The Status of Bengal Florican in the Bengal Florican Conservation Areas, 2010/11 monitoring report

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Contents

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[1] The Critical Ecosystem Partnership Fund is a joint initiative of l'Agence Française de Développement, Conservation International, the Global Environment Facility, the Government of Japan, the John D. and Catherine T. MacArthur Foundation and the World Bank. A fundamental goal is to ensure civil society is engaged in biodiversity conservation.

សេចក្តីសង្ខេប

សត្វឪ្យឹប *Houbaropsis bengalensis* គឺជាប្រភេទសត្វដែលជិតផុតពូជបំផុត នៅក្នុងអំបូរ bustard ដោយសារការបាត់បង់ទីជម្រក និងការប្រមាញ់។ នៅក្នុងពិភពលោកពួកវាភាគច្រើនរស់នៅក្នុងតំបន់វាលស្មៅលិចទឹកនៃបឹងទន្លេសាប និងតំបន់វាលស្មៅនៅក្បែរបឹងទន្លេសាប។ តំបន់ការពារត្រូវបានបង្កើតឡើងដើម្បីធ្វើការការពារ និងអភិរក្សសត្វឪ្យឹប និងប្រភេទសត្វកម្រផ្សេងៗទៀត និងត្រួតពិនិត្យការចូលទៅក្នុងតំបន់អភិរក្សរបស់ប្រជាជនមូលដ្ឋានដើម្បីទាញយកធនធានធម្មជាតិសម្រាប់ផ្គត់ផ្គង់ជីវភាពរបស់ពួកគាត់មានដូចជា៖ ការនេសាទ ដីសម្រាប់កសិកម្ម និងវាលស្មៅ សម្រាប់សត្វពាហនៈ។

នៅខែកុម្ភៈ ឆ្នាំ ២០១០ តំបន់កសិ-ជីវៈចម្រុះ (IFBAs) ដែលទទួលស្គាល់ដោយអាជ្ញាធរខេត្តត្រូវបានក្រសួងកសិកម្មរុក្ខាប្រមាញ់ និងនេសាទរៀបចំជាប្រកាសតំបន់គ្រប់គ្រង និងអភិរក្សសត្វ និងជីវចម្រុះនៃប្រព័ន្ធអេកូឡូស៊ីរួម (BFCAs) ដែលមានសារៈសំខាន់សម្រាប់ជាតិ លើទំហំផ្ទៃដីចំនួន៣១២ គីឡូម៉ែត្រការ៉េ សម្រាប់ជាទីជម្រកនៅរដូវ បន្តពូជ និងរដូវមិនបន្តពូជរបស់សត្វឪ្យឹប ហើយបច្ចុប្បន្នត្រូវបានការពារ និងគ្រប់គ្រងដោយរដ្ឋបាលព្រៃឈើ នៃក្រសួងកសិកម្មរុក្ខាប្រមាញ់ និងនេសាទ ។ ទោះបីជាយ៉ាងណាក៏ដោយក៏អតីតតំបន់កសិ-ជីវៈចម្រុះវាលស្រងៃ និងតំបន់គោកព្រៃបឹងទ្រានៅក្នុងភូមិសាស្ត្រខេត្តកំពង់ធំ មិនត្រូវបានបញ្ចូលទៅក្នុងការរៀបចំប្រកាសឡើយ ។

ការសិក្សាស្រាវជ្រាវចំនួនសត្វឪ្យឹបនៅក្នុងប្រទេសកម្ពុជា គឺត្រូវបានអនុវត្តដោយមន្ត្រីរដ្ឋបាលព្រៃឈើ និងមានកិច្ចសហការជាមួយអង្គការសមាគមអភិរក្សសត្វព្រៃ (WCS) ដែលសកម្មភាពនេះទទួលបានមូលនិធិពី CEPF និងការគាំទ្រពីអង្គការនិងម្ចាស់ជំនួយផ្សេងៗទៀត។ របាយការណ៍នេះគឺសង្ខេបពីលទ្ធផលនៃការសិក្សាស្រាវជ្រាវ និងសកម្មភាពពាក់ព័ន្ធផ្សេងៗទៀតដែលបានអនុវត្តចាប់ពី ខែ កញ្ញា ឆ្នាំ ២០១០ ដល់ខែ ធ្នូ ឆ្នាំ ២០១១។

នៅកំឡុងខែមិនា-មេសា ឆ្នាំ ២០១១ ការរាប់ចំនួនសត្វឪ្យឹបឈ្មោលដែលហើរបង្ហូតខ្លួន ដោយប្រើសំណាកជាលក្ខណៈប្រព័ន្ធ ត្រូវបានធ្វើឡើងនៅក្នុងតំបន់អភិរក្សសត្វឪ្យឹបចំនួន ៥ ដែលជាតំបន់បន្តពូជ (វាលស្មៅលិចទឹកបឹងទន្លេសាប) រួមទាំងអតីតតំបន់កសិ-ជីវៈចម្រុះវាលស្រងៃ តំបន់វាលស្មៅនៅជិតវាលស្រងៃក្នុងទឹកដីខេត្តកំពង់ឆ្នាំង (ក្នុងតំបន់អភិរក្សជីវៈចម្រុះព្រៃកោះ)និងតំបន់វាលស្មៅនៅក្បែរតំបន់អភិរក្សសត្វឪ្យឹបបាវាយណ៍ដែលពីមុនគឺជាផ្នែកមួយរបស់តំបន់កសិ-ជីវៈចម្រុះបាវាយណ៍។ សរុបប្លុកទាំងអស់ចំនួន៦៧ប្លុក ដែលប្លុកនីមួយៗមានទំហំ ១x១ គីឡូម៉ែត្រ គឺត្រូវបានធ្វើការអង្កេតដែលវាតំណាងឱ្យ២៥ភាគរយនៃតំបន់អភិរក្សសត្វទាំងអស់។ សត្វឪ្យឹបឈ្មោលដែលហើរបង្ហូតខ្លួន គឺត្រូវបានប៉ាន់ប្រមាណថាមានដង់ស៊ីតេ ០,២៧ក្បាល ក្នុង១គីឡូម៉ែត្រការ៉េនៅក្នុងតំបន់អភិរក្ស និងមានដង់ស៊ីតេ០,២៨ក្បាល ក្នុង១គីឡូម៉ែត្រការ៉េក្នុងតំបន់សិក្សាទាំងមូល។ សរុបរួមទិន្នន័យនេះផ្តល់នូវការប៉ាន់ប្រមាណទាំងស្រុង ទៅលើសត្វឪ្យឹបឈ្មោលដែលហើរបង្ហូតខ្លួនចំនួន៤៦ក្បាល នៅក្នុងតំបន់អភិរក្សសត្វឪ្យឹប (ជាមួយនឹងភាពជឿជាក់៩៥ភាគរយថាចំនួនសត្វឪ្យឹបឈ្មោលដែលហើរបង្ហូតខ្លួន គឺមានចន្លោះពី២៤-៦៩ក្បាល) ហើយនិងសត្វឪ្យឹបឈ្មោលហើរបង្ហូតខ្លួនចំនួន៧៨ក្បាល នៅក្នុងតំបន់សិក្សាទាំងមូល (ជាមួយនឹងភាពជឿជាក់៩៥ភាគរយ ថាចំនួនសត្វឪ្យឹបឈ្មោលហើរបង្ហូតខ្លួនគឺមានចន្លោះពី៥៦-១១០ក្បាល)។

លទ្ធផលក្នុងឆ្នាំ២០១១ នៅក្នុងតំបន់អភិរក្សសត្វឪ្យឹបទាំងមូល គឺវាមានចំនួនសត្វឪ្យឹបឈ្មោលដែលហើរបង្ហូតខ្លួនតិចជាង៨៨ក្បាល ដែលជាចំនួនបានប៉ាន់ប្រមាណនៅក្នុងតំបន់ដូចគ្នាកាលពីឆ្នាំ២០១០ ហើយដូចគ្នានេះដែរចំនួនសត្វឪ្យឹបឈ្មោលដែលបានហើរបង្ហូតខ្លួនតិចជាង៥៧ក្បាលបានប៉ាន់ប្រមាណនៅឆ្នាំ២០០៩។ ទោះបីជាចំនួនរបស់វានៅក្នុងតំបន់អភិរក្សសត្វឪ្យឹបស្មោង-ជីក្រែងបានធ្លាក់ចុះប្រហាក់ប្រហែលនៅក្នុងឆ្នាំ២០០៩ (៣៧ក្បាល នៃសត្វឪ្យឹបឈ្មោលហើរបង្ហូតខ្លួន) គឺពុំមែនជាការប្រែប្រួលនូវស្ថិតិដ៏សំខាន់នោះទេ ព្រោះចំនួនសត្វឪ្យឹបឈ្មោលដែលមិនបានហើរបង្ហូតខ្លួនមានការកើនឡើងស្របពេលជាមួយគ្នា។ បើយោងទៅតាមការកើនឡើងបន្តិចបន្តួច នៃចំនួនសត្វឪ្យឹបឈ្មោលហើរបង្ហូតខ្លួននៅក្នុងតំបន់អភិរក្សសត្វឪ្យឹបបាវាយណ៍ និងតំបន់អភិរក្សសត្វឪ្យឹបចុងដូងក្នុងឆ្នាំ២០១០ និងនៅក្នុងឆ្នាំ ២០១១ ចំនួនសត្វឪ្យឹបឈ្មោលហើរបង្ហូតខ្លួនធ្លាក់ចុះនៅត្រឹម១១ក្បាល ស្មើនឹងចំនួនពាក់កណ្តាលនៃការប៉ាន់ប្រមាណក្នុងឆ្នាំ ២០០៩ ។

ចំណែកឯនៅខាងក្រៅតំបន់អភិរក្សសត្វខ្សឹបវិញ ចំនួនសត្វខ្សឹបឈ្មោលហើរបង្ហូតខ្លួនមានការកើនឡើងយ៉ាងខ្លាំងគួរឲ កត់សំគាល់ ។ ការវិភាគដោយប្រើកម្មវិធីរាប់ចំនួនជាក់លាក់ បានបង្ហាញថា បន្ទាប់ពីការចុះទៅអង្កេតចំនួនបីដង ក្នុងការ៉ េនីមួយៗចំនួនសត្វខ្សឹបឈ្មោលដែលហើរបង្ហូតខ្លួនត្រូវបានបាត់បង់ចំនួន១០ភាគរយ។

ការបាត់បង់ទីជម្រក គឺប្រហែលជាកត្តាចម្បងដែលនាំឱ្យមានការថយចុះនូវចំនួនរបស់សត្វខ្សឹប ទាំងនៅក្នុង តំបន់អភិរក្សសត្វខ្សឹប និងតំបន់សិក្សាទាំងមូល។ នៅក្នុងតំបន់អភិរក្សសត្វខ្សឹបការអភិរក្សទីជម្រក គឺត្រូវបានធ្វើឡើង តាមរយៈការចុះទៅអង្កេតនៅទីវាលជាទៀងទាត់ និងការប្រើប្រាស់រូបភាពពីផ្កាយរណប។ ការពង្រីកស្រែប្រាំង គឺនៅ តែបន្តនៅក្នុងតំបន់អភិរក្សសត្វខ្សឹប ក្នុងឆ្នាំ ២០១០-២០១១ ជាពិសេសនៅក្នុងតំបន់អភិរក្សសត្វខ្សឹបជីក្រែង។ ប្រហែល ជាប្រមាណ ២៣ភាគរយនៃទីជម្រកដែលមានសក្តានុពលសម្រាប់រដូវបន្តពូជ នៅក្នុងតំបន់អភិរក្សសត្វខ្សឹប បច្ចុប្បន្ននេះស្ថិត នៅក្រោមទម្រង់នៃការពង្រីកវិស័យកសិកម្ម។ តំបន់ដែលគ្របដណ្តប់ដោយព្រៃគម្ពោធ គឺពុំត្រូវបានធ្វើការសិក្សាស្រាវជ្រាវ នៅឡើយទេ ប៉ុន្តែវាក៏ស្ថិតនៅក្រោមការព្រួយបារម្ភផងដែរ។

ស្ថិតនៅក្រោមគម្រោង នៃការការពារសម្បុកពងកូនរបស់សត្វខ្សឹប គឺមានសម្បុកចំនួន ៧ ត្រូវបានរកឃើញ ដោយ អ្នកភូមិ ហើយសម្បុកចំនួន ៦ ត្រូវបានពិនិត្យឃើញដោយក្រុមការងារអភិរក្ស។ ភាពជោគជ័យក្នុងការការពារសម្បុកសត្វខ្សឹប គឺមានការកើនឡើងក្នុងឆ្នាំ ២០១១ ស្មើនឹង៤៣ភាគរយ បើប្រៀបធៀបទៅនិងឆ្នាំ ២០១០ មានត្រឹមតែ ២៥ ភាគរយ ទោះបីជាមានការលំបាកក្នុងការវាយតម្លៃឱ្យបានត្រឹមត្រូវអំពីសម្បុកទាំងនោះក៏ដោយ។ កម្មវិធីការការពារសម្បុក គឺត្រូវបានផ្លាស់ប្តូរបន្តិចបន្តួច ដើម្បីកាត់បន្ថយការរំខានដល់សត្វដែលក្រាបពង ហើយនេះអាចជាមូលហេតុដែលនាំឱ្យ កម្មវិធីការការពារសម្បុកមានភាពជោគជ័យកាន់តែខ្លាំងឡើងថែមទៀត ។ ការចំណាយសម្រាប់អ្នកភូមិដែលបានផ្តល់ពតិមាន និងប្រាក់បន្ថែមក្រោយពីពងញាស់ ដោយជោគជ័យ គឺមានចំនួន១២៥ ដុល្លា។

