

Is the extirpation of Irrawaddy dolphins *Orcaella brevirostris* in Laos imminent: an assessment of status and recommendations for conservation

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ABSTRACT

All freshwater sub-populations of Irrawaddy dolphin, *Orcaella brevirostris*, are considered critically endangered, including those inhabiting the Mekong River in Cambodia and Laos. In Laos, dolphins historically ranged in a number of tributaries in the Sekong River Sub-basin, and in the mainstream of the river around a trans-boundary deep pool on the Laos-Cambodia border – downstream of a large waterfall complex that prevents dispersal upstream. Dolphins now appear to be extirpated from the Sekong sub-basin, and only six individuals remain in the trans-boundary pool. These last six dolphins in Laos are isolated and their population declining. The use of gillnets, explosives, and electric fishing gears was common in the pool in the 1990's. Despite efforts at protection on both sides of the border, and these threats continue. The proposed Don Sahong dam would also likely cause the extirpation of dolphins in Laos. Conservation measures are urgently needed in Laos' dolphins are to persist. Eliminating dangerous fishing gears from the area and managing boat traffic are key. Conservation efforts will require coordinated action across the trans-boundary area from both Laos and Cambodia.

KEY WORDS: ASIA, ABUNDANCE ESTIMATE, CONSERVATION, FISHERIES, GILLNETS, WHALEWATCHING.

INTRODUCTION

All freshwater populations of Irrawaddy dolphin, *Orcaella brevirostris*, are critically endangered (Smith *et al.*, 2007). In the Mekong River dolphins were once distributed from the delta in Vietnam, throughout the Tonle Sap, and into southern Laos (Smith & Jefferson, 2002). In Laos, dolphins occurred in two distinct areas: in a trans-boundary deep pool area on the Laos–Cambodia border, and in a number of tributaries to the Sekong River sub-basin, which branches from the Mekong downstream in Cambodia (Baird & Mounsouphom, 1997). The Mekong population has declined greatly from its former range and is now absent from the Tonle Sap and Vietnam (Beasley, 2007). In 2010, just 85 adults were estimated in the Mekong River, and there is great concern that a very few individuals remain in Laos (Ryan *et al.*, 2011).

Irrawaddy dolphins are the only cetacean present in Laos, a land-locked country. Irrawaddy dolphins also hold special status as a sacred species – traditional tales tell of their human ancestry (Baird & Mounsouphom, 1994). More recently, rapid expansion in dolphin watching tourism in Laos has brought direct financial benefit to local communities. For instance, tours leaving Hang Khone have risen from 3,480 visitors in 2008, to 7,200 visitors in 2011, directly resulting in income of over US\$15,000 for the local community in 2011 (S. Schipani, Asian Development Bank, *unpublished data*). This represents only a portion of the total tourism activity at the site and does not include the associated service income from guesthouses, restaurants, etc. The same tourism activity may be at risk however, if the dolphin population is threatened.

Here I review available information on Irrawaddy dolphins in Laos: the distribution and abundance of dolphins in Laos, sources of mortality, and current and ongoing threats. Combining this with new survey work and unpublished data, I assess the status of dolphins in Laos. Based on this assessment, I then make a series of recommendations to conserve dolphins in Laos. The paper is based on an unpublished report to WWF (Ryan, 2012), and includes additional information from 2013.

METHODS

Review

To review evidence of dolphins in Laos, I examined the output of successive research efforts, namely: Baird and collaborators in the early-mid 1990's (e.g., Baird *et al.*, 1994), Beasley and collaborators in the early-mid 2000's (e.g., Beasley, 2007), and ongoing work from WWF and the Cambodian Fisheries Administration since 2005 (e.g., Ryan *et al.* 2011), which included some as-yet unpublished data. Reports of dolphins in Laos were also sought through my own informal contact networks, and via web searching on Google Scholar (scholar.google.com).

