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ARTICLE

The unintended role of the local private sector in biodiversity conservation in the Tonle Sap Biosphere Reserve, Cambodia

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ABSTRACT The local private sector currently plays an important role in the protection of biodiversity of the Tonle Sap Lake. Large parts of the lake and surrounding floodplain—so-called fishing lots—are auctioned for private exploitation of the rich fisheries. The owners of fishing lots go to great lengths to ensure that there is a maximum amount of fish inside the lot by protecting the area from disturbance and poaching. The core areas of the Tonle Sap Biosphere Reserve are situated inside such fishing lots. Although it is unintended, the fishing lots and the protective measures taken by their owners to maximize extraction of fish provide effective protection for the large colonies of water birds nesting inside the core areas on the floodplain and possibly for other elements of biodiversity. Plans to end the fishing lots system in the core areas and to replace it by more effective, public-sector management and protection are prepared. Will they be counterproductive and put the core areas and their biodiversity further at risk?

Introduction

Despite worldwide recognition as habitats rich in biodiversity, wetlands currently are the most threatened ecosystems on the planet (Wetlands International 2005). The Mekong River is one of the few relatively untouched large rivers in the world and its basin is rich in wetlands and floodplains. Economic development in China and Southeast Asia is putting growing pressure on the water

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resources of the Mekong basin, in particular through the construction of dams for hydropower generation and diversion of water from the river and its tributaries for irrigation and industrial use.

The Tonle Sap ecosystem in Cambodia is a major component of the Mekong basin, consisting of the Tonle Sap Lake, the Tonle Sap River and their surrounding floodplains. The 100-km-long Tonle Sap River connects the lake to the Mekong River. It is a flood-pulsed system (Junk *et al.* 1989, Lamberts 2001, Sarkkula *et al.* 2003), driven by huge seasonal variations in Mekong River flow (Welcomme 1985). As water levels in the Mekong River rise following the monsoon rains, the flow in the Tonle Sap River reverses and water is pushed up into the river and the Tonle Sap Lake, inundating the vast surrounding floodplains.

Knowledge of the biodiversity of the Tonle Sap ecosystem is still poor. Nonetheless, existing knowledge was deemed sufficient to justify its inclusion in 1997 in the United Nations Educational, Scientific, and Cultural Organization (UNESCO) Man and the Biosphere network as a biosphere reserve, as well as the inscription in 1999 of an important part of the ecosystem on the Ramsar list of wetlands of international importance.

The most conspicuous biodiversity elements of the Tonle Sap are the birds, the fish and the ecosystem processes of the flood pulse believed to be the driving force behind the system's natural productivity. A recent count of species known from the Tonle Sap indicated the presence of 885 species of floodplain plants and animals (Mok *et al.* 2001), but this does not include for instance the 197 species of phytoplankton found by Nguyen and Nguyen (1991). The open connection with the Mekong River limits the number of aquatic species that are endemic to the Tonle Sap (Rainboth 1996).

The birds are the best-studied and -known component. One area at the north-western tip of the lake, known as Prek Toal, is a breeding site for several colonial large water birds. Breeding species include the globally threatened greater adjutant (*Leptoptilos dubius*), lesser adjutant (*Leptoptilos javanicus*), Bengal florican (*Houbaropsis bengalensis*), milky stork (*Mycteria cinerea*) and the globally near-threatened grey-headed fish eagle (*Ichthyophaga ichthyaetus*), darter (*Anhinga melanogaster*), painted stork (*Mycteria leucocephala*), black-necked stork (*Eppypiorhynchus asiaticus*) and black-headed ibis (*Threskiornis melanocephalus*) (Goes & Hong 2002, International Union for the Conservation of Nature and Natural Resources (IUCN) 2004).