របាយការណ៍នេះរួមមានលទ្ធផល នៃការអង្កេតសត្វខ្សឹបនៅរដូវមិនបន្តពូជក្នុងឆ្នាំ ២០១០ និង ឆ្នាំ ២០១១។ នៅ ក្នុងឆ្នាំ ២០១០ គឺយើងធ្វើការអង្កេតដោយប្រើខ្សែ Transect ដែលមានប្រវែង ២៣៥ គីឡូម៉ែត្រ នៅកំឡុងខែ កញ្ញា ដល់ខែវិច្ឆិកា ដោយផ្តោតទៅលើតំបន់អភិរក្សសត្វខ្សឹប នៅតំបន់ខ្ពង់រាបរួមមាន៖ តំបន់ទួលគ្រើល-ជាន់ញើម, តំបន់ទ្រា-សាមគ្គី និងសហគមន៍ព្រៃឈើដែលនៅខាងត្បូងតំបន់អភិរក្សទាំងពីរនេះ។ សត្វខ្សឹបចំនួន ៧ក្បាល ដែលរួមមាន ឈ្មោល ៣ ក្បាល និងញី ៤ក្បាល ត្រូវបានកត់ត្រាដោយក្រុមអភិរក្ស។ នៅក្នុងឆ្នាំ ២០១១ វិធីសាស្ត្រនៃការអង្កេតត្រូវបានផ្លាស់ប្តូរ ដើម្បីបង្កើន អត្រាភាគរយនៃការជួបប្រទះសត្វខ្សឹប និងកំណត់ទីតាំងសំខាន់ៗសម្រាប់ការអភិរក្សសត្វខ្សឹបនៅរដូវវស្សា។ ការអង្កេតលើខ្សែ Transect ប្រវែងសរុប ២៨៣ គីឡូម៉ែត្រ ត្រូវបានធ្វើឡើងនៅទីតាំងចំនួន ១៤០ ក្នុង ៣៦ តំបន់។ សត្វខ្សឹបចំនួន២១ក្បាល ត្រូវបានកត់ត្រាដែលរួមមាន ឈ្មោល ១៥ក្បាល និងញី ៦ក្បាល។ ប្រសិនបើសំណាកនៃភេទនេះ តំណាងឱ្យចំនួននៃសត្វខ្សឹបទាំងអស់ នោះចំនួននៃសត្វខ្សឹបឈ្មោលដែលបានអង្កេតនៅរដូវបន្តពូជ អាចមានចំនួន ២ភាគ៣ នៃចំនួនសត្វខ្សឹបសរុប។

កម្មវិធីសិក្សាស្រាវជ្រាវគួរតែអនុវត្តបន្ត នៅលើទីតាំងសំខាន់ៗជារៀងរាល់ឆ្នាំ។ សំណាកដដែលនៃការ៉ េដែល ធ្វើការអង្កេតនៅរដូវបន្តពូជ គួរតែធ្វើការអង្កេតនៅឆ្នាំក្រោយទៀត ដើម្បីធានានូវការប្រៀបធៀបការប្រែប្រួល។ ការ សិក្សាស្រាវជ្រាវពីគម្របដីដោយការបង្ហាញរូបភាពពីផ្កាយរណប និងការអង្កេតនៅទីវាលនៅក្នុងតំបន់បន្តពូជ និងតំបន់មិន បន្តពូជ គួរតែអនុវត្តរៀងរាល់ឆ្នាំ។

អនុសាសន៍ដែលលំអិតសម្រាប់ការអភិរក្សសត្វខ្សឹប គឺនៅក្រៅវិសាលភាពនៃរបាយការណ៍នេះនិងមិនត្រូវបាន ដាក់បញ្ចូលសារឡើងវិញនៅសកម្មភាពអភិរក្សជាច្រើន ដែលត្រូវបានអនុវត្តរួចរាល់ហើយ។ ទោះបីជាយ៉ាងណាក៏ដោយ អនុសាសន៍ដែលបានមកពីពតិមាននៃការងារសិក្សាស្រាវជ្រាវគឺរួមមាន៖

- ពង្រឹងការការពារស្របច្បាប់នៃប្រព័ន្ធតំបន់អភិរក្សសត្វខ្សឹប ដើម្បីទប់ស្កាត់គម្រោងអភិវឌ្ឍន៍ទ្រង់ទ្រាយធំ ដែលធ្វើឱ្យប៉ះពាល់យ៉ាងធ្ងន់ធ្ងរទៅដល់តំបន់អភិរក្ស និងធ្វើការជំទាស់ទៅនឹងគម្រោងទាំងនោះ ដែលបាននឹង កំពុងចាប់ផ្តើមជាពិសេសនៅក្នុងតំបន់អភិរក្សសត្វខ្សឹបជីក្រែង។
- ពង្រឹងវិធីសាស្ត្ររាយការណ៍ ដូច្នោះការចាប់យកដីដោយខុសច្បាប់ នឹងត្រូវបានរាយការណ៍បានយ៉ាងរហ័ស និងអាចត្រូវបានបញ្ឈប់ភ្លាមៗ

- ការត្រួតពិនិត្យកិច្ចព្រមព្រៀងជាមួយកសិករ ដើម្បីធានាថាពួកគាត់នឹងមិនត្រឡប់នៅធ្វើស្រែចំការ លើដីដែលពួកគាត់បានចាប់យកដោយខុសច្បាប់
- បន្តការសិក្សាស្រាវជ្រាវ ដើម្បីបង្ហាញពីតម្រូវការបរិស្ថានរបស់សត្វឪ្យឹបជាពិសេសនៅក្នុងតំបន់បន្តពូជ និងដើម្បីយល់ដឹងបន្ថែមទៀតអំពីកត្តាដែលធ្វើឱ្យមានឥទ្ធិពលដល់ការជ្រើសរើសទីតាំងពងកូននិងការហើរបង្ហូតខ្លួនរបស់សត្វឪ្យឹបឈ្មោលដែលមានទំនាក់ទំនងទៅនឹងសារព័ន្ធនៃរុក្ខជាតិដូចជាៈការប្រែប្រួលវាលស្មៅ ។

Summary

The Bengal Florican *Houbaropsis bengalensis* is a Critically Endangered species of bustard threatened by habitat loss and hunting. The majority of the world's population is dependent on grasslands located in and near to the floodplain of the Tonle Sap lake. Protected areas have been set up in order to safeguard a part of the population, conserve other rare species and maintain the access of local villages to key livelihood resources such as fisheries, agricultural land and pasture.

In February 2010 the existing provincial Integrated Farming and Biodiversity Areas (IFBAs) were recognized as conservation sites of national importance by the Ministry of Agriculture, Forestry and Fisheries (MAFF) and 312 km^2 of breeding and non-breeding habitat are now protected and managed by MAFF as Bengal Florican Conservation Areas (BFCAs). The former Veal Srongai and Kouk Presh Beung Trea IFBAs were not included in the BFCA network and are now unprotected.

Florican population monitoring in Cambodia is conducted by the Wildlife Conservation Society as an activity under a CEPF funded project, with support from other organizations and donors and in partnership with the Forestry Administration. This report summarises results of monitoring work and related activities conducted between September 2010 and December 2011.

During March-April 2011 a systematic sample count of displaying males was conducted in the four BFCAs located within breeding grounds (floodplain grasslands), as well as the former Veal Srongai IFBA, an adjacent sector of the Veal Srongai grassland block in Kampong Chhnang (in the Prey Koh Biodiversity Conservation Area) and grassland adjacent to Baray BFCA that was formerly part of Baray IFBA. A total of 67 1x1 km blocks was included in the survey, representing 25% of the total study area. Displaying males were estimated to occur at an overall density of 0.27 per km^2 within BFCAs and 0.28 per km^2 over the entire study area. Extrapolating this figure gives an overall estimate of 46 displaying males in the BFCAs (with a 95% confidence interval of 24-69 displaying males) and 78 (95% confidence interval of 46-110) displaying males in the overall study area.

The 2011 result for the BFCAs is lower than the 88 displaying males estimated for the same area in 2010, and represents a statistically significant change, and also lower than the 57 displaying males estimated for the population in 2009. Although the population in Stoung and Chikraeng BFCAs dropped back to 2009 levels (37 displaying males) from a remarkably high population estimate in 2010 (66 displaying males) this change was not statistically significant. Following a slight increase in displaying males in Baray and Chong Doung BFCAs in 2010, in 2011 the population fell to 11 displaying males, half the 2009 estimate; this change was statistically significant. Outside the BFCAs the number of displaying males apparently increased, although changes were not statistically significant. An occupancy analysis conducted using the programme Presence indicated that after three visits to each survey square 10% of displaying males are likely to have been missed. Therefore estimates of displaying males are likely to be a slight underestimate, although apparent population trends remain unchanged.

Habitat loss is probably the primary factor driving declines in the Bengal Florican population, both in the BFCAs and across the overall study area. In the BFCAs habitat conversion was

monitored through regular field visits and use of satellite images. Dry season rice expansion continued in the BFCAs during 2010/11, particularly in Chikraeng BFCA. Approximately 28% of potential breeding season habitat in the BFCAs is now under some form of intensive agriculture. Expansion of scrub was not monitored but is also of potential concern.

Under the nest protection scheme seven nests were reported by villagers and six of these were confirmed by the project team. Nest success was higher in 2011 at 43%, compared to 25% in 2010, although it is notoriously difficult to accurately assess the fate of nests. The nest protection scheme was changed slightly to reduce the possibility of disturbance to incubating birds, and this may account for the increase in nest success. Reporting payments and success bonuses to the villagers amounted to $125.

This report contains the results of both the 2010 and 2011 non-breeding season surveys. In the 2010 non-breeding season 235 km of randomly placed line transect surveys were conducted, from September to November, focusing on the two upland BFCAs, Toul Kreul-Phan Nheum and Trea-Samaki and Community Forests located to the south of them. Seven floricans comprising three males and four females were recorded although encounter rates were too low to estimate densities. In 2011 the survey methodology was changed to maximise encounter rates with floricans, to identify key sites for protection in the non-breeding season. A total of 283 km of recce transect surveys was conducted across 140 locations within 36 sites. Twenty-one Bengal Floricans were recorded, comprising 15 males and six females. If this sex ratio is representative of the population as a whole then the number of males estimated during the breeding season survey as might comprise two thirds of the population.

It is recommended to continue the monitoring program on an annual basis. The same breeding season sample squares should be surveyed in future years to ensure comparability. Land-cover monitoring based on satellite image interpretation and field surveys in both the breeding and non-breeding areas should be implemented on an annual basis.

Detailed conservation recommendations are outside the scope of this report since it does not include a review of the many conservation activities already underway. However, recommendations that can be made on the basis of findings from the monitoring work are:

- Strengthen legal protection for the existing BFCA network in order to prevent inappropriate large scale destructive development projects and reverse those that have begun, particularly in Chikraeng BFCA
- Improve reporting protocols so that encroachment is quickly reported and can be stopped
- Monitor agreements with farmers to ensure that they do not go back to farming land which they had illegally encroached
- Continue research to clarify the ecological requirements of Bengal Floricans, particularly in breeding areas, to gain an understanding of the factors that influence display and nest site selection and success in relation to vegetation dynamics such as grassland alteration, regeneration and succession.

Introduction

The Bengal Florican *Houbaropsis bengalensis* is a large grassland bird that is Critically Endangered with extinction due to rapid habitat loss and hunting (BirdLife International 2012). It occurs patchily from Nepal to Vietnam, with at least 60% of the world's population breeding around the Tonle Sap Great Lake (Gray *et al.* 2009). It is one of the highest priorities for species conservation in Cambodia.

The Bengal Florican is also an important and useful species for monitoring because:

- It and the Tonle Sap grasslands are the target of on-going conservation, habitat protection and education work
- It is an obligate grassland specialist, so monitoring may detect changes in grassland quality affecting many other species
- The display behaviour of displaying males makes them obvious and relatively easy to survey

In Cambodia the florican breeds on floodplain grasslands in the late dry season, then moves to open upland forests with a grassy understory in the rainy season. Therefore florican monitoring in the Tonle Sap consists of four aspects, all designed to provide information to guide management:

- Long-term population monitoring at protected breeding sites to detect and assess trends in numbers
- Breeding season habitat assessment
- Nest monitoring
- Surveys of non-breeding season distribution and habitat choice

Florican population monitoring in Cambodia is conducted by the Wildlife Conservation Society under contract to the Tonle Sap Conservation Project, and in partnership with the Forestry Administration, the Fisheries Administration, the Ministry of Environment, the University of East Anglia and the Angkor Centre for the Conservation of Biodiversity. This report summarises results from non-breeding season surveys in September-October 2010 and September-December 2011 and surveys of displaying males, habitat monitoring and the results of a nest protection incentive scheme carried out between March and August 2011. Three previous annual monitoring reports have been produced, for 2007-8 (Evans *et al.* 2009), 2008-9 (van Zalinge *et al*. 2009) and for 2009/10 (van Zalinge *et al*. 2010). An annual project report summarises all conservation activities in 2010-11 (Hong Chamnan *et al.* 2011).

The status of Bengal Florican in Cambodia

The Bengal Florican was first recorded in Cambodia in 1928 and following this there were scattered records up until the 1960s (Gray *et al.* 2009). After the period of civil unrest, they were rediscovered in 1999 in Banteay Meanchey Province (Goes and Sam Veasna 1999). Since then several surveys have been conducted, culminating in a major systematic breeding season survey across the whole Tonle Sap floodplain and nearby areas during 2006 and 2007 (Gray *et al.* 2009).

The survey found 20 areas with displaying floricans in six provinces and on the basis of available habitat estimated the total population to be 416 displaying males in 2005, about half of them in Kampong Thom Province. Outside of the floodplain fewer then ten displaying males are known from two small sites, Ang Trapeang Thmor and Boeung Prek Lapouv. Very rapid habitat loss was recorded in most of the main areas during this period and so by 2007 the Tonle Sap population was estimated as only 294 displaying males, based on extent of suitable grassland. Habitat is known to have declined further since then. Another range-wide survey, following the same methodology as Gray *et al.* (2009), was conducted in March-May 2012.

