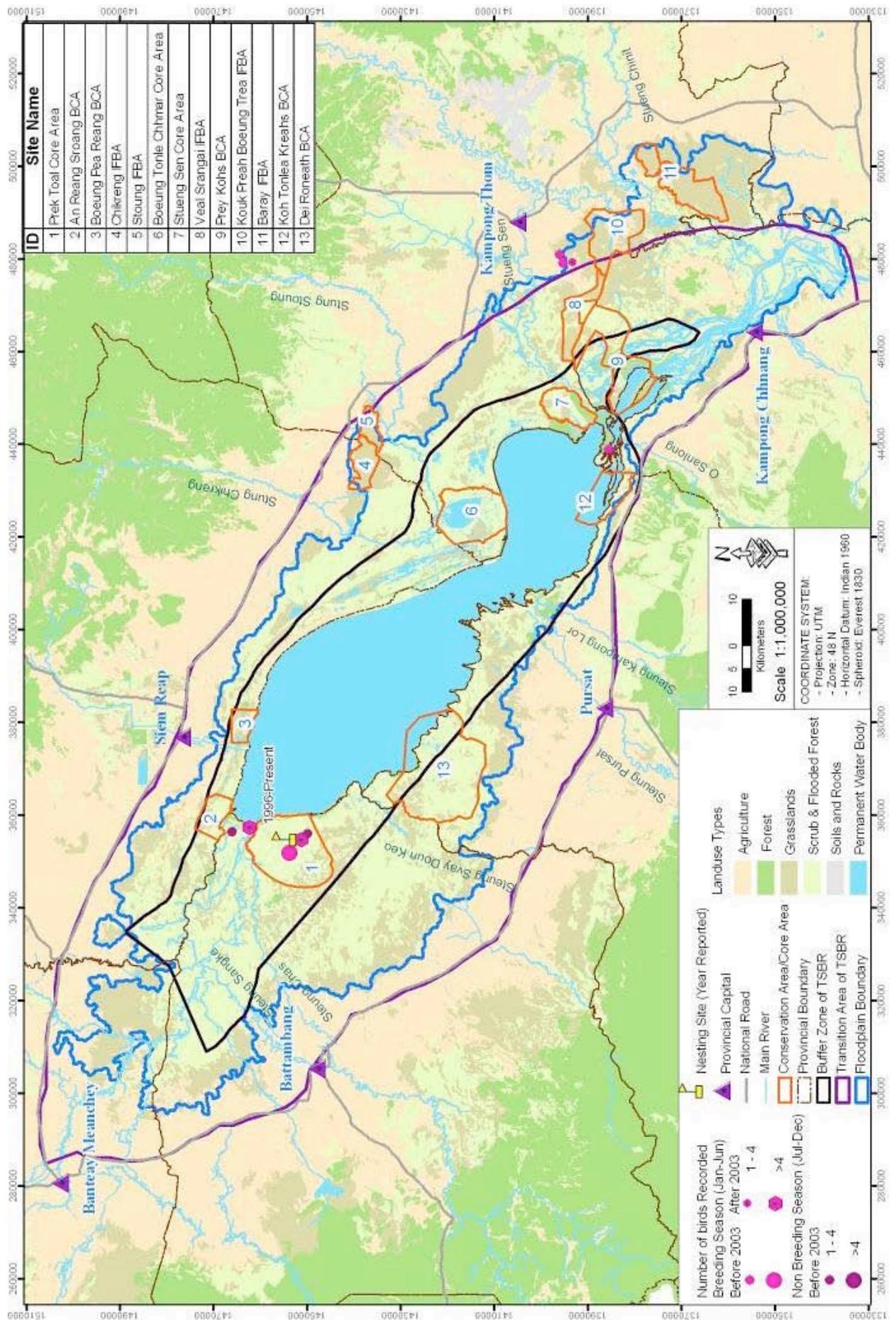
Map 6: Records of Painted Stork in the TSBR before 2003