Of all the vertebrates of the Tonle Sap ecosystem, fishes are undoubtedly the largest group, both in number of species as well as in biomass. About 500 species have been described for the Mekong system in Cambodia (including the Tonle Sap ecosystem) but the real number is certainly higher (Rainboth 1996). There is not much reliable information about the biogeography of most species inside Cambodia. Some of the species remain permanently in the Tonle Sap, while many other fishes use the lake and the floodplain only temporarily and migrate back and forth to the Mekong. Several fish species, in particular those growing to big sizes, are endangered (Mattson *et al.* 2002). The giant Mekong catfish (*Pangasianodon gigas*), which grows to several hundred kilograms, is considered critically endangered (IUCN 2004).

Other animals of particular conservation concern include the endemic Tonle Sap water snake (*Enhydryis longicauda*). The Siamese crocodile (*Crocodylus siamensis*) is also critically endangered in the wild, but kept and bred in captivity throughout the country. *Orcaella brevirostris*, the freshwater Irriwaddy dolphin, is occasionally seen in the Tonle Sap ecosystem.

Ecosystem processes are an important aspect of biodiversity. The flood pulse and its associated processes are not only part of biodiversity but also determining factors for many other biodiversity elements (Junk 1997). This flood pulse event occurs in highly predictable annual patterns. Maximum water depth in the Tonle Sap Lake varies between less than a metre and up to eight metres. The duration of the flood is about five months. In addition to diurnal variations, the water quality in the ecosystem shows extreme natural variations throughout the year, associated with the flood pulse (Lamberts 2001, Sarkkula *et al.* 2003).

The Tonle Sap Biosphere Reserve

The Tonle Sap Biosphere Reserve (TSBR) was given legal recognition in 2001. It covers nearly 15,000 km² and comprises three core areas (total 708 km²), a contiguous buffer zone of 5,108 km² and a surrounding transition area of 8,997 km² (Figure 1). The activities permitted in each of the zones are determined by law. While in the buffer and transition areas human activities are allowed, these are restricted in the core areas to essential conservation research, monitoring and

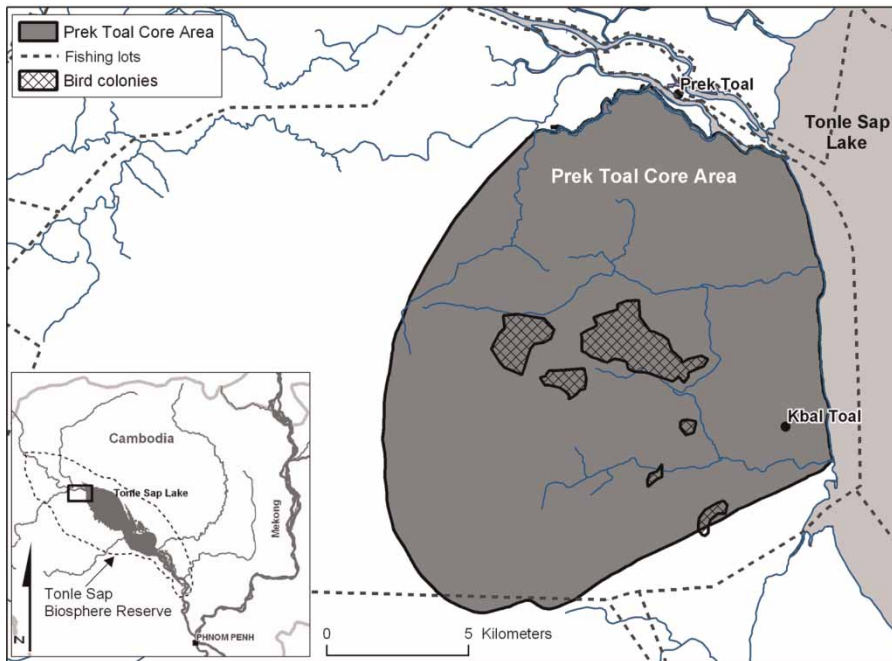


Figure 1. Map of the Tonle Sap Biosphere Reserve and the Prek Toal Core Area (bird colonies location based on Goes and Hong [2002]).

ecotourism activities. Biodiversity conservation is the prime objective in the core areas. Fishing activities that were ongoing at the time of the establishment of the TSBR were permitted to continue but must be adjusted to be conducive to the long-term protection and conservation objectives of the core areas.