The principal threats to the florican are habitat loss and hunting. Hunting was initially the greatest threat, but was rapidly brought to a low level by conservation measures. Habitat loss, largely due to expansion of intensive farming, is now the most significant threat to the florican population in Cambodia. Since 2004 there has been a rapid expansion of large-scale intensive farming including irrigated dry-season rice (with associated channels and earth dams) and eucalyptus plantations. Such habitats are wholly unsuitable for floricans and also displace existing traditional uses by local communities. Floricans can survive in some areas of low intensity farming and seasonal burning of grasslands by people to prevent scrub encroachment appears to be beneficial (Gray *et al.* 2007).

In February 2010 the existing provincial Integrated Farming and Biodiversity Areas (IFBAs) were recognized as conservation sites of national importance by the Ministry of Agriculture, Forestry and Fisheries (MAFF) and 312 km^2 of breeding and non-breeding habitat are now protected and managed by MAFF as Bengal Florican Conservation Areas (BFCAs). This was a major step forward. The former Veal Srongai IFBA and Kouk Presh Beung Trea IFBAs were not included in the BFCA network and are now unprotected. A part of the Baray IFBA was also excised at this time (see Table 1 and Figure 1).

The BFCAs protect existing grassland management systems. New large-scale earth dam projects are not permitted, but economic land concessions already given by the provincial government were allowed to continue operating. Use by local communities is encouraged to continue under co-management frameworks. The two non-breeding BFCAs overlap to some extent with Community Forests.

Table 1. Name and size of current Bengal Florican Conservation Areas

BFCA	Province	Size (ha)
Bengal Florican Breeding Habitat		
Chikraeng	Siem Reap	4,636
Stoung	Kampong Thom	2,812
Chong Doung	Kampong Thom	2,569
Baray	Kampong Thom	7,314
Sub-total Breeding Habitat		17,331
Bengal Florican Non-breeding Habitat		
Trea-Samaki	Kampong Thom	11,138
Toul Kreul-Phan Nheum	Kampong Thom	2,690
Sub-total Non-breeding Habitat		13,828
Grand Total		*31,159*

Methodology

Methods are detailed in Gray and Hong Chamnan (2007) and summarised here with some alterations.

Long-term monitoring at breeding sites

Floricans occupy breeding sites from at least December to June or July, with the actual period depending on the timing of the annual inundation of the floodplain grasslands. From late February onwards the males begin to make conspicuous mating displays, allowing density to be estimated. The males display in territories that have been estimated at around 1.6 km^2, therefore a systematic sampling design with a random start point comprising $1km^2$ grid squares with two kilometer spacing between each survey square is considered appropriate for surveys. Survey squares were originally chosen in 2008 and the same squares are monitored on an annual basis during the peak display season (mid-March to early May). The trend in density of displaying males is probably a good index of overall trends in the breeding population in the area surveyed, although this assumption should be tested periodically, if possible. Changes between years were tested for significance using two-tailed paired samples t-tests at the 5% significance level.

We attempted to survey all sample squares within the BFCAs, even if habitat was suboptimal. This allows estimation of the mean density per 1 km square (and hence total number) of displaying males across the whole area covered by the BFCAs. Each sample square was visited three times and presence/absence of displaying (displaying) males recorded by different observers on each visit. This was expected to give a very high probability of recording any displaying males present at least once, since previously established protocols assume 100% detectability after two visits (Gray and Hong Chamnan 2007). The survey design also allows analysis under an occupancy framework (MacKenzie *et al*. 2006), which allows us to test the assumption that all displaying males within occupied squares are detected. This allowed us to calculate detection rates at all the survey sites and for the survey area as a whole. Correction factors derived from these are used to calculate occupancy rates corrected for detection rates, and from these corrected estimates of the number of displaying males are calculated.

Displaying birds are detected visually, with wing flapping and calls sometimes aiding their detection. To confirm the presence of a displaying male within the boundaries of the survey square a range finder and compass was used to estimate location of the bird from known observer location. If there was no point of reference near to the bird for targeting with the range finder, actual display locations were checked with a GPS. The number of non-displaying floricans and other large waterbirds seen during monitoring activities was also recorded.

Although some former conservation areas were not included in the final declaration creating the Bengal Florican Conservation Areas in February 2010 and some boundary changes were made to others, we chose to conduct a full repeat of the 2010 survey, including the five extra squares in the Veal Srongai grasslands which were surveyed for the first time in that year. Therefore sixty-seven sample survey squares were included in the 2011 survey. Uncorrected occupancy rates and estimates of the number of displaying males in each of the survey sites and across the survey area are reported based on these sample squares.

Breeding season habitat assessment

Construction of dams/channels and expansion of irrigated rice has been mapped as comprehensively as possible from patrol team observations and inspection of satellite images. Other forms of change (such as intensified ploughing for deep water rice production and increased scrub cover) are difficult to map with this approach so the results of a new systematic habitat cover assessment developed by Packman *et al.* (in press) are reported.

Nest monitoring and protection

Floricans nest on the ground during the late dry season but nests often fail. Giving cash incentives to individuals to protect nests that they find is a conservation measure that has been tried on a small scale with floricans (since 2004) and on a larger scale with some other species in Cambodia (Clements *et al.* 2007). It can potentially improve nest success, increase community support for conservation and generate useful biological information.

When a nest is reported the project team checks the nest and the number of eggs and date of finding is recorded. The finder is paid a reward of $15 per egg. The scheme was changed slightly in 2011 and the CMC was made responsible for the protection of the nest and receives a similar reward if the eggs hatch successfully. Normally, the monitoring officer will then check the nest at intervals of 3-5 days together with the finder until the fate of the nest is decided (i.e. the chicks hatch and leave the nest, or the eggs are predated, destroyed or abandoned). During 2010 eggs were weighed and measured, whenever possible, so as to get an approximate lay date and work out a rough date of hatching following formulae prepared for Houbara Bustard *Chlamydotis undulata* (Combreau *et al*. 2002). However, it was thought that this practice might be contributing to low nest success and it was discontinued. Hatching is considered successful when eggshell fragments are found at the nest site without any clear indication of predation, or if a live chick is found on or near the nest, but this rarely occurs. After the nest is empty, habitat variables are measured.

In 2011 the nest protection scheme was widely publicised during village level extension meetings held across all the BFCAs. All members of the team are open to receive reports, which are then passed on to the project manager who notifies the conservation officer to monitor the nest. From 2010 the BFCA community management committees were active in the Stoung-Chikraeng area and were in most cases the first to receive information of a nest having been found, which was then passed on to the project team.

Surveys of non-breeding season habitat

Floricans leave the breeding areas after the breeding season, as the grasslands slowly flood. Non-breeding season records only come from a few areas, almost all within Kampong Thom, but it seems likely that there are other sites yet to be found, there and in other provinces (Gray and Hong Chamnan 2007). Known sites are in grasslands, grassy scrub and open deciduous forests, but precise habitat preferences are less well understood than for breeding areas. Floricans are much less conspicuous in the non-breeding season so surveys are very laborious, and take place when access conditions are difficult. It is not feasible to monitor population sizes or densities given current resources and limited biological knowledge. Therefore the aim of the non-breeding season surveys is simply to:

- determine non-breeding season distribution (in particular, finding sites with high concentrations of floricans);
- identify broad-scale habitat preferences;
- improve understanding of threats, particularly land-use change.

In September-November 2010 transect-based count data were collected from multiple 1.5 km transects following the same methodology as in the previous two years. Transects were located within and in close proximity to the two new BFCAs in non-breeding habitat.

Owing to a very low encounter rate with floricans on transects, the non-breeding season survey methodology was changed in 2011. Instead of monitoring established transects, survey sites were located in non-breeding BFCAs and Community Forests where Bengal Florican had been reported by local people, or where satellite tagged individuals had been recorded. At each potential survey location villagers were interviewed to determine if they had recently seen Bengal Florican or if suitable habitat existed. Where there were reports, or where there was suitable habitat, the survey team (Sun Virak and at least one local guide) walked a zigzag transect through the habitat that looked most promising.

Regardless of the method used to locate transects, the method used to survey floricans in both 2010 and 2011 was the same. A team of 2-3 observers forming a line perpendicular to the direction of movement, with observers keeping a distance of approximately 20 meters between each other, following the protocol set out by Gray and Hong Chamnan (2007). The transect surveys have a very limited effective strip width with floricans only being flushed from the grasslands in the immediate vicinity of the researchers.

Field survey data were augmented with data from 14 satellite tagged floricans collected throughout the 2010 and 2011 non-breeding seasons.

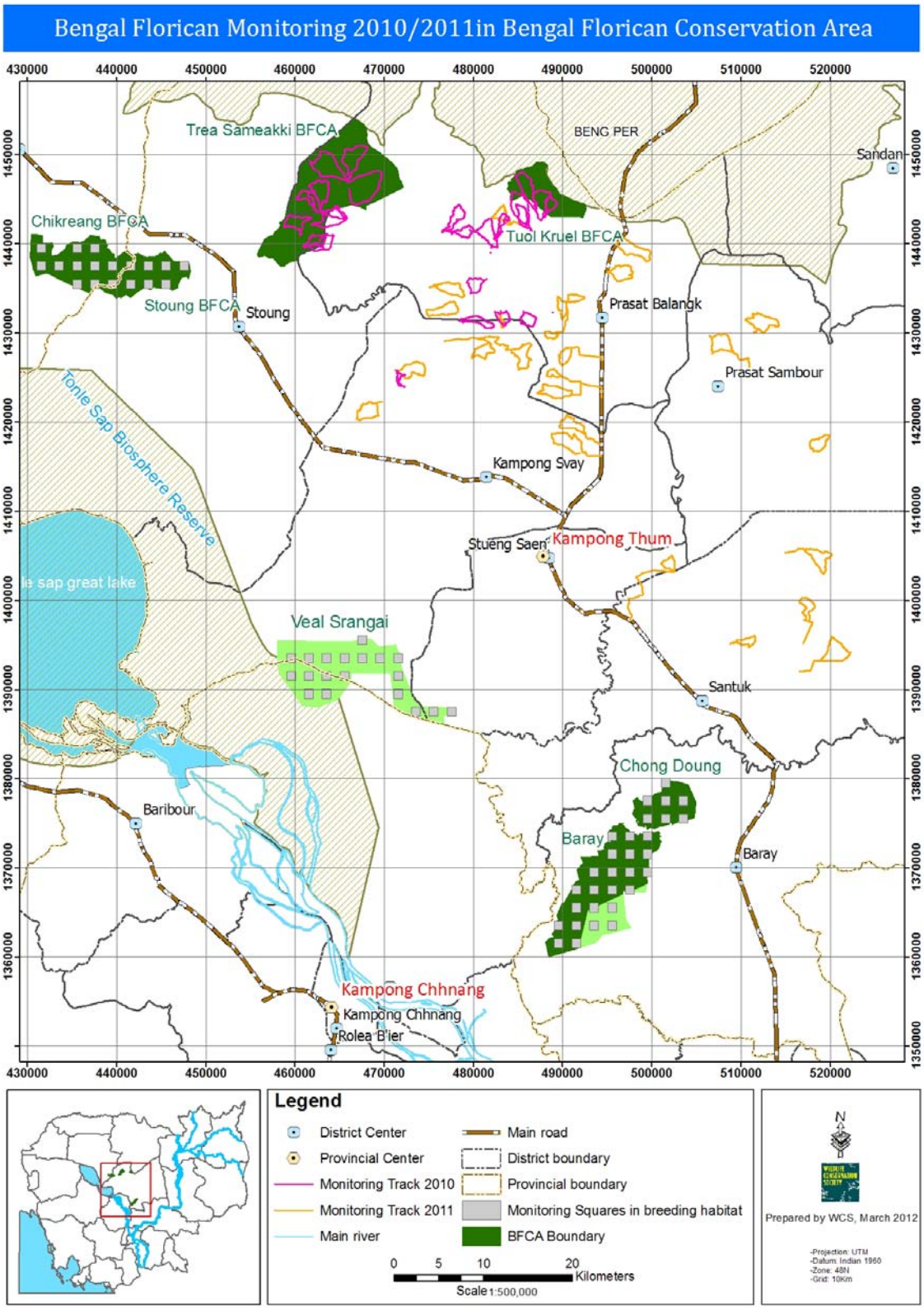

Figure 1. Location of 2011 breeding season monitoring squares and 2010/11 non-breeding season transects in relation to BFCAs.
Note: Pale green denotes former IFBAs.

Results

Long-term monitoring at breeding sites

Surveys ran from mid March to early April 2011 with four surveyors participating on a continuous basis and assistance from two other surveyors in Veal Srongai and Baray and Chong Doung BFCAs. Results are shown in Table 2, Figure 2 and Appendices 1-6. Of the 67 target squares, seven squares were not surveyed and conservatively given a zero value (not occupied) because owing to habitat characteristics they were very unlikely to support floricans. Two of these squares were located in flooded forest or scrub and two were entirely covered by irrigation ponds rendering them entirely unsuitable for floricans, whilst another three were impossible to access). Eleven squares were surveyed only twice and all other squares were surveyed three times with the maximum number of floricans on any one-day used in the analysis.

The population estimate is 78 displaying males across the whole study area, a decrease from the 107 estimated in 2010, but similar to the 80 displaying males estimated in 2009. Of these birds a little over half (46) are located in the BFCAs (down from 57 in 2009 and 88 in 2010). Although changes in the number of displaying males in the BFCAs between 2010 and 2011 were statistically significant ($p=0.03$), across the overall study area during the same period changes were not ($p=0.109$). Between 2009 and 2011 changes in the number of displaying males in the BFCAs were not significant ($p=0.372$) and during the same period the change in the number of floricans was unsurprisingly also not significant ($p=0.784$). Marked declines took place in Baray and Chong Doung (22 displaying males in 2009 increasing slightly to 26 in 2010 and then falling to 11 in 2011 ($p=0.043$ for the period 2010-11, $p=0.083$ for 2009-11)), although these may have been partially offset by increases in the estimates of the number of displaying males outside the BFCAs (5 displaying males in 2009 and 4 in 2010 increasing to 17 in 2011 ($p=0.83$ for the period 2010-11, $p=0.165$ for 2009-11)). In 2011 the estimated number of displaying males in Stoung-Chikreang BFCAs returned to 2009 levels (37 displaying males, $p=1.00$) from the unprecedented high estimate obtained in 2010 (66 displaying males, $p=0.032$).