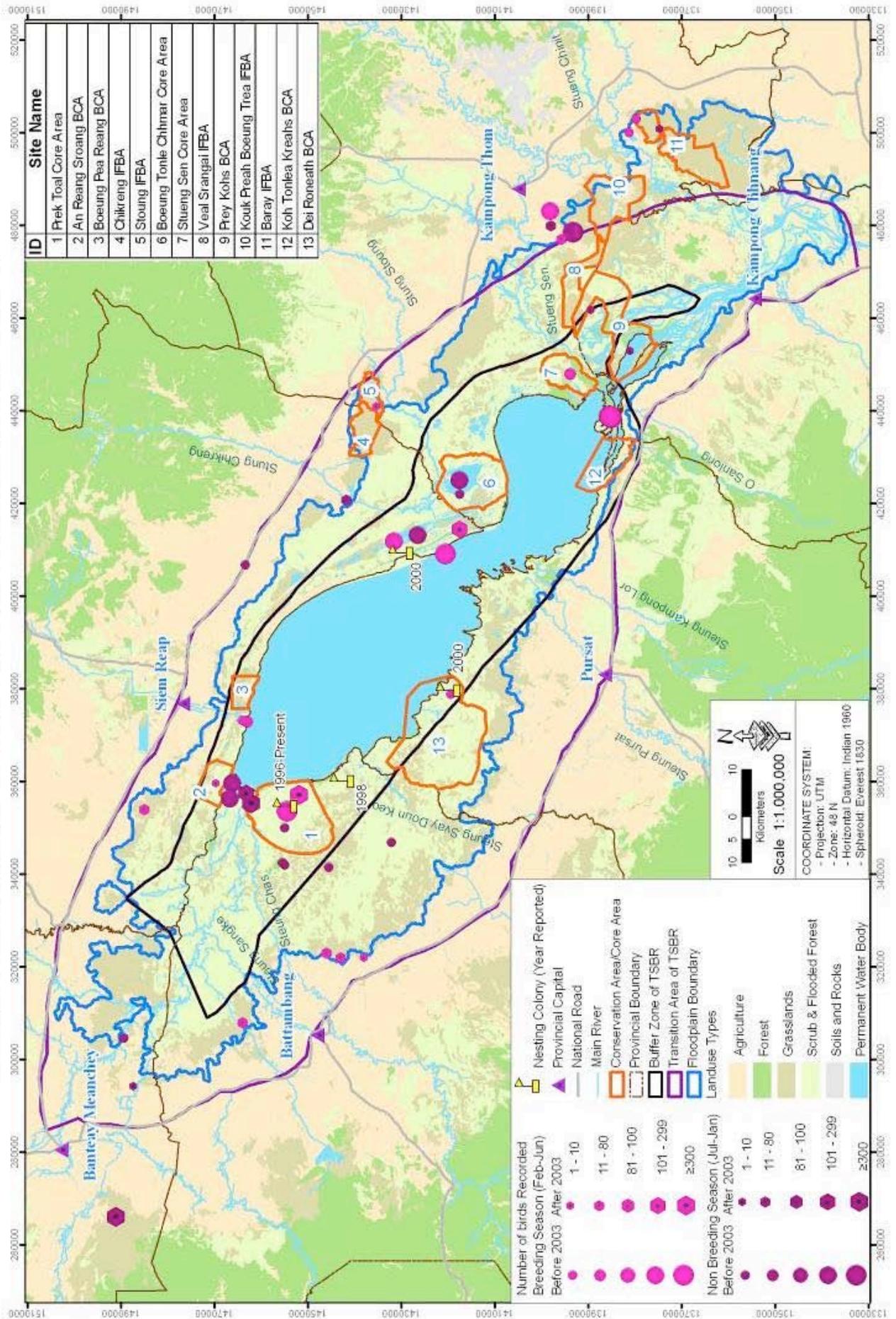
Map 7: Records of Painted Stork in the TSBR after 2003



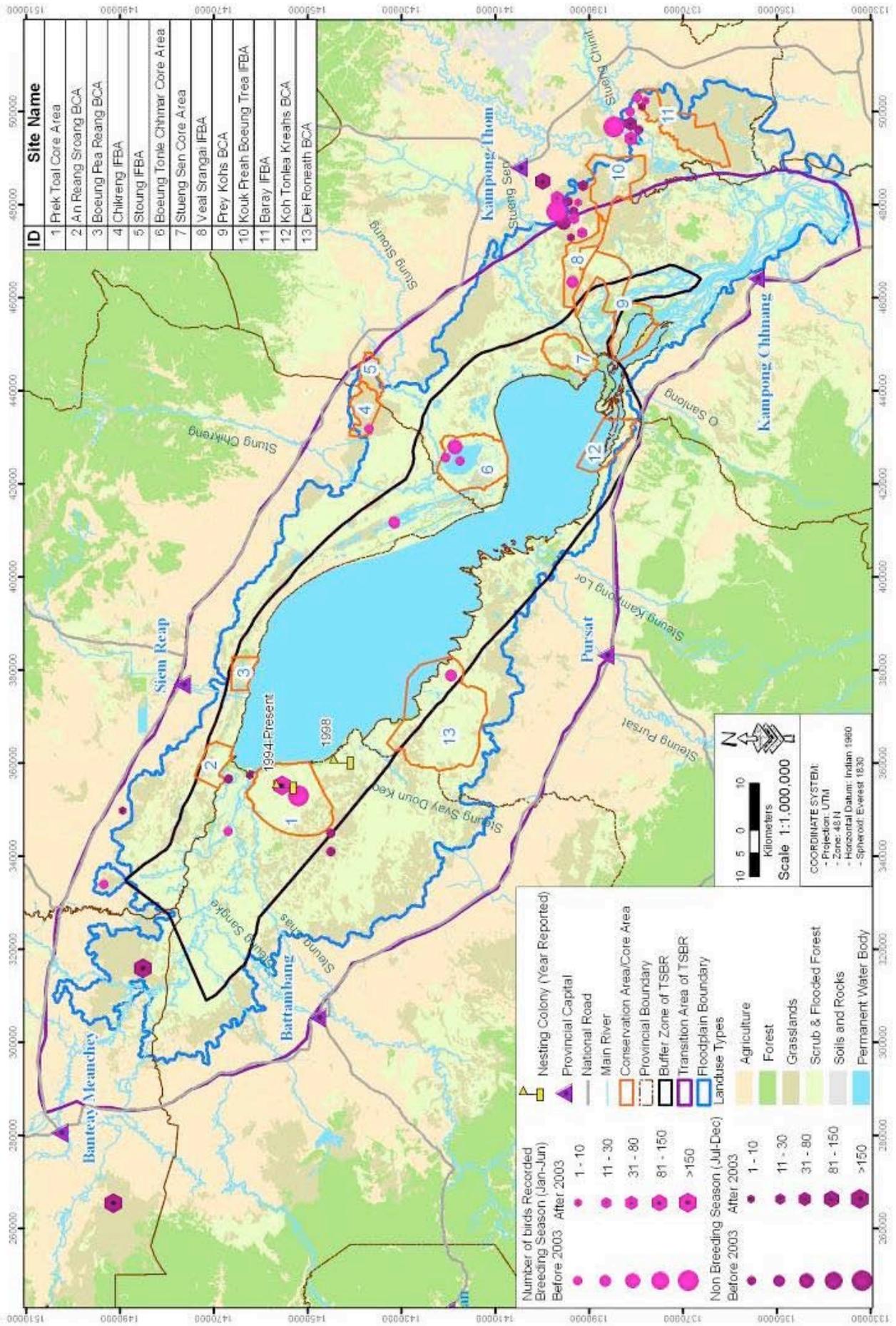
Map 8: Records of Milky Stork in the TSBR