Also in 2001, a secretariat was established to facilitate coordination and to strengthen communication and cooperation among relevant agencies, provincial authorities and civil society in the protection and sustainable management of the TSBR. Comprised of representatives of relevant ministries, the TSBR Secretariat has a coordinating and monitoring role in the management of the TSBR. The effective management responsibility for the entire Tonle Sap ecosystem remains with the Department of Fisheries (DOF) of the Ministry of Agriculture, Forestry and Fisheries. Fisheries management determines the activities in the TSBR. The different departments within the Ministry have very strong mandates, and areas are clearly divided between them based on the predominant interest (in particular forestry or fisheries).

The fisheries management system of the Tonle Sap is an area-based co-management system. There are four categories of areas and hence co-managers: (i) open access areas under direct control of the DOF, (ii) community fisheries where local communities are given limited management responsibility for a designated area, (iii) fish sanctuaries where all fishing is prohibited, under direct control of the DOF, and (iv) so-called 'fishing lots', large parts of the lake and surrounding floodplain that are auctioned for private exploitation. Apart from the access and revenue controlling agent(s), there are few differences in management practices between the categories. Some fishing operations require the scale of a fishing lot, but most gear types are found in use everywhere.

Apart from the fishing lots, the fisheries are under public management, either directly through the DOF or through legally recognized community fisheries organizations. The fishing lots are managed by individuals and are a private-sector form of management. The auction provides the purchaser of a fishing lot exclusive access to and ownership rights over the fish from the fishing lot. Auctions are held every two to six years and are public.

Most fishing lots include parts of the permanent lake as well as large areas of flooded forest on the floodplain. Much of the natural fish production occurs in the floodplain, after fish migrate from the lake into the flooded habitats where they find rich feeding grounds or spawning habitats. Fishing lot owners will ensure that their area attracts as many migratory fish as possible, and then prevent them from leaving the area again. Guided by extensive fences, fish are often caught in massive numbers when they begin to move out of the floodplain when the water levels begin to drop.

To ensure that as many fish as possible will enter their area, fishing lot owners and operators will go to great lengths to limit any disturbance during the time when fish are moving onto the floodplain. This means total exclusion of people and boats, and even the lot operators will not enter the area at this stage. When the inward migration is complete, the entire floodplain area of the fishing lot is then encircled with a bamboo fence stretching for several kilometres (Figure 2). An additional fence is erected in the lake part of the fishing lot to prevent returning fish from escaping and ensure that they are guided into large traps.

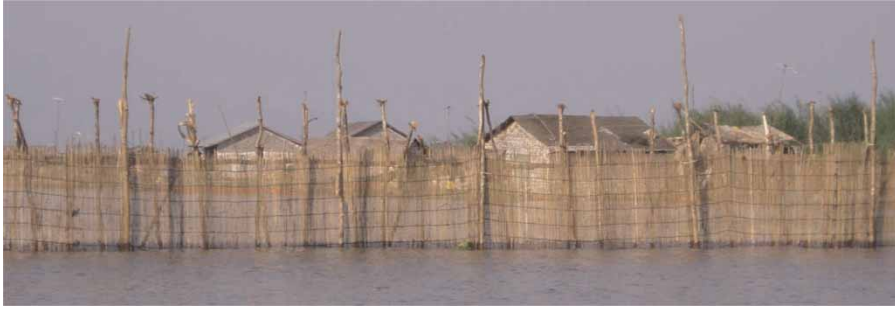


Figure 2. Bamboo fence on the fishing lot perimeter. The houses in the background are located outside the fishing lot.

In most cases, parts of fishing lots are subleased, allowing others to operate large-scale fishing gear or fishing activities. Tight control is exercised at all time throughout the system built on extensive patron–client networks (Degen & Nao 1998).