A preliminary analysis of the data in an occupancy framework was conducted (Appendix 7). Trends in the proportion of squares occupied were similar to those noted for estimated absolute density, although numbers of displaying males corrected for detection probability are slightly higher. Probability per visit of detecting at least one bird in a square that is occupied was 0.53 in 2011, decreasing from 0.63 in 2010, but the same as it was in 2009.

Table 2. Comparison of results from breeding season surveys in 2009, 2010 and 2011

Survey Area	Number of squares surveyed*			Density of displaying males per km^2			Significance of change 2010-2011	Estimated number of displaying males^		
	2009	2010	2011	2009	2010	2011		2009	2010	2011
Stoung-Chikraeng BFCAs	17 (18)	18	18	0.50	0.89	0.50	Not significant (p=0.30)	37 (18 – 57)	66 (41 – 91)	37 (18 – 56)
Baray-Chong Doung BFCAs	26 (27)	26 (27)	27	0.22	0.26	0.11	Significant (p=0.043)	22 (5 – 39)	26 (5 – 46)	11 (0 – 24)
Overall BFCAs	43 (45)	44 (45)	45	0.33	0.51	0.27	Significant (p=0.03)	57 (33 – 83)	88 (55 – 122)	46 (24 – 69)
Veal Srongai and Prey Koh Conservation Area+#	12	19	19	0.08	0.05	0.21	Not significant (p=0.83)	5 (1 – 15)	4 (0 – 13)	17 (1 – 39)
Baray-outside BFCA	3	3	3	0.67	0.67	1.00	-	-	-	-
Overall study area+	58 (60)	67	67	0.30	0.39	0.28	Not significant (p=0.109)	80 (50 – 110)	107 (67 – 147)	78 (46 – 110)

* Numbers in parentheses are the total number of squares used in data analysis. Squares that were partially surveyed, but where conditions were unsuitable for Bengal Florican presence, were conservatively assumed to be unoccupied. Squares that were not accessed and site condition not determined on the ground, were left out of the analysis (two squares in 2009)

^ Numbers in parentheses are the 95% confidence interval

+ The 2010 density estimates have been re-calculated using results from five extra squares in Prey Koh Conservation Area which were not presented in van Zalinge *et al*. (2010) to allow better comparison with 2011.

2009 results do not include the five extra squares surveyed in the Prey Koh Conservation Area sector since 2009.

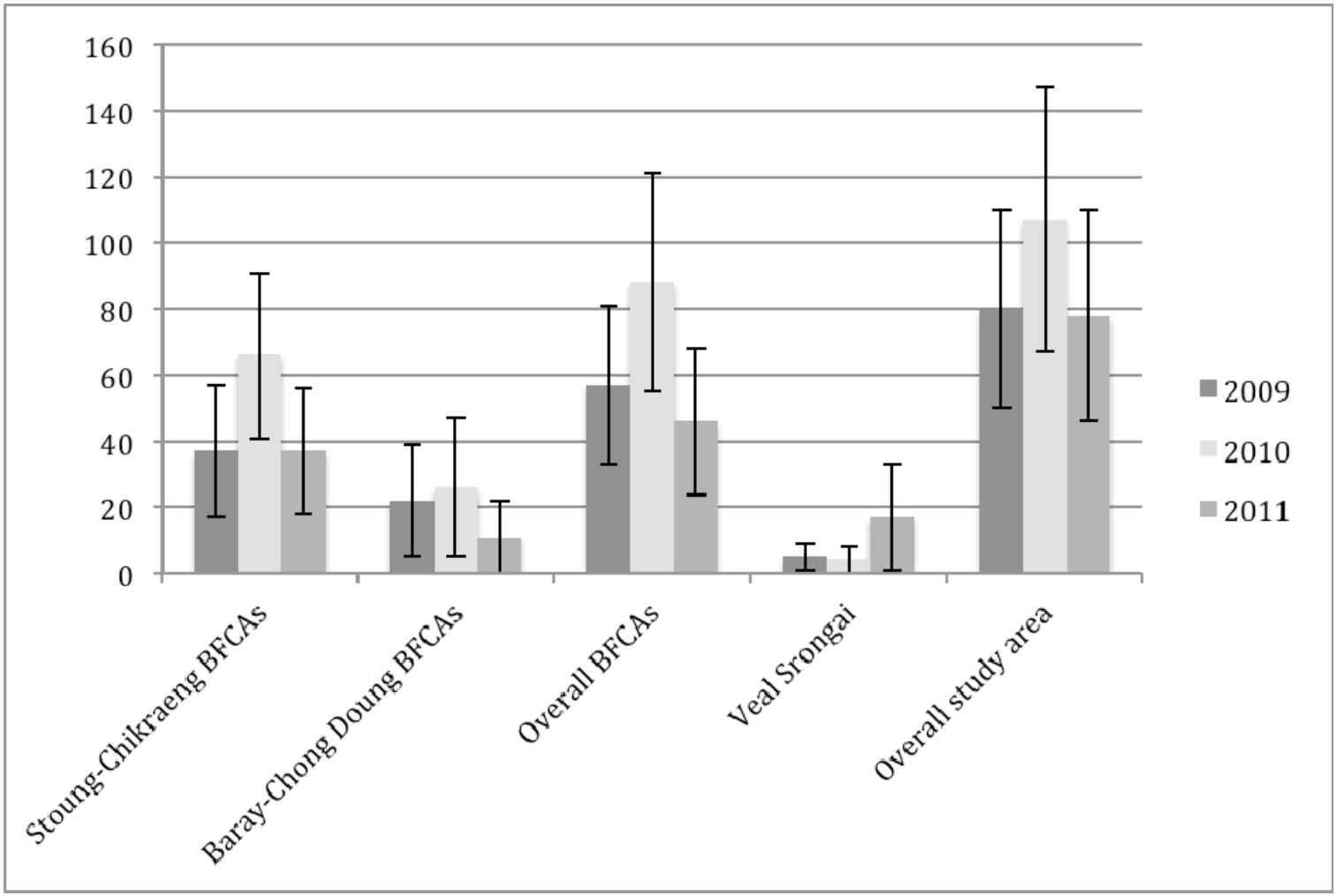

Figure 2. Graph of estimated number of displaying males, with 95% confidence intervals, for survey areas in 2009, 2010 and 2011

Breeding season habitat monitoring

Following expansion of dry-season and deep-water rice cultivation in the BFCAs since 2009, large areas of grassland has been lost. Maps of the distribution of rice within the BFCAs (Figures 3 and 4) reveal the extent of this encroachment, and data are quantified in Tables 3a and 3b. Tables 3a and 3b include the area of legal rice cultivation, namely that started before the deika that put the BFCAs into law, and not just encroachment since the BFCAs were established. The area of Chikraeng BFCA under cultivation stated in Table 3 is probably a slight over-estimate since it assumes that all area in the western sector is under rice cultivation. Although this is very nearly the case, detailed mapping of this area was not complete at the time that this report was produced and there are undoubtedly areas of scrub and perhaps even grassland remaining in this sector. In contrast, the area of Baray and Chong-Duong BFCAs under cultivation stated in Table 3 is likely to be an under-estimate, again because survey is incomplete. The total area of potential Bengal Florican breeding habitat that is now under intensive cultivation within the breeding season BFCAs is approximately 4,781 ha or 28%, although there is considerable variation in the proportion of grassland that has been converted to rice cultivation between BFCAs.

Table 3a. Annual extent of encroachment in BFCAs

BFCA	Developments in BFCAs*			
BFCA	Pre July 09	Jul 09-Jun10	Jul 10-Dec11	*Dec 2011 Total*
Stoung	111 ha	97 ha	29 ha	*237 ha*
Chikraeng	1,017 ha	916 ha	248 ha	*2,181 ha*
Baray	388 ha	462 ha	613 ha	*1,463 ha*
Chong Doung	242 ha	408 ha	250 ha	*900 ha*
Total	*1,758 ha*	*1,080 ha*	*1,140 ha*	*4,781 ha*

* *Source is a combination of field data and satellite imagery (Landsat 7 from January 2012)*

Table 3b. Cumulative percentage of land in BFCAs under cultivation

BFCA	Cumulative percentage of land under cultivation		
BFCA	Pre July 09	Jul 09-Jun10	Jul 10-Dec11
Stoung	4%	7%	8%
Chikraeng	22%	42%	47%
Baray	5%	12%	20%
Chong Doung	9%	25%	35%
Total	*10%*	*21%*	*28%*

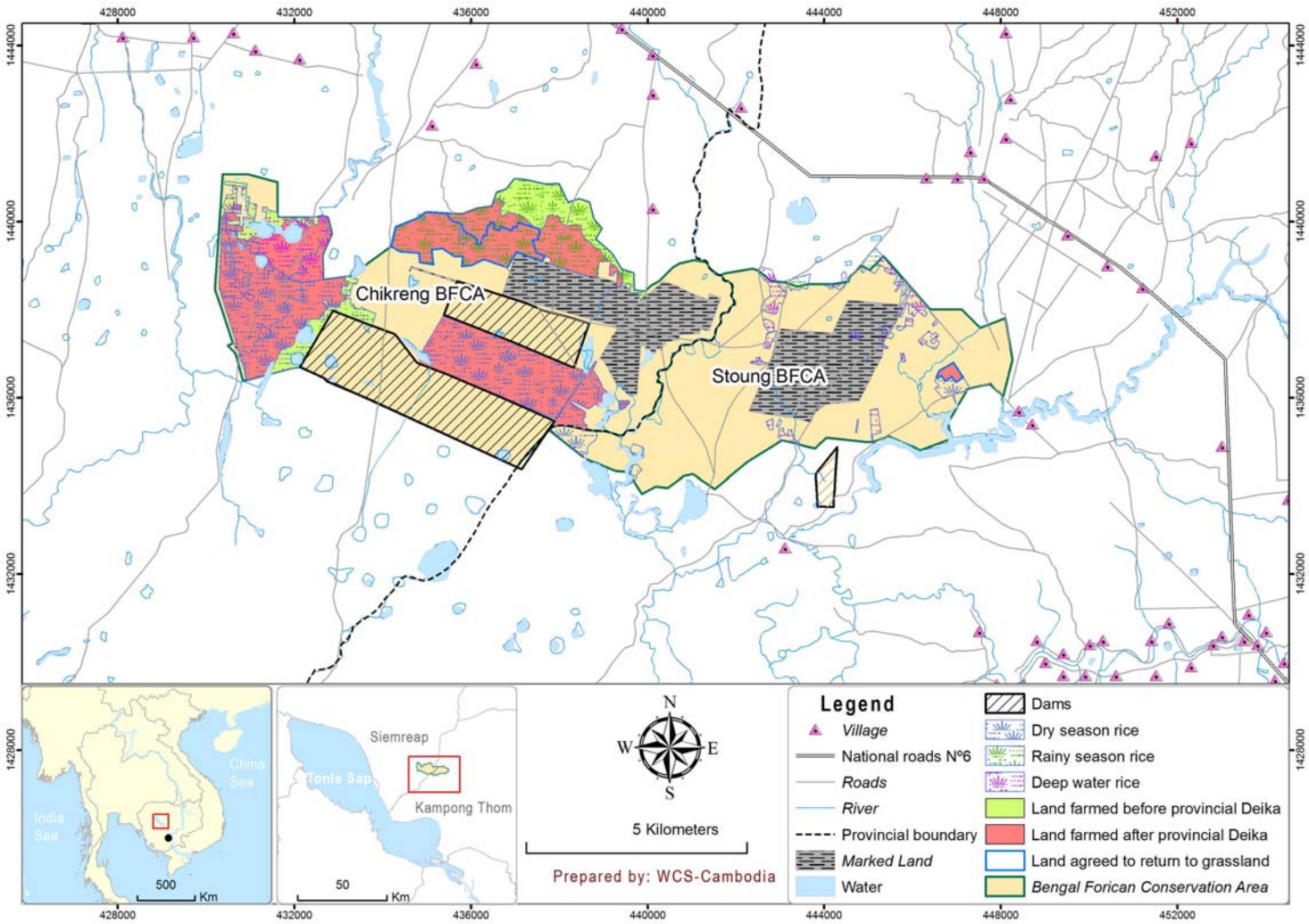

Figure 3. Encroachment in Stoung and Chikraeng BFCAs. Note that "Marked Land" is illegally allocated for development by some official but is currently still under natural grassland.