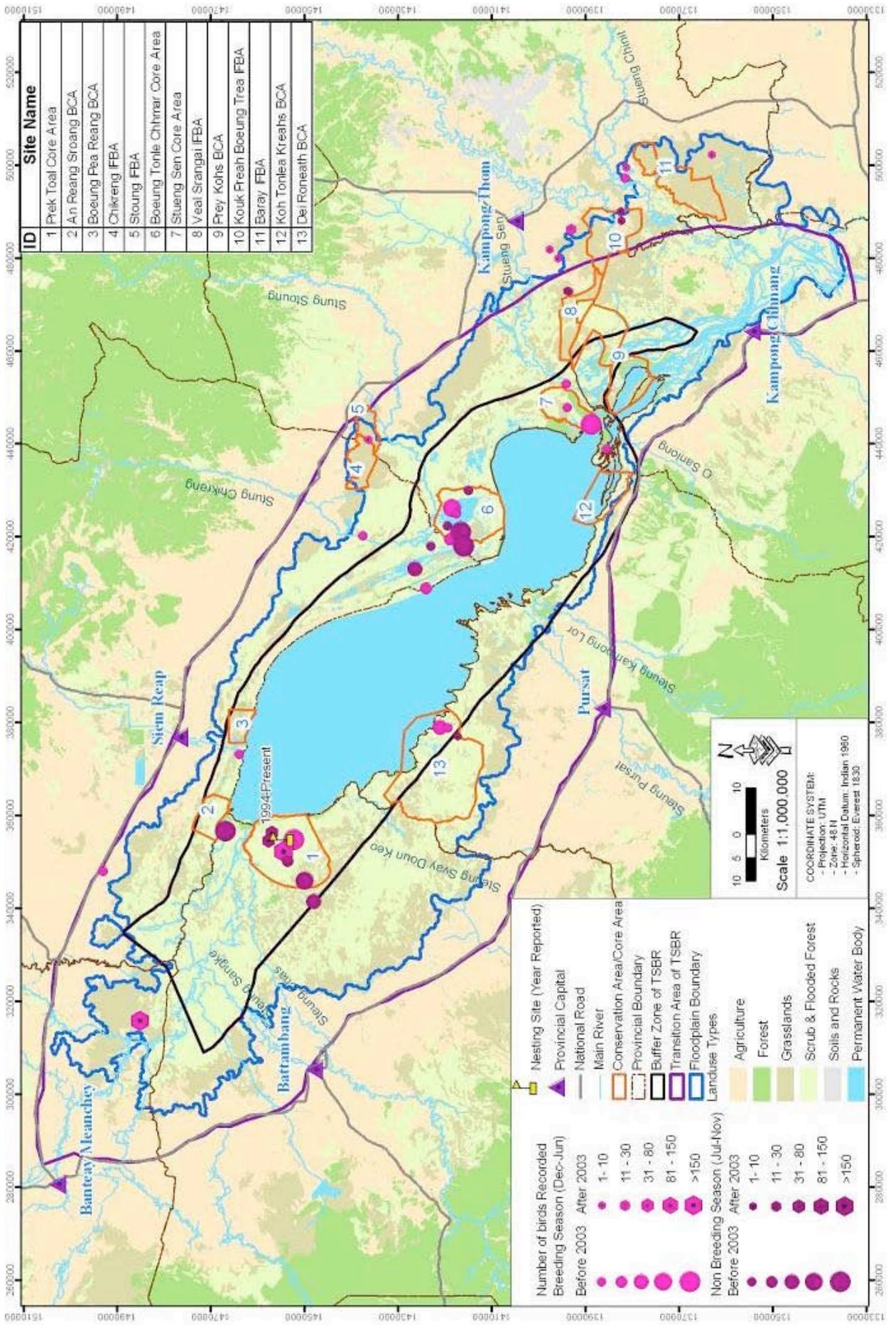
Map 9: Records of Asian Openbill in the TSBR