Fishing lots operations are subject to clear regulations (operating times, permitted gear and techniques, required conservation measures, etc.) and specifications (location, boundaries) which are an integral part of the lease. In general, no activities are allowed in the fishing lots during the closed season (1 June to 30 September) and there is little or no control of access or natural resources use during that time. Fishing lot owners have few other than commercial objectives, and for many buying fishing lot rights is purely an investment, as opposed to the hundreds of thousands of subsistence fishers to whom fishing is a matter of survival. This results in very high fishing pressures. In many cases, fishing lot operators will resort to illegal or destructive fishing methods such as damming channels and streams, or pumping the water out of permanent floodplain pools. The fishing lot regulations are enforced through a system of fines (undermined by the weak judiciary system), gear confiscation and licence revocation.

Threats to biodiversity of the Tonle Sap

The single largest threat to biodiversity of the TSBR is alteration of the flood pulse. Developments in the Mekong basin are likely to alter the characteristics of the annual flooding cycle as well as the quality of the inflowing water, and this could have a devastating impact on the entire ecosystem, disrupting fish migration, reducing the extent and intensity of the flooding, and reducing the amount of sediments and nutrients that are brought into the system and that fuel flooded forest growth, thus undermining ecosystem productivity (Junk *et al.* 1989, 1997, Sarkkula *et al.* 2003, Welcomme & Halls 2004).

The core areas are directly vulnerable to more local threats. The bird colonies have always been subject to collection of eggs and chicks at the nest, to the extent that next to fish they formed—and possibly still are—the largest source of animal protein for some of the floodplain resident communities (Parr *et al.* 1996; Ear-Dupuy *et al.* 1998). Juvenile birds are collected as pets. While this threat was reduced in the late 1990s following intense awareness-raising campaigns,

the practice nowadays seems to be going on as before (Goes & Hong 2002). This disturbance of nesting sites is believed to be the largest single factor threatening the large water bird colonies. Other local threats include draining of dry season pools and streams for fishing. This leads to direct loss of essential fish habitats but also to loss of important sources of food for the water birds. Clearing flooded forest for agriculture has been going on relentlessly over the past three decades. It is a threat not only in terms of loss of habitats and roosting places; it also undermines overall ecosystem productivity.

Private-sector involvement in biodiversity protection

The core areas of the TSBR are all at least partly situated inside fishing lots. The royal decree on establishment of the TSBR stipulates that these fishing lot activities are allowed to continue but need to be brought in line with the protection and conservation objectives of the core areas.

Currently, fishing lots provide protection to the core areas, albeit unintended, and more as a by-product of fishing lot operations than as an explicitly recognized and agreed management objective and responsibility. Biodiversity conservation is provided as long as and to the extent that it coincides with fishing lot operations. These operations differ from lot to lot, depending on the fish species targeted, the fishing gear and techniques used and the kinds of habitats present in the lot.

This protection is particularly valuable for the colonies of breeding large water birds, as the largest and most important colonies are found inside these few fishing lots. It is not clear how much protection other biodiversity elements are deriving from the fishing lots operations, if any at all. The migratory fishes are relentlessly pursued when they leave the floodplain and the core areas, but some species (such as those reproducing in the floodplain) will benefit from the protection during their residence time in the flooded forest and escape capture. Floodplain pools are crucial refuges for many fishes during the dry season, and their emptying or intensive fishing has undoubtedly a negative impact. The fishing methods and gear used in fishing lots are targeting commercially interesting species.

The fishing lots offer little or no protection of essential ecosystem processes such as the flood pulse. Although all fishing lots must protect the flooded forest vegetation in their area, in many cases the fishing lot operators have been clearing flooded forest, for example as a means to obtain legal ownership over the land. In other places, fishing lot owners recognize the importance of flooded forest as essential habitats for fishes (and hence for their catches) and provide active protection against clearing and excessive cutting.