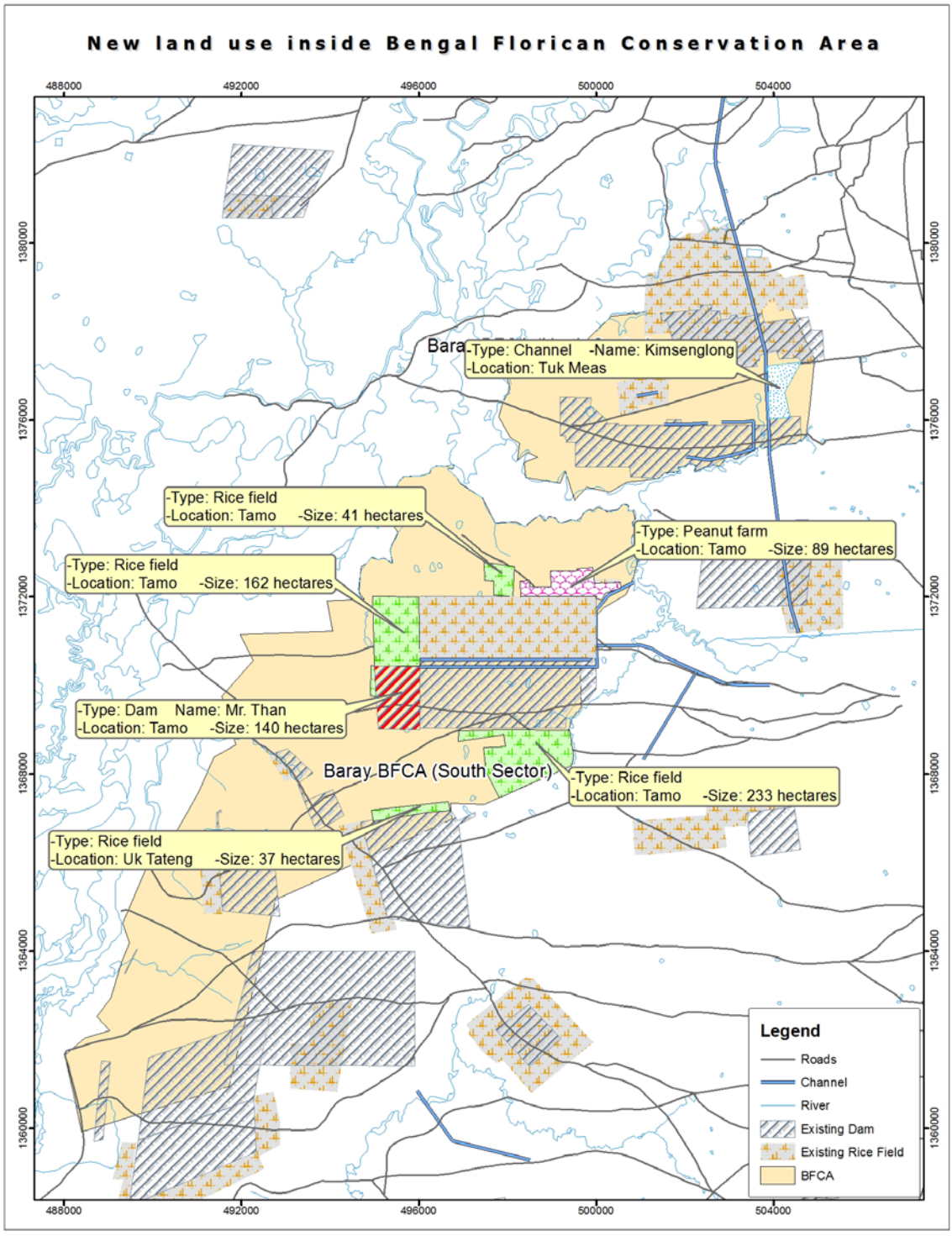

Figure 4. Encroachment in Baray and Chong-Doung BFCAs.

Nest monitoring

Seven Bengal Florican nests were found in 2011. Other than one nest that had two eggs, all others had only one. Because it was feared that people paid to protect nests were inadvertently contributing to nest failure, in 2011 nests were not actively protected by the finders but instead were regularly checked by WCS staff and CMC members. Of the nests reported, three were probably successful since the female was regularly seen incubating the nest until eggshell fragments were found nearby. One recently hatched chick was reported by a villager at a third nest site and this probably represents a successful nest, although the finder was not paid because the chick and eggshell fragments could not be found by WCS staff. Of the other three nests two were probably unsuccessful because the female was only seen incubating occasionally and no evidence of eggs or chicks was found, whilst the third reported nest was not seen by WCS staff. This equates to a success rate of up to 43% although this figure should be treated with caution. In total $125 was paid to villagers who reported nests. Amounts paid were variable depending on outcome and certainty. Table 5 summarises the results for each nest monitored.

Table 5. Results of the florican nest protection program in 2011

BFCA	Date found	Date of fate	Eggs	Fate	Paid	Notes
Stoung	24.04.11		1	Successful	$30	Incubating female seen regularly. Eggshell fragments on the last day
Stoung	29.04.11	30.04.11	1	Possibly predated	-	Nest reported, but not seen during checking, possibly predated
Chikreang	7.05.11		1	Successful	$30	Incubating female seen regularly. Eggshell fragments on the last day
Stoung	1.06.11		1	Probably successful	-	A chick and fragments of eggshell reported by villager but not seen during checking.
Stoung	3.06.11	23.06.11	2	Undetermined	$20	Incubating female seen occasionally
Stoung	15.06.11		1	Successful	$30	Incubating female seen regularly. Eggshell fragments on the last day
Stoung	9.07.11	23.07.11	1	Probably predated	$15	Nest located next to track, no eggs or chicks seen
Totals			*8*	*c.3 successful*	*$125*	

Surveys of non-breeding season areas 2010

From September to November 2010, 235 km of line transect surveys were conducted in suitable habitat (grasslands or grassland mosaic mixed with rice fields and very open deciduous forests) in areas located beyond the Tonle Sap floodplain in Stoung and Prasat Balang districts, Kampong Thom province. The survey area was limited to potential areas in or near to the Trea-Samaki and Toul Kreul-Phan Nheum BFCAs. No surveys were done in Baray, where areas have recently been identified that floricans move to in the non-breeding season (Packman 2011). The wet season started late and was not very severe and data from satellite-tracked floricans indicated that only five out of fourteen floricans, or 36%, migrated out of the floodplain (Packman 2011). This probably impacted on the number of floricans encountered during non-breeding surveys in 2010 because these surveys focussed on the traditional non-breeding season distribution. Data from the survey are presented in Appendix 8 and Figure 5. Seven floricans were recorded, comprising three males and four females. The location of encounters with Bengal Floricans during surveys is very similar to last year, with most birds found in the southern section of Trea-Samaki BFCA and adjacent areas, with other encounters in the area southwest of Toul Kreul-Phan Nheum BFCA and grasslands around Thnal village.

The team also asked Community Forest Management Committee members and other local guides that participated in surveys about florican presence in their areas. Several areas were mentioned and when location was established these are shown in Figure 5. Small groups of Painted Storks and Woolly-necked Storks were found at various locations within the forest/grassland/agriculture mosaic and one group of Asian Openbills was seen in an area dedicated to wet-season rice cultivation.

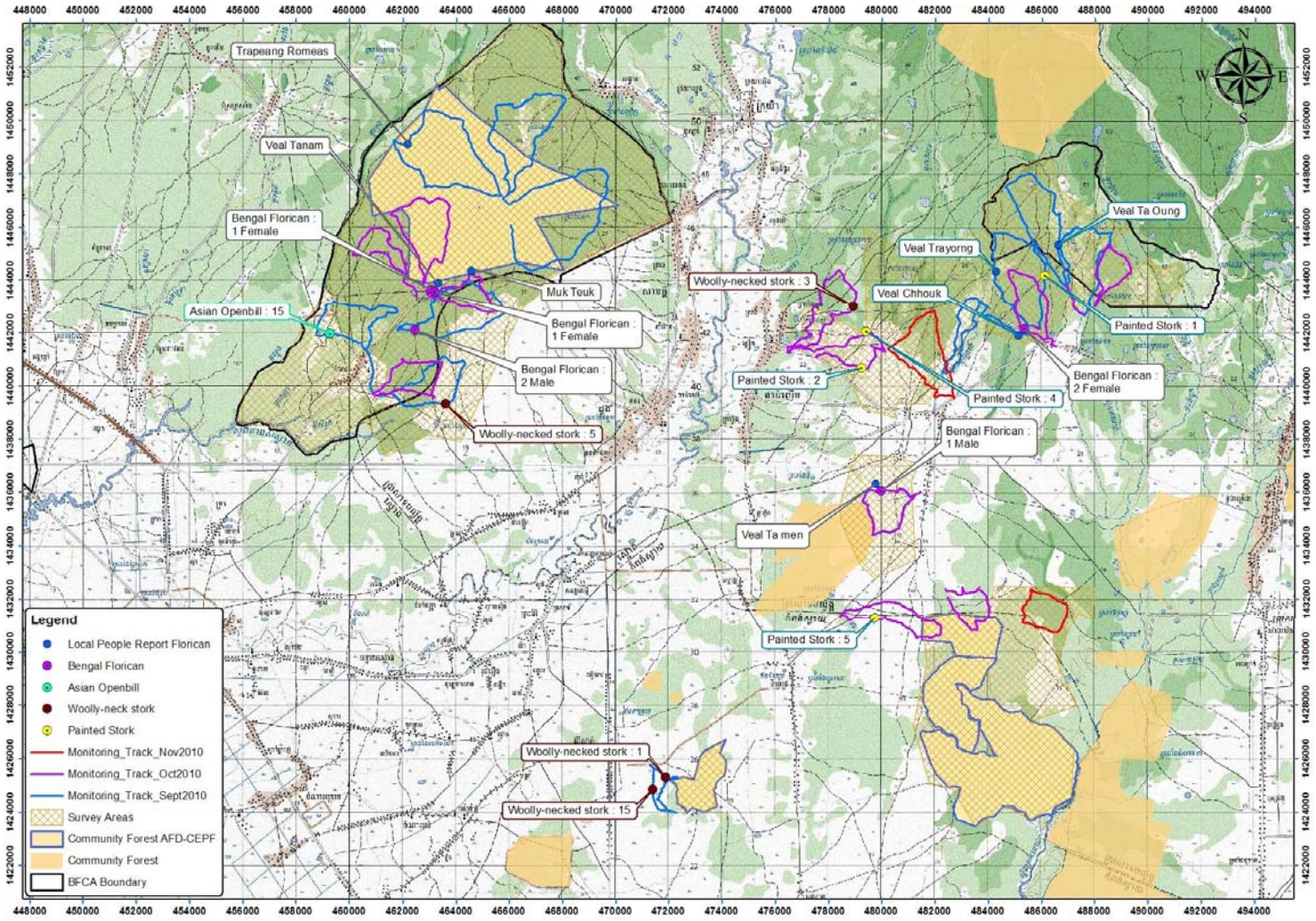

Figure 5. Results of the 2010 non-breeding season survey.

Surveys of non-breeding season areas 2011

From September to December 2011, surveys were conducted in suitable habitat in areas located beyond the Tonle Sap floodplain in Stoung and Prasat Balang districts, Kampong Thom Province. Transects with a total length of 283 km were walked. Thirty-five sites were visited and within these 140 locations were surveyed. Of these, habitat that looked suitable for floricans was found at 98 locations. Twenty-one floricans comprising 15 males and six females were seen at 15 locations spread over 15 sites. Local people reported an additional nine birds (some of which might have been the same individuals as recorded during the survey) at five additional locations (two additional sites), comprising six males, one female and two birds whose sex was not recorded (Appendix 9). Reported floricans were only included in the data when informants were able to provide a specific number of individuals seen and where the reported sighting had taken place during the month prior to the survey. Data are presented in Figure 6.

Five additional species of conservation concern were recorded during the 2011 non-breeding season Bengal Florican survey. The most notable was a record of two White-shouldered Ibis *Pseudibis davisoni* on 25th November at Trapeang Tul UTM (0499744 1438290), Munty Knong Community Forest. It is unknown whether these birds are resident at this site or if they were birds from Baray BFCA that had dispersed from the flooded grassland and scrub on the margin of the Tonle Sap Lake. Sixteen Lesser Adjutants and 8 Greater Adjutants seen together at Veal Neak Ta Kanil (0467597 1421977), Prey Hurm Community Forest, on 26th November was a relatively high count of both species. Although the latter species was not recorded from any other sites, a total of 24 additional Lesser Adjutants were recorded at four other sites. A total of 89 Painted Storks were recorded from 10 locations. Black-headed Ibis was recorded only once with nine birds near Dum Tum village (at 0515889 1371837) and the same location held the highest count of Wooly-necked Stork, 25, on 23rd November.

By compiling all records obtained during 2008-2011 from field surveys as well as radio and satellite telemetry data (the latter two being part of a research project being implemented by Charlotte Packman and the University of East Anglia) inferences can be made regarding the distribution of Bengal Floricans in the non-breeding season (Figure 7). There are no records from Toul Kreul-Phan Nheum BFCA and most records from community forests have been towards the edge of the sites.

Habitat trends in the non-breeding range of the Bengal Florican are less well understood than those in the breeding areas. However, the conversion of grassland to dry-season rice and plantation agriculture is known to be extensive. Open deciduous dipterocarp forest is also being cleared to make way for agriculture, although this probably temporarily results in suitable florican foraging habitat when the plantation is young.