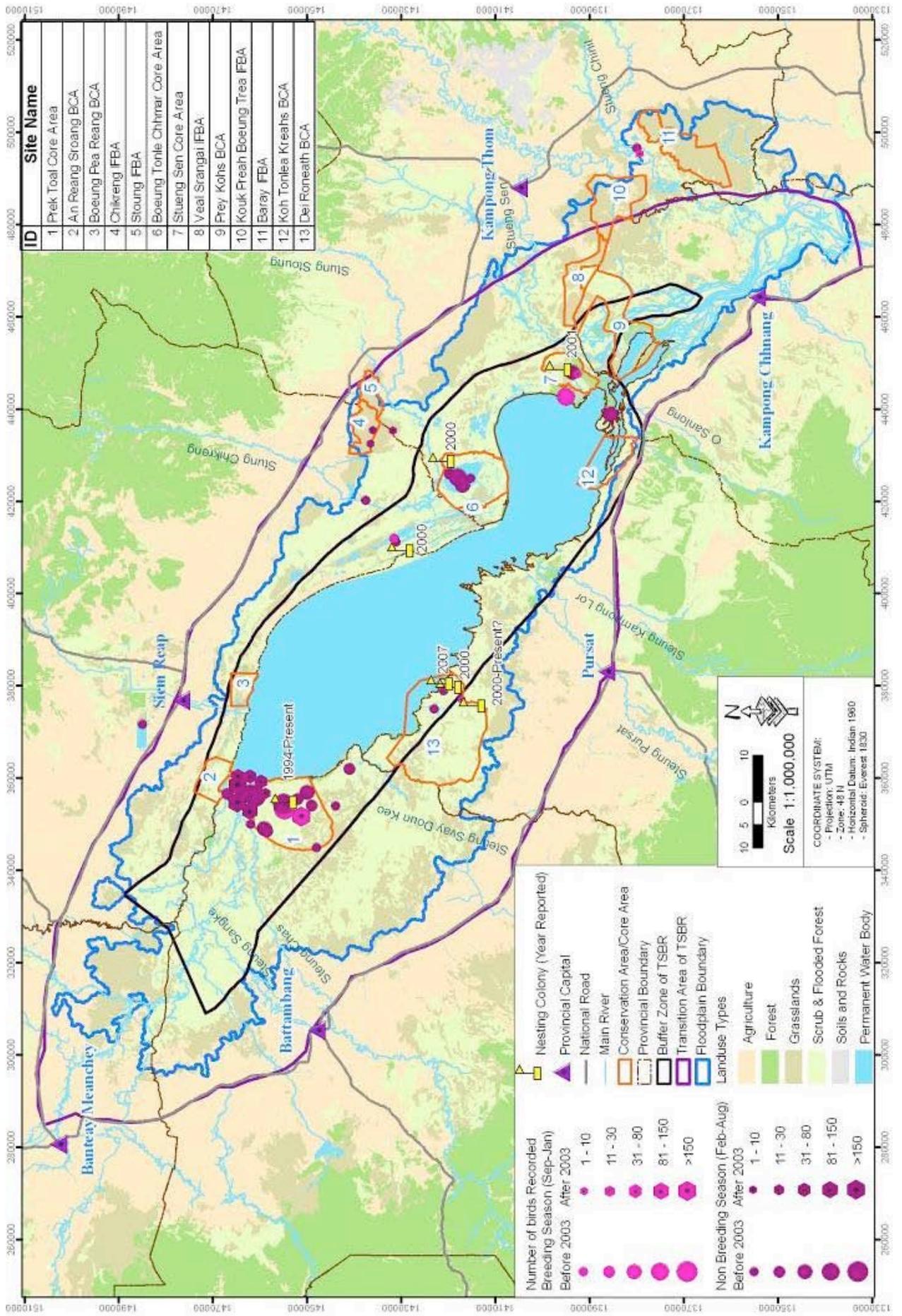
Map 10: Records of Black-headed Ibis in the TSBR