Goes and Hong (2002) speculate that disturbance at nesting sites and egg and chick collection are the main driving forces for the location of nesting colonies. The fact that the largest colonies are found inside the fishing lots in Prek Toal is probably due to a combination of ecological conditions and comparatively low levels of disturbance. There are no immediate indications of specific ecological conditions at Prek Toal that would explain this as a preferred location of these colonies.

Overall, there are few direct benefits for fishing lot owners from protecting biodiversity. The water bird colonies are actually competitors for the same resource, and there are cases where strong suspicions exist of fishing lot owners being

responsible for the sudden disappearance of entire colonies elsewhere in the ecosystem (Goes & Hong 2002). It would seem that fishing lots covering the core areas at least slow down biodiversity loss compared with other parts of the Tonle Sap ecosystem that are under different management regimes.

There is also a public-sector involvement in the management and conservation of the core areas. The Ministry of Environment has a small network of rangers charged with protecting the integrity of the core areas. However, these are funded through an international non-governmental organization, and in practice are subordinate to the fishing lot operators.

Plans for the future: from private to public protection

The local private sector here is understood as entirely private undertakings without involvement of the government and carried out by local actors, mostly residing in or near the protected area in question. Because their protection role is not explicit and in general poorly recognized, the fishing lots system and its exploitation focus can be considered incompatible with or detrimental to the biodiversity conservation objectives of the TSBR. The compromise arrangement whereby pre-existing fishing activities were allowed to continue on the condition they adjust to meet core areas objectives has not been implemented. Only minor changes to fishing lot operations were made in connection with the bird colonies and ecotourism.

In 2000, the Asian Development Bank (ADB) launched its Tonle Sap Initiative, aimed at preserving the Tonle Sap ecosystem and the livelihoods of its people (ADB 2002). The ADB has since repeatedly added its voice to that of the Ministry of Environment (MOE) and non-governmental organizations to remove the fishing lots status from the core areas and bring these under a new management and protection regime, ending commercial fishing inside the core areas. The ADB (ADB 2005) and the Global Environmental Facility (GEF 2002) are now financing and preparing activities aimed at the removal of the fishing lots from core areas and replacing them with a new management and protection structure.

This would mean that the role of the local private sector in the protection of the core areas would be ended, and replaced by a public system. Such a system would require the development of effective co-operation formats and structures between the two main government agencies charged with the management and conservation of the Tonle Sap, i.e. the DOF and the MOE. The current compromise arrangements that were written in the decree establishing the TSBR have not significantly affected the authority of the DOF in the core areas. It is most likely, however, that the new management and protection structure will require a redistribution of management authority. This was already identified at the time the TSBR was established (Mam 1998) but little has been achieved. There are no plans at all at the moment to abandon the fishing lots system altogether.

As with the institutional arrangements, the technical plans also face considerable difficulties. One example is how to deal with migratory species. Suggestions have been made to exclude the core areas from fishing lots but otherwise to maintain the fishing lots surrounding a core area. This way, the fish that move into the core area during the flood will still largely be caught during their migration back to the lake when the floodwaters recede. This would be very similar to the current situation.

Discussion

Conservation methods are increasingly including the local private sector, with varying degrees of involvement and of success (e.g. Productivity Commission 2001). Private-sector involvement in GEF projects has been extensive (more than two-thirds of all its projects), but has also been identified as an area in which there remain many unexploited opportunities (GEF 2004). While the GEF 'plans to aggressively engage private sector actors' (GEF 2004, p. 29), then why would in Cambodia (the opposite) be pursued ending the private sector's involvement?

The main risk associated with the process of ending the current involvement of the private sector through the removal of fishing lots from the core areas is the creation of a protection vacuum during the time following lot removal until alternative arrangements become effective. In particular the breeding birds colonies are vulnerable in this respect. This risk is illustrated by the recent introduction of community fisheries in parts of many of the commercial fishing lots on the Tonle Sap prior to establishment of relevant new management structures, which has led to chaos. The massive influx of fishers during the transition period led to a substantial aggravation of the over-exploitation of the fisheries and widespread habitat degradation. While over half of the total area of the fishing lots was turned into community fishing areas, the best parts of most fishing lots remain in private hands.