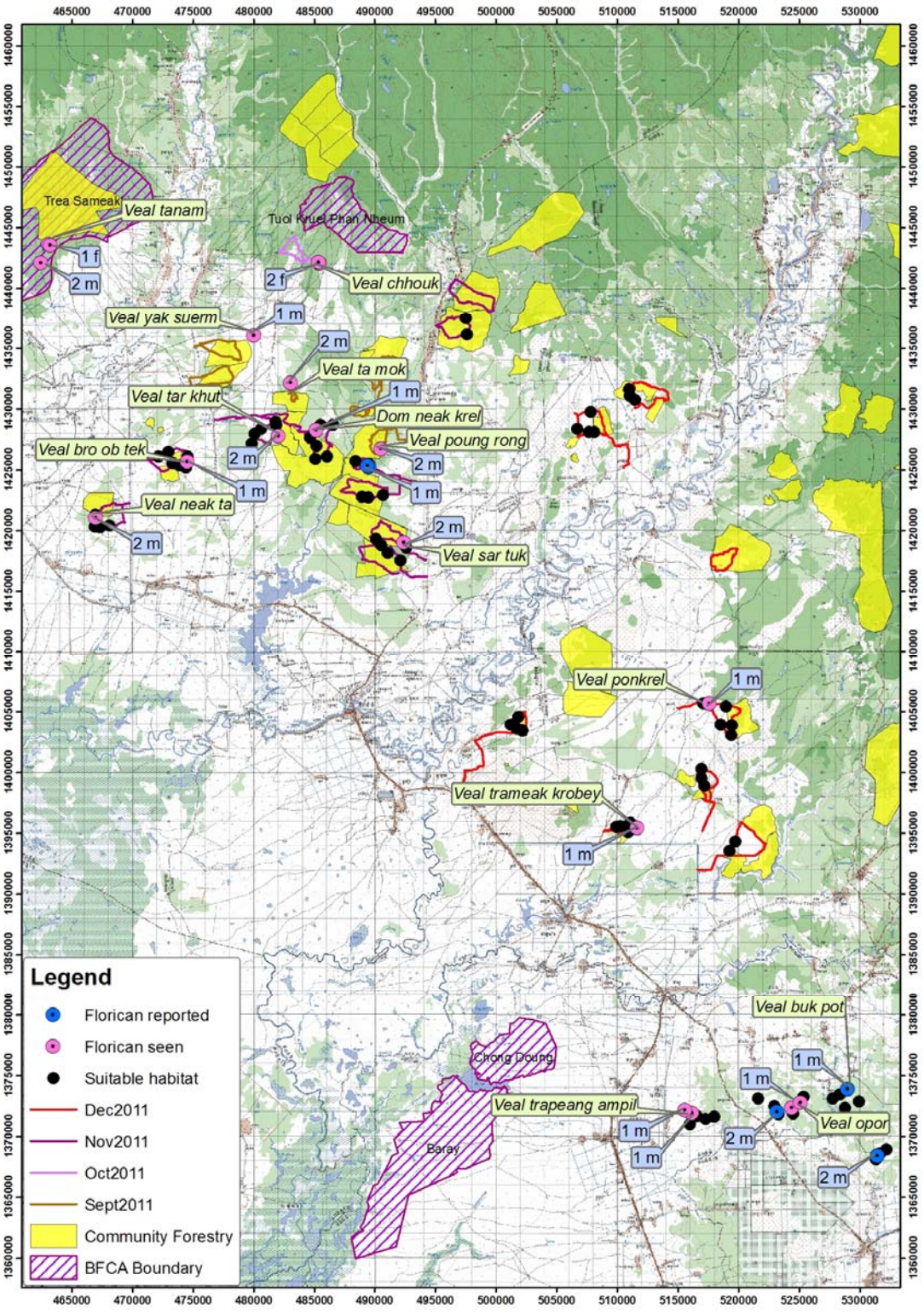

Figure 6. Results of the 2011 non-breeding season survey.
Note: all labelled locations supported Bengal Florican.

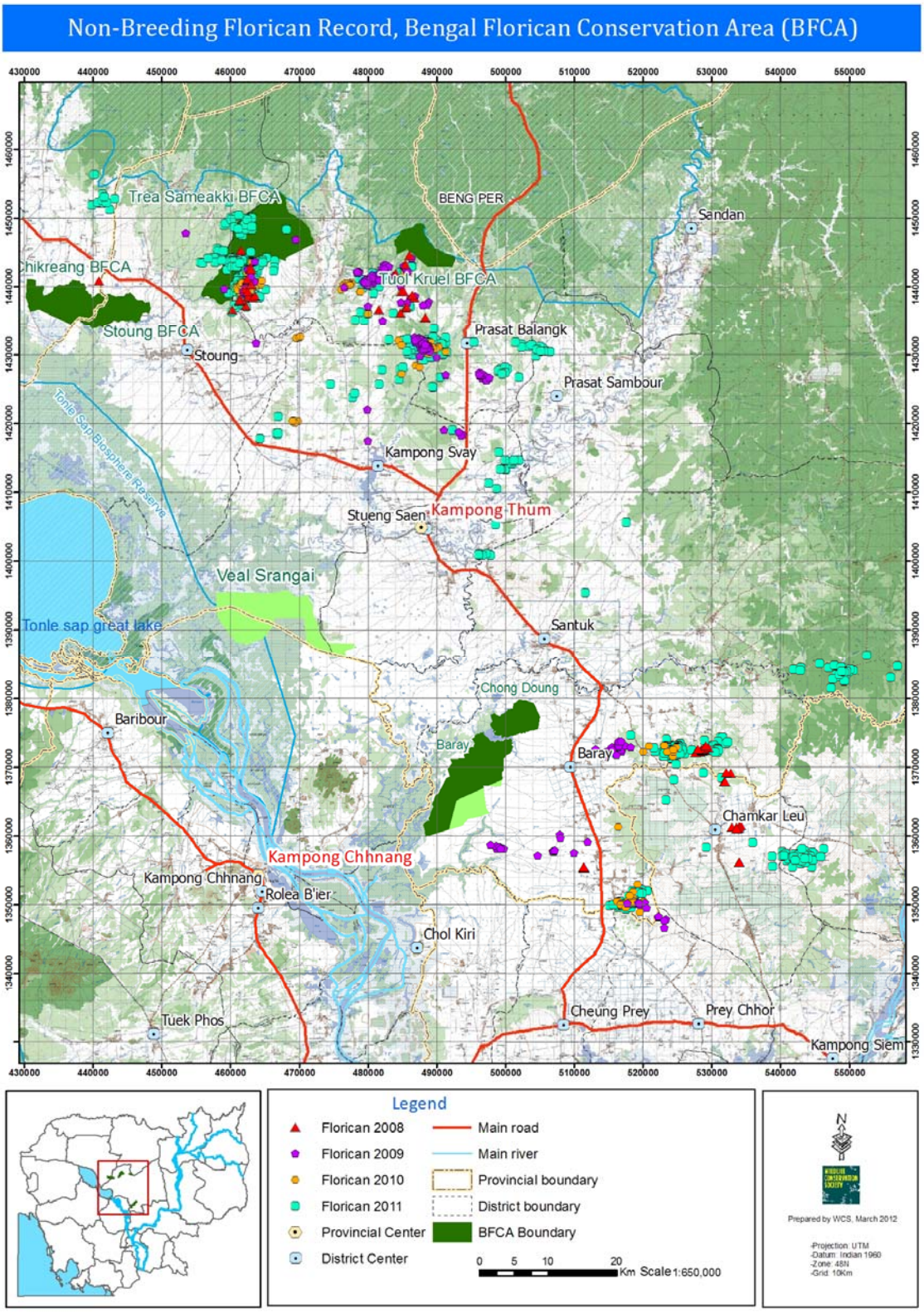

Figure 7. Bengal Florican records from the 2008 - 2011 non-breeding seasons

Discussion

Habitat change

Grassland habitats in the Tonle Sap floodplain remain very highly threatened, both inside and outside the BFCAs. Table 3 indicates that the situation is worst at Chikraeng BFCA where 47% of the protected area is now under rice cultivation. In the western sector of Chikraeng BFCA local people repaired an irrigation canal previously destroyed by the provincial authorities, and used this water to illegally extend the area under rice cultivation so that it destroyed all or almost all of the remaining grassland in that area of the BFCA. This was confirmed by a field visit in early 2012. Local authorities and commune heads have agreed that the irrigation canal can be destroyed after the current rice crop has been harvested and after the national commune election in June. The area of deep-water rice cultivation in the centre of Chikraeng BFCA was illegally expanded in 2011 or 2010. Since a powerful company owns this area with permission from the agriculture department in Siem Reap Province it will be difficult to return this area to grassland. In 2011 in the northern part of Chikraeng BFCA local people ploughed 289 hectares of grassland adjacent to existing rain-fed rice cultivation. The rice they planted on this land failed to grow properly and in early 2012 they agreed to allow this area to return to grassland. The adjacent rain-fed rice cultivation has been illegally cultivated since 2010. In 2011 local people agreed to abandon rice cultivation in this area, but they planted rice again and now wish to continue cultivating this area. The on-going loss of habitat in Chikraeng BFCA is a cause for concern because together with Stoung, it is the single most important site for Bengal Florican in Cambodia. Stoung BFCA has seen very little encroachment during 2011 and the overall proportion of land under cultivation remains very low. In 2011 30ha of grassland was taken for rice cultivation in the eastern side of the protected area, and local people have agreed to abandon this area in 2012. However, the safety of this BFCA is far from secure because a company that illegally obtained permission to cultivate dry season rice over a large area repeatedly attempt to the get the block on this development removed.

In Baray BFCA existing dry-season rice fields were expanded in four places, destroying 613 hectares of grassland, nearly doubling the area of dry-season rice cultivation in the BFCA. To service these areas a ditch and dam were expanded and an additional 140 hectares of grassland permanently flooded as a water storage area. Owing to the already low population of Bengal Floricans in Baray, any additional grassland loss is a cause for concern, especially because it is most likely to affect areas of optimal florican habitat rather than the more difficult to farm scrub. In addition, grassland loss in Baray BFCA is likely to have been more extensive than documented in this report owing to incomplete mapping of encroached areas. This will be rectified in 2012. Cultivation of peanuts requires large amounts of water, so head ponds are likely to be as necessary for this crop as for dry-season rice, however, they do not require land to permanently flooded as rice does. In Chong-Doung BFCA an additional area of grassland was destroyed by the expansion of a channel for collecting water to service an existing area of dry-season rice. A third of the area of this BFCA was under rice cultivation by the end of 2011.

Nest monitoring

Seven nests were reported in 2011, containing eight eggs. This is less than in 2010 when ten nests with thirteen eggs were reported, but much more than in 2009 when only two nests were

reported. All of the nests were found in Stoung or Chikraeng BFCAs where community management committees were formed in 2009 and the project is most active. Community management committees will be formed in Baray and Chong Doung BFCAs in early 2012 and it is hoped that they will be begin reporting nests from those sites.

Although the number of nests reported was lower than last year, nest success was higher, at 43% rather than 25%. However the sample size is very small and accurately determining the success of nests is difficult and subjective and these figures should be treated with caution. If a female was seen regularly incubating the nest and then following incubation egg fragments were found close to the nest site it was assumed to have hatched successfully, although it might have been predated by rats at a late stage in incubation. This is still a low rate for bustards, despite the nest protection system in place. Nesting success for Houbara Bustards has been reported as 58%, with annual variation from 35-88% (Combreau *et al*. 2002) and as 50% for Great Bustard in a single study year (Ena *et al*. 1987 in Combreau *et al*. 2002) and 65% in Little Bustard *Tetrax tetrax* in a stable population (Morales *et al* 2005). Human predation was not cited in these studies. Chick mortality is unquantified in the Bengal Florican population in Cambodia, however, in the Little Bustard study mentioned above it was conservatively estimated at 15-20% (Wolff 2001). The nest protection scheme will be continued in 2012 using the 2011 method, as much for the awareness it raises among local people as for the direct effect it is hoped to have on nest success.

Surveys of floricans in non-breeding season habitat

The 2010 florican surveys in the upland BFCAs recorded birds at Trea Sameakki BFCA and two additional sites. There are still no records from Tuol Kruel Phan Nheum BFCA despite additional survey effort. The transect surveys were discontinued owing to low encounter rates with birds and replaced with a more efficient method of detecting occupied locations. In 2011 thirty-five sites were visited and within these 140 locations were surveyed. Of these, habitat that looked suitable for floricans was found at 98 locations. Twenty-one floricans comprising 15 males and six females were seen at 15 locations spread over 15 sites. Although these data cannot be used to monitor population trends in floricans in the non-breeding season, these data can be used to identify key Community Forests at which to engage in conservation activities (Appendix 8). Most records were from the edge of Community Forests, presumably because this is where forest is most degraded with an open structure and abundant grass. Suitable habitat is patchy in distribution and consequently floricans are spread over a wide area. Satellite telemetry data indicate that birds sometimes stay only a few days in each habitat patch, possibly moving on when feeding resources are depleted. Unless large areas of contiguous suitable non-breeding habitat can be maintained at certain sites, conservation interventions will have to focus on maintaining a network of smaller suitable patches in Community Forests, land concessions and plantations.

Although until 2011 field surveys were relatively limited in extent and constrained by low detection rates, the fifteen males recorded in 2011 might represent up to 20% of the 2011 male florican population (assuming all birds detected during the non-breeding season survey breed in the breeding season survey area, that no birds breed outside of that area, that all males display and that non of the birds in the non-breeding season were counted twice because they moved between sites). However, because birds are known to move between sites in the non-breeding season, it is possible that some birds were recorded more than once. These can therefore be used to make relatively robust conclusions about Bengal Florican site preferences.

However, using field surveys and satellite telemetry florican presence can only be confirmed at sites, not excluded. To draw stronger conclusions about the distribution of Bengal Floricans, telemetry can be used to obtain a better understanding of habitat selection by floricans. When combining this information with a detailed land cover map it can be determined where floricans are most likely to be concentrated in the non-breeding season. This work will undertaken by Richard Hilliard, an MSc student from the University of East Anglia, in 2012.

Non-breeding habitat is threatened by large-scale land conversion, for now mainly outside the designated BFCAs, but at times impacting prime habitat (e.g. the area south of Toul Kreul-Phan Nheum BFCA, which was not included within a BFCA as it was already part of a land concession). Rice farming and agro-industrial plantations of acacia, eucalyptus, jatropha and other crops are expanding rapidly in this landscape, and land sales/land concessions are common. A study will be undertaken in early 2012 to ground-truth data from satellite-tagged floricans to enable improved mapping of suitable florican habitat from satellite images. This will facilitate monitoring of trends in the extent of suitable habitat.