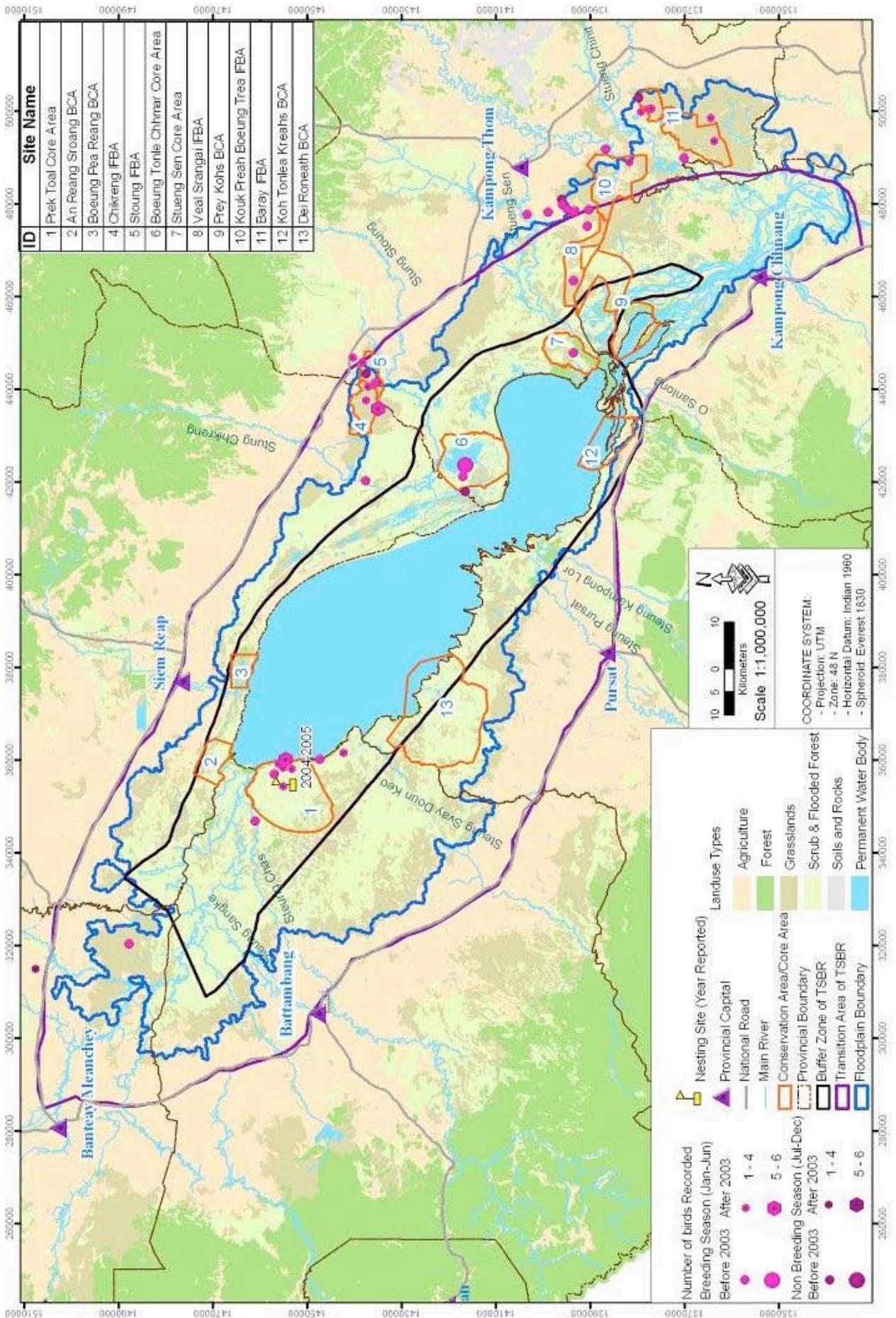
Map 11: Records of Spot-billed Pelican in the TSBR