There are obvious problems with the current involvement of the private sector in the biodiversity conservation of the TSBR. There is no doubt that the private sector provides a certain level of protection to some of the most important biodiversity elements of the TSBR. But the protection provided by the fishing lots is weak. It is only partial, as it is not enforceable, not recognized and not monitored or evaluated. No specific conservation responsibilities are assigned to the fishing lot owners. Biodiversity conservation is a by-product of fishing lot operations, with little or no perceived benefits for the fishing lot owner. As such, it is gratuitous, and there is no commitment by the fishing lot owner other than his or her commercial interests. If these interests change, or in years of extreme drought or flooding, fishing lot operations may change and the protection might not be established. However, it is so intrinsically linked with the fishing lot operations that it can be expected to be maintained as long as the fishing lot exploitation remains worthwhile and the fishing practices do not substantially change. The latter, however, is uncertain, as alterations to the Mekong hydrology could have a significant impact on the flood pulse and the subsequent changes to the Tonle Sap fisheries could be dramatic.

The primary objective of the fishing lots is uncapped catching of fish from the lot area. The permitted methods are prescribed in the lease agreements but the level of compliance varies widely, with many examples of fishing lot owners clearing large areas of flooded forest or using otherwise destructive and prohibited practices. Monitoring of fishing lot activities and enforcement of their regulations have always been problematic and highly ineffective. There are many other problems associated with the fishing lots system as such: the auction system is non-transparent and there is widespread corruption in the allocation of lots; only a fraction of the auction fees are effectively collected. Conflicts with other resource users over access rights and illegitimate expansion of fishing lots in the recent past

have been at times violent, in the overall climate of lawlessness on the lake. The seasonal character of the natural resources use also means that private-sector managers have clearly identified periods of interest, outside which little or no conservation activities, intended or other, take place. Often, dry season natural resource users such as mung bean farmers or fuel wood collectors are not even aware of the management arrangements during the flood.

The fishing lots system has its roots in a feudal system whereby revenue from the fisheries was collected as a form of tax through an extensive system of intermediaries (Degen & Nao 1998). In colonial times, the French institutionalized the system to maximize tax revenues. The fishing lots are essentially local private-sector enterprises, mostly run by investors with few other than commercial objectives. This makes them susceptible to financial incentives and penalties.

The major advantage of the fishing lots system is that it is very well known by all stakeholders, and fits well in the cultural and social structures of the society (Luco 1997, Blunt & Turner 2005). This is demonstrated in the recent establishment of community fisheries which have turned out to be a copy of the fishing lots system in all but that they are owned by communities instead of a private individual. Many of the operating methods are the same. Fishing lots are still the backbone of the fisheries exploitation of the Tonle Sap ecosystem, and are therefore a well-suited entry point to develop a new system in which fishing lots are improved to provide effective protection of biodiversity and ecosystem productivity. The small number of fishing lot owners and the commercial character of their undertakings makes the use of specific incentives and enforcement tools possible.

How well will the public sector perform? In Cambodia, rivalry between departments and ministries over control of natural resources in general is intense, and particularly so for the most lucrative fisheries and forestry sectors (Degen & Nao 1998). Institutional reform is moving at a very slow pace in Cambodia (for a recent analysis see Blunt & Turner [2005]) and there are few working examples of shared management responsibilities. The underlying explanation is that there is much more at stake than just management authority. With the latter comes direct and indirect control over a huge informal income and benefits system. This enables senior staff to allow subordinates to generate indispensable supplements to inadequate government salaries, and to generate benefits for themselves and their own superiors. The fishing lot covering the Prek Toal core area is officially producing about 1,700 tonnes of fish per year, worth at least half a million US dollars, and possibly three or four times that much (Troeng 2001).