The sex ratio of floricans recorded during the non-breeding season survey is highly skewed in favour of males, however it is conceivable that flushing behaviour might differ between the sexes. It is unlikely that this is due to a bias in survey location towards areas favoured by males, as evidenced by satellite telemetry data that includes an almost equal numbers of males and females. A more extreme male biased sex ratio is evident in the additional nine birds reported by local people: of nine birds reported six were males, one female and two unidentified. Although it is probable that local people might be more likely to notice or remember the more distinctive males, the WCS surveys had an equal chance of detecting males and females. Data therefore indicate that the Bengal Florican population may be highly male biased, with an adult sex ratio of 0.71 (expressed as the proportion of the population that is male) using only the data from the field surveys. Because males are indistinguishable from females for the first year of their life some of the birds identified as females during the non-breeding season survey may also have been one-year-old males and therefore 0.71 is likely to be a minimum estimate of the male proportion of the population. Male biased adult sex ratios are the norm in birds, a review of 201 published estimates of adult sex ratio found that the average proportion of males in a population was 0.56, presumably owing to greater vulnerability of female birds during nesting (Donald 2007). One possible causal factor for a male biased sex ratio in Bengal Florican in Cambodia is snaring of females around the nest – when a nest is found local people will sometimes set snares close to the nest in order to catch the female – since males play no part in the incubation of chick rearing they are unaffected by this practise (Hong Chamnan *pers. comm.*). The apparent adult sex ratio of 0.71 in the Bengal Florican population is very high for a bird species although not atypical for a globally threatened bird species, since species with small populations typically have more strongly male biased populations, which is one of the driving forces behind the Allee effect (Donald 2007). Species with a lek based mating system typically have female biased sex ratios, and theoretical models predict that in polygynous species such as Bengal Florican extinction risk is lowest when the adult sex ratio is female skewed (Bessa-Gomes *et al.* 2004). Estimates of population persistence of Little Bustard *Tetrax tetrax* (a species with a very similar breeding strategy to Bengal Florican) in France using population viability analyses indicated that population persistence was more sensitive to a shortage of females than males and that population viability would start to rapidly decline when the adult sex ratio rose above 0.55 (Morales *et al.* 2005). Clearly a highly male biased population is a cause for concern in a species with a polygynous mating system like the Bengal Florican.

Breeding season densities

The 2011 survey gives an estimate of 46 displaying males (range 24-69) within the BFCAs. Only 1-2 males are thought to survive in each of two other protected areas outside the Tonle Sap floodplain (Hong Chamnan pers obs. and Seng Kimhout pers. comm.). Hence the best current estimate of florican numbers in protected areas in Cambodia is approximately 50 displaying males. The 2011 survey gives an estimate of 78 displaying males (range 46-110) for the study area as a whole (the BFCAs, adjacent unprotected grassland and one former IFBA). This figure is almost double that derived from only the BFCAs although it is perhaps an overestimate for reasons discussed below. It is imprudent to estimate the percentage of the Cambodian population that these population estimates represent, since based on rates of habitat loss reported by Gray *et al.* (2009) it is probable that most grassland outside of protected areas has been lost. All sites surveyed by Tom Gray in 2006-7 will be surveyed again in 2012 to obtain a new estimate for the entire Cambodian Bengal Florican population.

The 2011 population estimate for the BFCAs is almost half that obtained in 2010 (88, range 55-122), but only slightly lower than the 2009 population estimate (57, range 33-83) (van Zalinge *et al.* 2010). In 2010 it was thought that the increase in displaying males relative to 2009 was probably genuine, although it was noted that unusual weather conditions might have encouraged more males than average to display (van Zalinge *et al.* 2010). The reasons suggested by van Zalinge *et al.* (2010) to explain the population increase included increased productivity owing to successful conservation and the arrival of birds displaced by habitat loss elsewhere. The much lower population estimate for 2011 might indicate that the high estimate from 2010 was largely a result of anomalous weather conditions causing a higher than average number of males to display. Conversely, because the only statistically significant change in the number of displaying recorded in 2010 (compared with 2009) was in Stoung-Chikraeng BFCAs and weather conditions were similar across the sites, it is plausible that there was a genuine influx of males displaced from elsewhere to that site in 2010. The time period involved is too short for increased breeding productivity to account for the increase in numbers of displaying males in 2010, and all data indicate that breeding productivity is low. The "extra" males of 2010 were not recorded in 2011, and it is likely that numbers at the Stoung-Chikraeng BFCAs have again declined, although this decline is not statistically significant. The 2011 data suggest a worrying statistically significant decline in the population at the BFCAs, driven largely by the decline in Baray–Chong Doung.

As in the previous two years nearly half of all displaying male Bengal Floricans are in Stoung-Chikraeng BFCA (37, range 18-56). This is the most important site for Bengal Florican conservation in Cambodia. The density of displaying males at Stoung–Chikraeng BFCA is significantly lower than in 2010 (0.89 males/km^2 in 2010 down to 0.50 males/km^2 in 2011) although this change is not statistically significant. The density of displaying males recorded in 2011 is identical to the density recorded in 2009. However, the pattern of sample square occupancy in 2011 is quite different to 2009 (Appendix 1), probably owing to changes in the distribution of optimal habitat. If the increase in 2010 was not genuine or was the result of an influx of displaced males that subsequently went elsewhere it is possible that the Bengal Florican population at Stoung–Chikraeng BFCA is stable. Although survey methods have differed slightly in past years, the assumption that this population is stable is supported by data from 2006 that indicated a density of 0.68 males/km^2 (Gray *et al*. 2009), while an earlier study conducted between 2002 and 2004 found 0.48 males/km^2 at Stoung-Chikraeng (Davidson

2004). All of these studies randomly located the survey squares within the survey areas and thus densities should be broadly comparable between years.

At Baray-Chong Doung BFCA the Bengal Florican population has declined over the last three years. In 2009 and 2010 the density of displaying males did not significantly differ (0.22 males/km^2 in 2009 and 0.26 males/km^2 in 2010) whilst in 2011 it has declined to 0.11 males/km^2 – the lowest density recorded to date at Baray BFCA. This statistically significant decrease is probably genuine and can perhaps be attributed to the loss of suitable habitat as documented in this report. In early 2012 two Fishery Conservation Areas (FCAs) were established by sub-decree in Baray and Chong Doung. These will be managed by the Fisheries Administration. The boundaries of the new FCAs overlap almost exactly with those of the existing BFCAs, and provide another important layer of protection to natural habitat within them. The FCAs are to be managed for fish conservation and the protection of scrub and natural grassland that provide important fish breeding habitat.

For the first time population data from outside the BFCAs appear to show a positive trend, although this is not statistically significant. The Bengal Florican population at Veal Srongai former IFBA (in 2010 and 2011 also including data from Prey Koh) was consistently very low in 2009 and 2010 (0.05 males/km^2 in the latter year) but increased to 0.21 males/km^2 in 2011. These data indicate that the estimated population has grown from 4 displaying males (range 0-13) to 17 (1-39) at this site since 2010. Since it is unclear if this represents a genuine change in population status at this site this result should be interpreted cautiously.

The change in the estimate of the number of displaying males in the overall study area from 2010 to 2011 (2010: 107, range 67-147; 2011: 78, range 46-110) is not statistically significant. However, the apparent trends in the Bengal Florican population in the study area are a cause for serious concern. The population at Stoung-Chikraeng BFCA is probably stable but still very small, owing to the size of the site. The population at the only other protected area, Baray-Chong Doung BFCA, has declined significantly and is now close to extinction. Baray BFCA is relatively large, and therefore has the potential to support a larger population of floricans than Stoung-Chikraeng BFCA but habitat loss is severe and on-going. Both sites are therefore essential as part of a strategy to conserve Bengal Florican in Cambodia, for slightly different reasons. It is likely that the apparent overall population increase in 2010 was a blip and that the number of displaying males in the study area has declined since 2009 and now numbers less than 80.

Based on sex ratios derived from the non-breeding season survey it is plausible that there are only 18 (range: 10-28) females in the BFCAs and 31 (range: 18-44) in the overall study area assuming (based on data from non-breeding areas) that 71% of the population consists of adult males and that all adult males display. It is not known what percentage of adult males display and thus the number of females is likely to be slightly higher than these estimates would suggest (e.g. if only half of adult males display then number of females would be double that predicted here). However, as already noted the proportion of the population which is female is likely to be an overestimate because one year old males will have been identified as females during non-breeding season survey. Given the relatively low nest success observed in the nests that are found, and the levels of pre-fledging mortality observed in other bustard populations, this suspected low number of females would imply that the total reproductive output of this population is also dangerously low.

Surveying floricans is highly challenging and we are continuously working to refine our survey techniques. The density estimates discussed here are probably a slight under-estimate because even after three visits to each square some displaying birds will have been overlooked. We cannot estimate the level of bias directly, but since in 2011 all except one square (which had two males) was occupied by either one or zero displaying males we can use the results of the occupancy analysis to obtain a rough measure by analogy. The average per-visit detectability fell to 0.53 in 2011 (from 0.63 in 2010), this implies that after three visits there is an approximate risk of $(1-0.63)^3 = 10\%$ of failing to detect any birds in a square that is, in fact occupied. Hence the survey results for 2011 presented in Table 2 are likely to be an underestimate, and density estimates calculated using occupancy rates corrected for detection rate are presented in Appendix 7. These are slightly higher than density estimates presented in Table 2, and are likely to be more accurate than those calculated for 2010, because in that year more squares were occupied by two displaying males. Survey data should therefore be treated as conservative, but only marginally so.

Recommendations

Monitoring recommendations

- Continue to monitor the same grid squares in 2012
- Conduct power analyses to determine the sample size needed to detect a statistically significant population decline in a population of the current size
- Continue nest monitoring following the 2011 methodology
- Revisit a sub-sample of 2011 non-breeding survey locations
- Accurately map the extent of encroachment in the BFCAs and always record the area (in hectares) of any new encroachment
- Develop an accurate system to monitor land cover changes using satellite imagery

Conservation recommendations

Detailed conservation recommendations are outside the scope of this report since it does not include a review of the many conservation activities already underway. However, recommendations that can be made on the basis of findings from the monitoring work are:

- Strengthen legal protection for the existing BFCA network in order to prevent inappropriate large scale destructive development projects and reverse those that have begun, especially in Baray, Chong Doung and Chikreang BFCAs
- Improve reporting protocols so that encroachment is reported more quickly and can be stopped more effectively
- Monitor agreements with farmers to ensure that they do not go back to farming land which they had illegally encroached
- Modify or expand the protected areas in non-breeding habitat to encompass other sites that hold high numbers of floricans
- Initiate florican conservation activities at Community Forests, or clusters of community forests which have been identified as sites of high importance for non-breeding Bengal Florican
- Continue research to clarify the ecological requirements of Bengal Floricans, particularly in breeding areas, to gain an understanding of the factors that influence display and nest site selection and success in relation to vegetation dynamics such as grassland alteration, regeneration and succession.

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Appendixes

Appendix 1. History of number of males holding territories in current survey squares in Stoung-Chikraeng BFCAs during 2002 - 2011

Square	2002	2003	2004	2005	2006	2008**	2009*	2010*	2011*
1	-	-	-	-	-	0	0	0	0
2	-	-	-	0	-	0	1	2	1
3	-	-	-	-	-	0	0	2	1
4	-	-	-	-	-	0	0	0	0
5	1	0	0	1	1	0	0	1	1
6	-	-	-	0	-	1	0	1	0
7	-	0	0	0	0	0	0	0	1
8	1	1	1	1	0	0	1	1	0
9	-	0	0	2	1	1	1	2	1
10	1	1	1	1	1	0	1	1	1
11	1	0	0	1	1	0	0	0	1
12	-	-	-	-	-	1	1	1	0
13	-	-	-	-	-	0	0	1	0
14	-	2	2	1	0	0	1	1	1
15	-	-	-	0	-	0	1	1	0
16	0	1	1	1	0	0	1	1	0
17	1	1	1	1	0	0	1	1	1
18	1	0	0	0	0	0	0	0	0
Total	*6*	*6*	*6*	*9*	*4*	*3*	*9*	*16*	*9*

* Squares visited three times; ** Squares visited once

Appendix 2. Coordinates (UTM Indian 1960) for centers of survey squares in Stoung-Chikraeng BFCAs

Square	UTM N	UTM E	Square	UTM N	UTM E
1	431500	1439500	10	443529	1437487
2	435500	1439500	11	445504	1437539
3	437500	1439500	12	447555	1437549
4	431500	1437500	13	435487	1435489
5	433500	1437500	14	437514	1435487
6	435500	1437500	15	439460	1435488
7	437500	1437500	16	441496	1435483
8	439500	1437500	17	443482	1435463
9	441500	1437500	18	445520	1435526

Appendix 3. History of number of males holding territories in current survey squares in Veal Srongai (former IFBA) during 2009 – 2011

Square	2009	2010	2011
19	1	1	1
20	-	0	0
21	0	0	0
22	0	0	0
23	0	0	1
24	0	0	0*
25	0	0	0*
26	0	0	0*
27^	-	0	0
28^	-	0	1
29^	-	0	0
30	-	0	1
31	0	0	0
32^	-	0	0*
33^	-	0	0
34	0	0	0
35	0	0	0
36	0	0	0
37	0	0	0
Total	*1*	*1*	*4*

* Two repeat visits to square

^ Squares in Kampong Chhnang (surveyed since 2010)

Appendix 4. Coordinates (UTM Indian 1960) for centers of survey squares in Veal Srongai former IFBA

Square	UTM N	UTM E	Square	UTM N	UTM E
19	467500	1395500	29*	463500	1391500
20	469500	1393500	30	465500	1391500
21	461500	1393500	31	471500	1391500
22	463500	1393500	32*	461500	1389500
23	465500	1393500	33*	463500	1389500
24	467500	1393500	34	499500	1377500
25	469500	1393500	35	473500	1387500
26	471500	1393500	36	475500	1387500
27*	459500	1391500	37	477500	1387500
28*	461500	1391500			

* Squares in Kampong Chhnang (only surveyed since 2010)

Appendix 5. History of number of males holding territories in current survey squares in the Baray-Chong Doung area during 2008 – 2011

Square	2008*	2009	2010	2011
38	1	0	0	0
39	0	0	0	0*
40	0	1	0	0
41	0	0	0	0

Square	2008*	2009	2010	2011
42	0	0	0	0
43	0	0	0	0
44	0	0	0	0
45	-	0	0	0
46	-	0	0	0
47	-	0	0	0
48	-	0	0	0
49	-	0	0	0
50	-	0	0	0
51	-	0	0	0
52	-	0	0	0*
53	-	1	1	0*
54	-	1	1	0
55	-	1	1	1*
56	-	0	0	0
57	-	0	1	0
58	-	0	0	0
59	-	0	0	0*
60	-	0	0	0*
61^	-	0	0	0
62	-	0	0	0*
63	-	0	0	0
64^	-	1	1	2
65^	-	1	1	1
66	-	1	1	1
67	-	1	2	1
Total	*(1)*	*8*	*9*	*6*

* Two repeat visits to square

^Squares not part of current BFCAs

Appendix 6. Coordinates (UTM Indian 1960) for centers of survey squares in the Baray-Chong Doung survey area

Square	UTM N	UTM E	Square	UTM N	UTM E
38	501500	1379500	53	497500	1369500
39	499500	1377500	54	499500	1369500
40	501500	1377500	55	491500	1367500
41	503500	1377500	56	493500	1367500
42	499500	1375500	57	495500	1367500
43	501500	1375500	58	497500	1367500
44	503500	1375500	59	491500	1365500
45	495500	1373500	60	493500	1365500
46	497500	1373500	61^	495500	1364500
47	499500	1373500	62	489500	1363500
48	495550	1371500	63	491500	1363500
49	497500	1371500	64^	493500	1363500
50	499500	1371500	65^	495500	1363500
51	493500	1369500	66	489500	1361500
52	495500	1369500	67	491500	1361500

^Squares not part of current BFCAs

Appendix 7 Results of a preliminary analysis under an occupancy framework

Analysis was conducted using the program Presence.