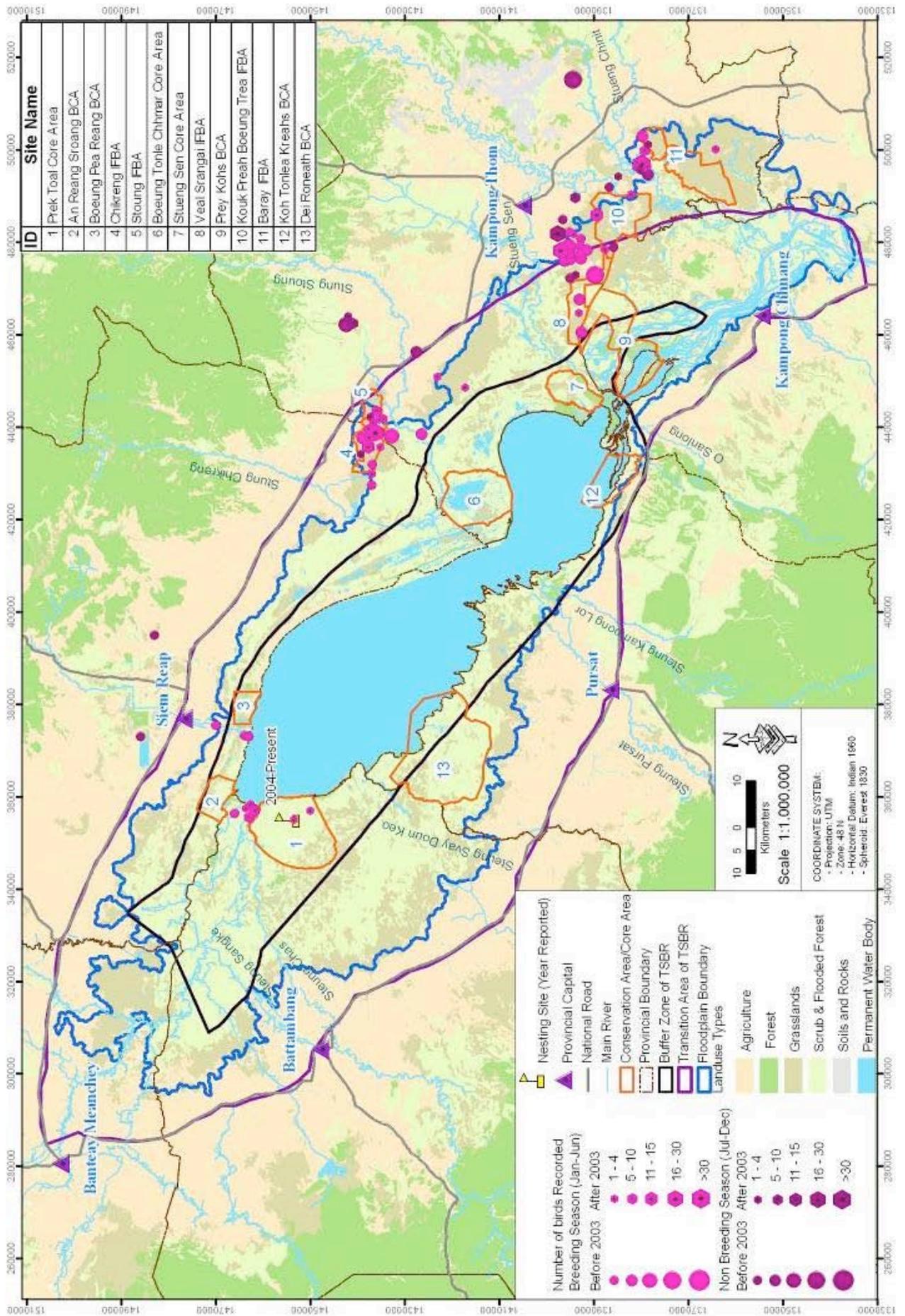
Map 12: Records of Oriental Darter in the TSBR



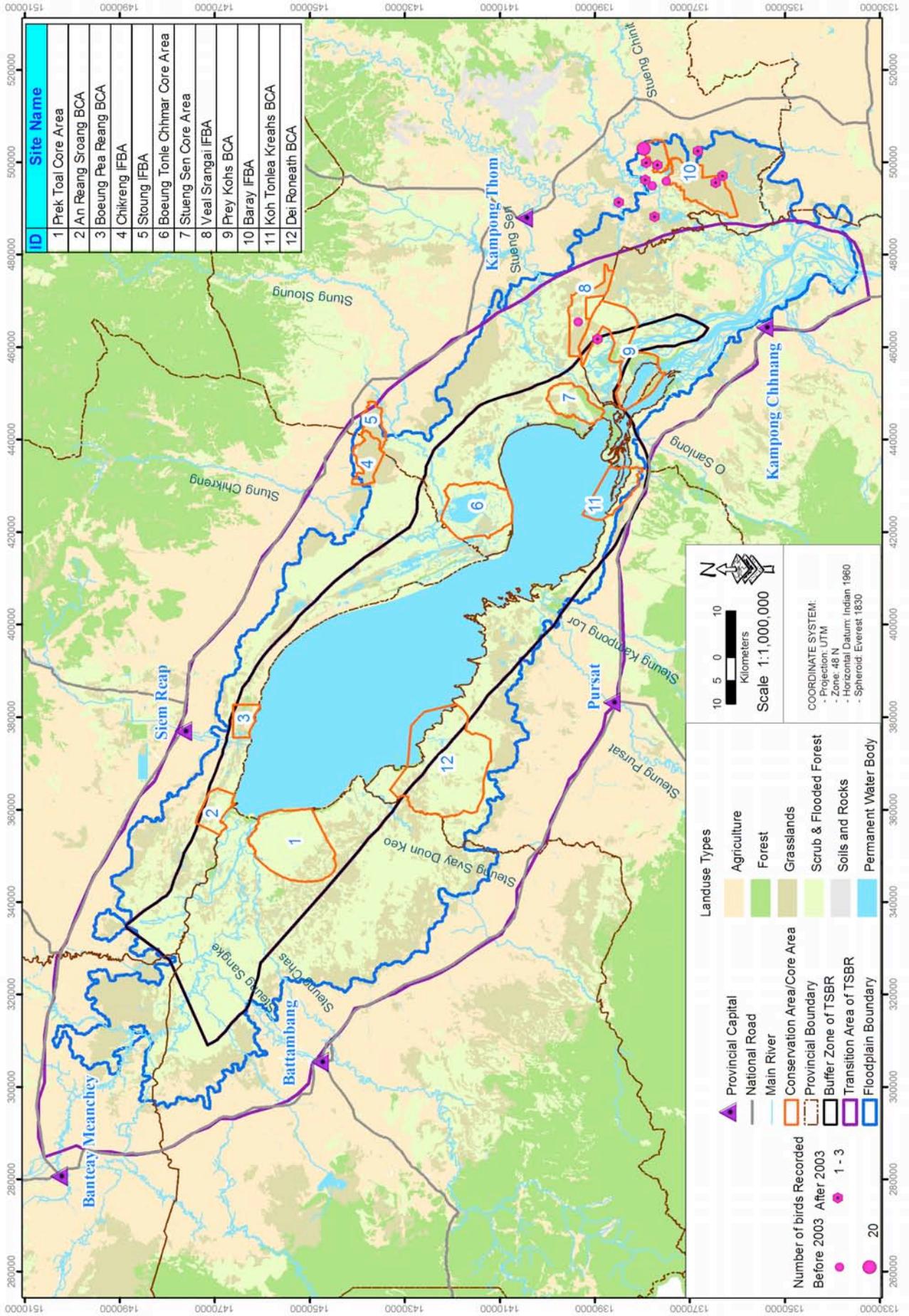
Map 13: Records of Black-necked Stork in the TSBR