It is highly unlikely that alternative management and protection arrangements will allocate control over part of the fisheries resources to any department other than DOF. This leaves the question of whom and how the management activities of the non-DOF partners under any new arrangement will be financed. As central government funding will not be available to cover all the costs, additional funds will need to be found elsewhere. The obvious sustainable source is the fishery but fishing lot auction fees are currently paid into central government coffers. Ecotourism could provide some of these but its potential is considered limited (Neou 2003). The public sector would have to bear the costs for the protective effects now generated by the fishing activities without getting their profits. At the moment, the public sector does not have the tools to generate the funds required from within the resource.

Public-sector management and conservation of biodiversity would place public goods back in public hands. The public administrations that would be involved in biodiversity conservation of the TSBR have a clear mandate in this respect, and are able to attract substantial external funding (i.e. donor support) that is otherwise not available to the private sector. The public sector has the potential to create an effective regulatory framework, and to adjust this to changes as required, for instance in response to the relocation of a breeding bird colony. Through the judicial and law enforcement systems, the public sector has in principle much larger and more effective resources for enforcement of its regulations than the private sector. The public sector through its conservation and management mandate can invest in capacity-building and other activities that have no or little commercial value but which are essential for effective conservation. The public sector is accountable for its performance, although this depends on the level of good governance.

The assessment of the benefits and disadvantages of different conservation systems is hampered by the lack of knowledge about the Tonle Sap. As there are no management plans for the core areas or the TSBR as a whole, and knowledge about the TSBR in all aspects is still rather limited, it is unclear what kind and level of protection the core areas would require. Clearly, the current protection requirements of the large water bird colonies are relatively well known (e.g. Goes & Hong 2002) but about the other species and processes much less is available. Only recently, for example, the rate at which water snakes are being caught in the TSBR became apparent (Stuart *et al.* 2000), possibly constituting the largest exploitation of any single snake assemblage in the world and with a potentially endangering effect on the endemic Tonle Sap water snake (*Enhydris longicauda*). The mobile character of most animals found in the TSBR adds to the complexity. Removing core areas from fishing lots would not at all end their involvement in biodiversity conservation of the whole ecosystem.

Conclusions

Current protection of biodiversity in the TSBR is weak, inadequate and largely provided, albeit unintentionally, by the private sector. It is providing some degree of protection for large water bird colonies and possibly some other groups of species, but little for ecosystem processes, and none to many fish species. The inadequacy of the current protection is recognized, both locally and internationally, but changes are slow and limited in scope. The ADB intends to support the transfer of conservation responsibility to the public sector, and has tied removal of fishing lots from the core areas to further financial support for poverty alleviation and livelihoods support in the TSBR (ADB, 2005). Contrary to a worldwide trend of engaging the private sector in biodiversity conservation, acknowledging its already existing contribution, this would effectively end direct involvement of the private sector in the TSBR core areas and replace it with more direct public-sector management and conservation.

The fishing lots are believed to be extremely lucrative. There appears to be large potential to reduce their profitability by mandatory allocation of part of the proceeds to biodiversity conservation and still attract private-sector interest. This would require a fundamental review of the auction process for these fishing

lots, including a realistic valuation of the fishing lots and effective open access to the bidding process. The level of good governance required, however, is not present today.

Looking for synergies between private- and public-sector interests, rooted in current conditions, would allow the development of improved conservation methods for the core areas. Extreme social and economic experiments of the last few decades have made Cambodians wary of any further novel developments, in particular when they relate to one of the pillars of their society and their food security.

Technically, there is a range of options to improve the management of fishing lots and engage them more effectively in biodiversity conservation. This requires the provision of incentives for additional investments in support of biodiversity conservation and compensation for loss of revenue compared to the current situation. The private sector has access to means that a fisheries or environment department can only dream of, but has little direct interest in biodiversity conservation. The commercial importance of fishing lots can fairly easily be combined with effective institutionalized biodiversity conservation, in partnership with and under guidance of the public sector. Given the strong linkages, any future plans and management arrangements for the core areas will need to consider neighbouring communities and fishing lots. In the overall co-management framework of the Tonle Sap—which still needs to be made explicit—the private sector plays a key role and needs to continue to do so.

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