Survey Area	Naive occupancy rate		Detection probability*		Occupancy corrected for detection rate		Estimated number of displaying males**	
	2010	2011	2010	2011	2010	2011	2010	2011
Stoung-Chikraeng BFCAs	0.72	0.50	0.56	0.53	0.79	0.56	59 (40-78)	42 (16-68)
Baray-Chong Doung BFCA^	0.22	0.11	0.63	0.48	0.23	0.13	23 (0-45)	13 (0-95)
Overall BFCAs	0.42	0.27	0.59	0.52	0.45	0.30	78 (49-108)	52 (19-85)
Veal Srongai+	0.05	0.21	1.00	0.52	0.05	0.24	4 (1-13)	20 (0-47)
Overall study area+	0.33	0.27	0.63	0.53	0.35	0.30	96 (63-129)	82 (47-118)

* For simplicity detection rates were assumed to be equal for all three visits and for all observers.
** Numbers in parentheses are 95% confidence intervals.
^ The three squares outside the BFCA are not shown in this table as the sample is too small for further analysis. All of the three squares were occupied.
+ The 2010 data presented in van Zalinge *et al*. (2010) have been re-calculated using results from five extra squares in Prey Koh Conservation Area which were not presented in van Zalinge *et al*. (2010) to allow better comparison with 2011.

Appendix 8. 2010 non-breeding season survey results (see also Figure 3 for location details)

Survey area	*Dates*	*Floricans seen on transect*	*Number of kilometres covered*
Samaki Community Forest (northern part of Trea-Samaki BFCA)	15-18/9 26/10	0	128 in September; 91 in October; 16 in November
Southern part of Trea-Samaki BFCA and adjacent areas	19-21/9 24-25/10	2 males 2 females	
Toul Kreul-Phan Nheum BFCA and adjacent areas to the southwest	22-25/9 15-18/10 11/11	0 2 females 0	
Trapeang Lapeak Community Forest and area east of CF	20-21/10 12/11	0	
Area adjacent to Tluk Popel CF	28/9	0	
Thnal village, Toul Kreul commune	27/9	1 male	
Totals		*3 males, 4 females*	*235*

Appendix 9. 2011 non-breeding season survey results (see also Figure 4 for location details)

Date	*Survey site*	*Location*	*UTM*	*Suitable?*	*Floricans*
15/09/11	Trapeang Ampil Community Forest	Veal Trapeang Tek Thlaer	0477982 1432190	Yes	0
		Veal Trapeang Ampil	0477926 1433428	Yes	0
		Veal Thom	0478250 1432719	Yes	0

16/09/11	Yak Seurm Community Forest	Veal Yak Seurm	0477467 1435578	Yes	0
		Veal Kab Kur	0478536 1435000	Yes	0
17/09/11	Trapeang Lapeak Community Forest	None suitable		No	0
17/09/11	North of Trapeang Lapeak Community Forest	Veal Ta Mok	0483024 1432171	Yes	2 males seen
21/09/11	Ou Sorm Community Forest	Veal On Deang Chab	0489646 1433943	Yes	0
29/09/11	Ou Ang Kub Thom Community Forest	Veal On Deang Chab	0490632 1433756	Yes	
		Veal Ang Kub Thom	0492384 1433872	Yes	
30/09/11	Peam La Bos Yeay Nheb Community Forest	None suitable		No	
30/09/11	West of Peam La Bos Yeay Nheb Community Forest	Veal Marjor Pherm	0487991 1429759	Yes	
01/10/11	Ou Poung Rong Community Forest	Veal Plov Phong	0490785 1427266	Yes	0
		Veal Sang Mey	0490656 1426995	Yes	0
		Veal Poung Rong	0490467 1426728	Yes	2 males seen
15/10/11	Salao Tong village	Veal Chok	0522932 1372467	Yes	0
		Toul Tarmok	0522746 1371882	Yes	0
17/10/11	Salao Tong village	Veal Dom Nak Chab	0523254 1371829	Yes	2 males reported
		Veal Sar Por	0524352 1372359	Yes	1 male seen
		Veal Krangknor	None	Yes	0
18/10/11	Salao Tong village	Veal Trapeang Ompil	0516135 1371898	Yes	0
		Veal Phnom Rab	None	Yes	0
		Veal Rom Chech	0517220 1371427	Yes	0
		Veal En Tungsor	0517966 1371605	Yes	0
		Tropeang Ompil	0516135 1371898	Yes	1 female seen
21/10/11	En Long Thmor village	Veal Buk Pot	0528961 1373879	Yes	1 male seen
		Veal Kjas	0529916 1372892	Yes	0
		Veal Trapeang Domnak	0528747 1372334	Yes	0
		Veal Trapeang Preng	0527710 1373122	Yes	0
		Veal Sragai	0528294 1373455	Not surveyed	2 males reported
22/10/11	West of En Long Thmor village	Veal Ou Por	0525065 1372763	Yes	1 male seen
		Veal Roneam Snor	0525314 1373275	Yes	0
23/10/11	Dum Tum	Veal Trapeang	0515579 1372146		1 male seen

	village	Ompil			
		Tuol Boskrok	0515956 1370978		0
24/10/11	Phum Bey village	Veal Trapeang Ktom	0531305 1368124	Yes	2 birds reported
		Veal Trapeang Ressey	0532147 1368899	Yes	0
26/10/11	West of Toul Krel BFCA	Veal Chok	0485427 1442077	Yes	2 females seen
16/11/11	Trapeang Kbal Kmoch Community Forest	Veal Tluk Tar	0490648 1422937	Yes	0
		Man	0489435 1422714	Yes	0
		Veal Kbal Kor	0488882 1422759	Yes	0
		Veal Trapeang Chong Er	0488229 1423105	No	0
		Veal Trapeang Knong	None	No	0
		Veal Tluk Ro El	None	No	0
		Veal Mot Steang	0488403 1424087	No	0
		Veal Trapeang Kbal Kmoch	0488766 1424061	No	0
		Veal Romdeang Veal Chum	0490406 1423609	No	0
		Rompren Veal Bos Salar	0490951 1423522	No	0
17/11/11	Ou Kladak Community Forest	Veal Ou Rolos	0489813 1425094	Yes	1 male reported
		Veal Ou Pha Oung	0489456 1425480	Yes	1 male and 1 female reported
			0488602 1425836	No	0
		Veal Kray Pear	0488356 1425698	Yes	0
		Veal Tar Mot Veal Tar Hey	0488275 1425164	No	0
18/11/11	Tluk Russei Community Forest	Veal Plov Chum	0490484 1418758	Yes	0
		Veal Bus Borbea	0491037 1418143	Yes	0
		Veal Eng Sakrong	0492055 1417524	Yes	0
19/11/11	Trapeang Roung Community Forest	Veal Trapeang Kong Hech	0490610 1419322	No	0
		Knach Russey	0492040 1419720	No	0
		Veal Sar Tuk	0492535 1418597	Yes	1 male and 1 female seen
		Veal Plat Mot	0490057 1419308	Yes	0
20/11/11	Kanseng Veal Community Forest	Veal Srear Chur	0497451 1437509	Yes	0
		Veal Phuk Phave	0497542 1436135	Yes	0
		Prey Hor Lar	0495916 1437481	No	0
		Prey Kanseng	0496433 1437496	No	0
		Veal Trapeang Sompoch Komprok Duch	0497442 1436502	No	0
			0496522 1437400	No	0
21/11/11	Ou Chreang Sor Community Forest	Veal Tluk Krodas	0484596 1427635	Yes	0
		Ou Om Pov	0485147 1426971	Yes	0
		Ou Kroch) Veal	0485040 1425919	Yes	0
		Ou Phung	0486005 1426080	Yes	0

		Veal Trapeang Leang	0486477 1428686	Yes	0
		Bus Songvat	0485463 1428718	Yes	0
		Veal Dom Naek Krel	0485126 1428238	Yes	1 male seen
24/11/11	Ou Plov Lok Community Forest	Veal Kbal On	0481782 1428933	Yes	0
		Song Veal Kamal	0481834 1428672	Yes	0
		Veal Ou Ta Khot	0482030 1427756	Yes	1 male and 1 female seen
		Veal Chong Kur	0479777 1427170	Yes	0
		Veal Trapeang	0480555 1428378	Yes	0
		Krat Veal Soving	0480045 1427949	Yes	0
		Veal Chom Ka Kromar	0480989 1428562	Yes	0
25/11/11	Munty Knong Community Forest	Veal Trapeang Santear	0498352 1438694	Yes	0
		Trapeang Tul	0499744 1438290	No	0
26/11/11	Prey Hurm Community Forest	Veal Neak Ta	0466931 1421056	Yes	1 male and 1 female seen
		Veal Trapeng	0466858 1420333	Yes	0
		Prey Veal Ta	0467304 1420258	Yes	0
		Kong	0468057 1420435	Yes	0
		Veal Trapeng Trobeak	0467597 1421977	No	0
		Veal Neak Ta Kanil			
27/11/11	Tluk Popil Community Forest	Veal Ta Ouk	0472981 1425285	Yes	0
		Veal Neak Tar Chor	0473827 1425354	Yes	0
		Veal Trapeang Chom	0474340 1425167	Yes	0
		Veal Bros Ob Tek	0474524 1425684	Yes	1 male seen
		Veal Tar Kerk	0474503 1426118	Yes	0
		Veal Sopy	0472916 1426460	Yes	0
		Veal Trapeang Thmor Kol	0472080 1426091	Yes	0
13/12/11	Preah Sakphea Community Forest	Trapeang Russey	511411 1430044	No	0
		Veal Tar Leat	512520 1430031	No	0
		Trapeang Prey	512936 1430388	No	0
		Ou Kroper	513535 1430853	No	0
		En Longpor	512865 1431802	No	0
		Ou Preykhos	512131 1432076	No	0
		Ou Kbal Klar	511283 1432132	No	0
		Veal Trapeang Sakphea	510923 1431629	Yes	0
		Bos Tarsov	510992 1431091	Yes	0
		Veal En Long	511440 1430766	Yes	0
14/12/11	Srey Yorl Community Forest	Veal Trapeang Snar Peang	508556 1427998	No	0
		Veal Tar Trang	508066 1428095	Yes	0
		Veal Kobpromat	507622 1428109	Yes	0
		Veal Tarbeng	506672 1428365	Yes	0
		Veal Dom Nak	507771 1429747	Yes	0

		Marak			
		Dop Prasat	508332 1429808	No	0
		Trapeang Morrie	508713 1429236	No	0
15/12/11	Prey Chrang Krohom Community Forest	Veal Bos Kol	None	No	0
		Toul Tar Hoch	501627 1403599	Yes	0
		Veal Ler	501183 1403979	Yes	0
		Tbong Domrey	501802 1404603	No	0
		Dom Bol Khpos	502288 1405016	Yes	0
16/12/11	Prey Ou Ta Kreh Community Forest	Veal Pon Krel	517055 1405707	Yes	0
		Veal Sat Lar Ert	517568 1405689	No	0
		Veal Jol Kei	518910 1405443	No	0
		Veal Pro Lang	519698 1405384	Yes	0
		Veal Plov Kdar	520104 1405132	No	0
		Veal Bros Som	519752 1404735	No	0
		Veal Re Reave	519428 1403888	No	0
		Veal Bro Tor	519342 1403082	Yes	0
		Veal Tar Trave	518501 1403974	Yes	0
		Veal Yey Chab	517579 1405179	Yes	1 male seen
17/12/11	Prey Trapeang Sandan Community Forest	Veal Traspeang Sandan	509866 1395518	Yes	0
		Veal Trapeang Trom	None	Yes	0
		Trapeang Veang	510237 1395575	Yes	0
		Veal Tro Mark Krobei	511409 1395175	Yes	1 male seen
		Veal Ouk Meas	511037 1395849	Yes	0
		Ou En Long Veang	510843 1395083	Yes	0
18/12/11	Brey Kbal Bey Community Forest	Veal Trapeng Porpel	519224 1393563	Yes	0
		Chher Khmao	519700 1394339	Yes	0
		Veal Tluk Svay	519773 1394838	Yes	0
19/12/11	Prey Chheung Phum Community Forest	Veal Trapeang	517017 1398460	No	0
		Kuy Veal Bos Keo	517122 1398906	Yes	0
		Veal Tar Team	516916 1399518	Yes	0
		Ou Bot Kong	516914 1400292	Yes	0
		Trapeang Krel	517386 1400230	No	0
		Veal Tar Kave	518130 1399570	No	0
		Trapeang Ateang	517904 1417946	Yes	0
20/12/11	Tumnob Community Forest	Veal Bos Veang	None	No	0
		Veal Smoy	None	No	0
Total floricans seen					*21*