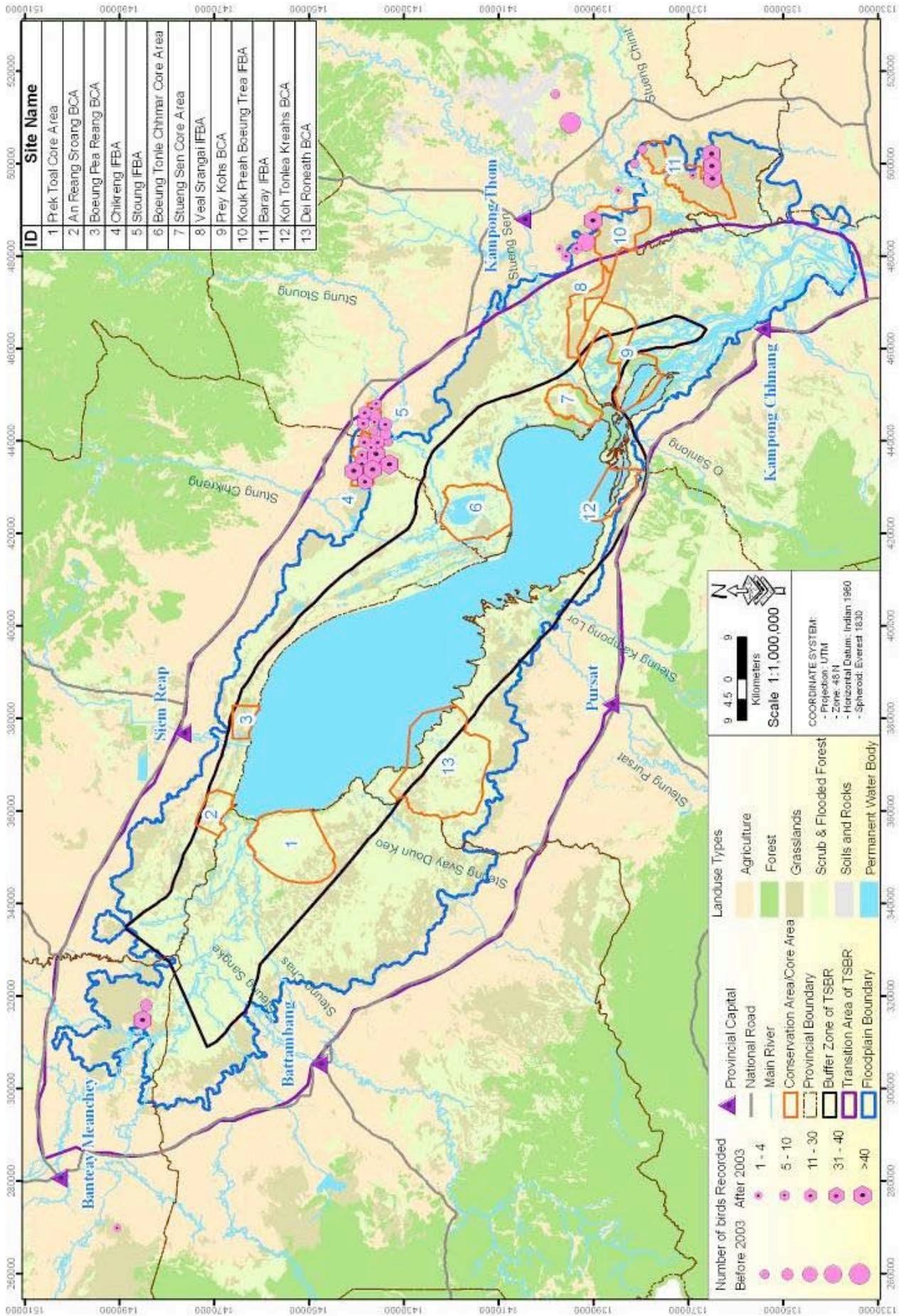
Map 14: Records of Woolly-necked Stork in the TSBR



Map 15: Records of White-shouldered Ibis in the TSBR



Map 16: Records of Sarus Crane in the TSBR



APPENDICES

Appendix I: A protocol for recording wildlife observations in the TSBR

I. Introduction:

Biodiversity and Protected Area management in Cambodia is currently only effective if interventions are constantly evaluated and improved through use of adaptive management techniques. Overall management includes wildlife monitoring, community engagement, and law enforcement. Improving the capacity of project staff and local communities to work in the supporting components is essential.

Law enforcement patrolling is recognized as the main task in stopping all illegal activities related to forest and wildlife crime in the conservation area and in order to continually improve the surveillance and protection strategy of the area. However patrols are often considered separately from wildlife monitoring while in fact they can usually be combined.

While rangers are out on patrol within the Core Areas as well as the newly established Biodiversity Conservation Areas there is ample opportunity to also collect data on various other topics relevant to protected area management including observations of species of wildlife that are the focus of management efforts. The fact that the rangers most often travel by boat and one ranger usually has his hands free make the recording of additional data all the more feasible in the Tonle Sap environment.

Collecting simple records on the number of individuals for each of the target species encountered related to location (GPS waypoint) and date will go a long way in ensuring that a long term data set is obtained providing information on seasonality of occurrence, trends and status for several locations around the Tonle Sap.

Conditions for using patrols as a tool for wildlife monitoring are that:

- the rangers are properly trained in wildlife identification, use of GPS and data collection
- sufficient funds and equipment are available and provided to the rangers to allow them to patrol on a regular uninterrupted basis
- they are regularly supervised to ensure data quality

Patrolling therefore would include:

- data collection (by rangers in the field) to provide information for day to day management of a PA, including sightings of target species

Patrolling will not include:

- data collection for systematic scientific monitoring

Patrolling can provide managers looking at wildlife status and distribution with:

- a record of patrols – where rangers have been and how long it took
- a record of observations or encounters on the patrol

The steps below only refer to how patrolling and collection of data on wildlife sightings can be effectively combined and what is needed to achieve this, but it does not refer to the entire MIST procedure. Trainings are currently being given to MoE rangers stationed in Core Areas of the TSBR by WCS staff on the complete implementation of MIST procedures.

2. Principals of patrol activities:

The principal activities of patrol teams should be:

- Looking for signs of human activity and other illegal activities
- Looking for wildlife presence in conservation areas
- Implementing the law (forestry, wildlife, protected area, land) through surveillance and intervention
- Informing people about the law
- Building good relationships with local communities

3. Patrol Operations:

In order to implement patrol activities following the MIST procedure there are some steps that should be done such as: equipping field patrol equipments and basic training on patrol strategy following MIST procedure.

3.3. Equipment Requirement:

A set of field work equipment: GPS, map, compass, binoculars, camera (one for each patrol team), datasheet book, note book, wildlife identification book and bird field guide, hammock, tent, mosquito net, blanket, torch, backpack, and boots.

3.4. Training:

The capacity of patrol teams will be improved through basic training on MIST implementation procedures. The monthly patrols should be carried out following this procedure with standardized patrol planning, observation data collection, use of MIST datasheets, and GPS location marks, using GPS.

3.4.1. Patrol Planning:

Every month, patrol team leaders and project managers will make plans for patrol activities to ensure the effective deployment of patrol teams over the protected site. They should plan for patrols lasting one day, two days, three days, one week or longer, depending on the specific purpose of the missions.

3.4.2. Standardize and Accurate Data Recording:

Standardized and accurate data recording will require training for all patrol teams to understand clearly how to record and observe signs of wildlife (identification) and human activities. The training will ensure that:

- Data will be understood according to the situation and the information reported.
- Data will be collected in a uniform manner
- Data will have long-term value
- Data can be directly compared with those collected in another time or place

3.4.3. Types of Patrol Data Collected:

Each patrol team should use the standardized MIST data forms to record all patrol information and observations as follows:

- Location, date, time and participating patrol personnel
- Wildlife observations
- Human activities observations, including digital photo (and their ID) for each significant case encountered
 - Hunting, logging, fishing, NTFP collection and land clearance activities, e.g. fires
 - Presence of road, settlement, camps, boats & vehicles
- Law enforcement activities
 - Warning letters and contracts issued
 - Confiscation of gears or weapons

3.4.4. GPS data collection:

In order to transfer the patrol waypoint recorded in GPS into the MIST database, it requires the patrol teams to use GPS carefully to record the location points (they should not change the waypoint number on the GPS) and to use GPS that is compatible with MIST (Garmin12XL, Garmin72 or 76). GPS data should be recorded as follows:

- Take waypoint at start and finish of a patrol or survey
- Take waypoint at all stops
- Take waypoint for each observation
- Take waypoint at transport changes
- If nothing happens waypoints should still be taken regularly: at least every **30mins** or at least twice in 1 hour if forest cover does not allow taking a waypoint.

3.4.5 Data review:

Data input should be reviewed frequently by somebody with biological expertise. Any unusual observations (e.g. unseasonal records, very large numbers) should be cross-checked with the datasheets and the observers. If erroneous records are being made, steps should be taken to improve the recording or identification procedures.