Abundance surveys

Photographic identification surveys for dolphins have been carried out at the trans-boundary pool since 2001, with good data in 2004 (Beasley, 2007), and from 2007–onward (Ryan *et al.*, 2011). Detailed methods from survey work in 2001–2007 can be found in Beasley *et al.* (2012; also Beasley, 2007) and from 2007 onwards in Ryan *et al.* (2011). Both Ryan *et al.* (2011) and Beasley *et al.* (2012) report on surveys for the whole population in the Mekong River; here I only consider those records from the trans-boundary pool. I also report previously unpublished data collected by WWF and the Fisheries Administration from 2011–2013, which follows the methods of Ryan *et al.* (2011), and comprises 40 formal photographic-identification days between 2007–2013, as well as many informal visits to the site. No abundance survey work is known from Laos outside of the trans-boundary pool area.

Mortality records

Carcass recording and recovery programmes have recorded dolphin mortalities in the trans-boundary pool area from 1991–1996 (Baird & Mounsouphom, 1997) and from 2001–onward (Gilbert & Beasley, 2006; WWF unpublished data). Under these programmes, information about the occurrence of dead dolphins is elicited and corroborated from local people through interviews. People are encouraged to report carcasses to conservation programmes. Carcasses are then recovered and necropsied where possible. These records therefore represent a minimum estimate of dolphin mortalities in the area for the years covered, rather than a complete record.

Gillnet presence

I made counts of gillnets set around the trans-boundary pool area on four visits to the site between January and April, 2012. The counts were conducted during dolphin photographic identification training and survey work. We surveyed the entire pool area, and the number and approximate location of nets were recorded. Lines of buoys typical of gillnets were recorded as a single gillnet, and a small portion of nets were drawn out of the water for confirmation. Having around 5 years experience working in the area, and conducting these surveys with local colleagues and government fishery colleagues from both Laos (in January) and Cambodia (February–April), I am confident that the portion of misidentified nets is likely to be very low.

RESULTS & DISCUSSION

Dolphin distribution in Laos

Mekong River mainstream

Dolphins are long-recorded from the trans-boundary pool on the Cambodia–Laos border, below the Khone Falls complex (Fig. 1). The broad area used by dolphins is around 6 km² across the base of the falls and above the shallow and rapid water typical of the Stung Treng Ramsar Site downstream. Between Ban Hang Khone, Hang Sadam (Laos) and Anlung Cheuteal (Cambodia; Fig. 1) lies the deep pool, an area of around 1 km² and >35 m deep, which is of key importance for both dolphins and fish (Poulsen *et al.*, 2002; Viravong *et al.*, 2006; WWF unpublished data). Dolphins are almost always found within this deep pool area, regardless of season (Stacey & Hvengaard, 2002; GER, *pers. obs.*)

The falls complex is a series of steep braided channels and small cascades that appear to be a barrier to upstream dispersal of dolphins (Baird & Mounsouphom, 1997). For a short period during one wet-season in the 1960's, there are anecdotal reports of dolphins just above the falls around Don Dtan Village, apparently returning downstream the same month (Baird & Mounsouphom, 1994). There is no evidence that dolphins were ever permanently established upstream.

Isolation in the trans-boundary pool

The trans-boundary pool is separated from the nearest downstream dolphins by a 60 km complex stretch of river containing a large number of rapids – the Stung Treng Ramsar Site. Although there is exchange of individuals among dolphin habitat core areas downstream (WWF, *unpublished data*), and dolphins are able to traverse rapids (GER, *pers. obs.*), evidence suggests that those dolphins inhabiting the trans-boundary pool have been isolated for at least 10 years.

Since 2001, photo-identification surveys have regularly recorded and re-recorded the presence of individual dolphins throughout their range in the Mekong River (Beasley, 2007; Ryan et al., 2011). During that time, there have been no records of dolphins dispersing into or out of the trans-boundary pool, and no new individuals have been recorded in the pool since 2007. One individual was reported by Gilbert and Beasley (2006) to have dispersed downstream from the pool, based on photographic-identification. Further work has suggested that this record was mistaken for a downstream individual (I. Beasley, James Cook University, *pers. comm.* 2012). The evidence now is very clear that this trans-boundary sub-population is isolated.

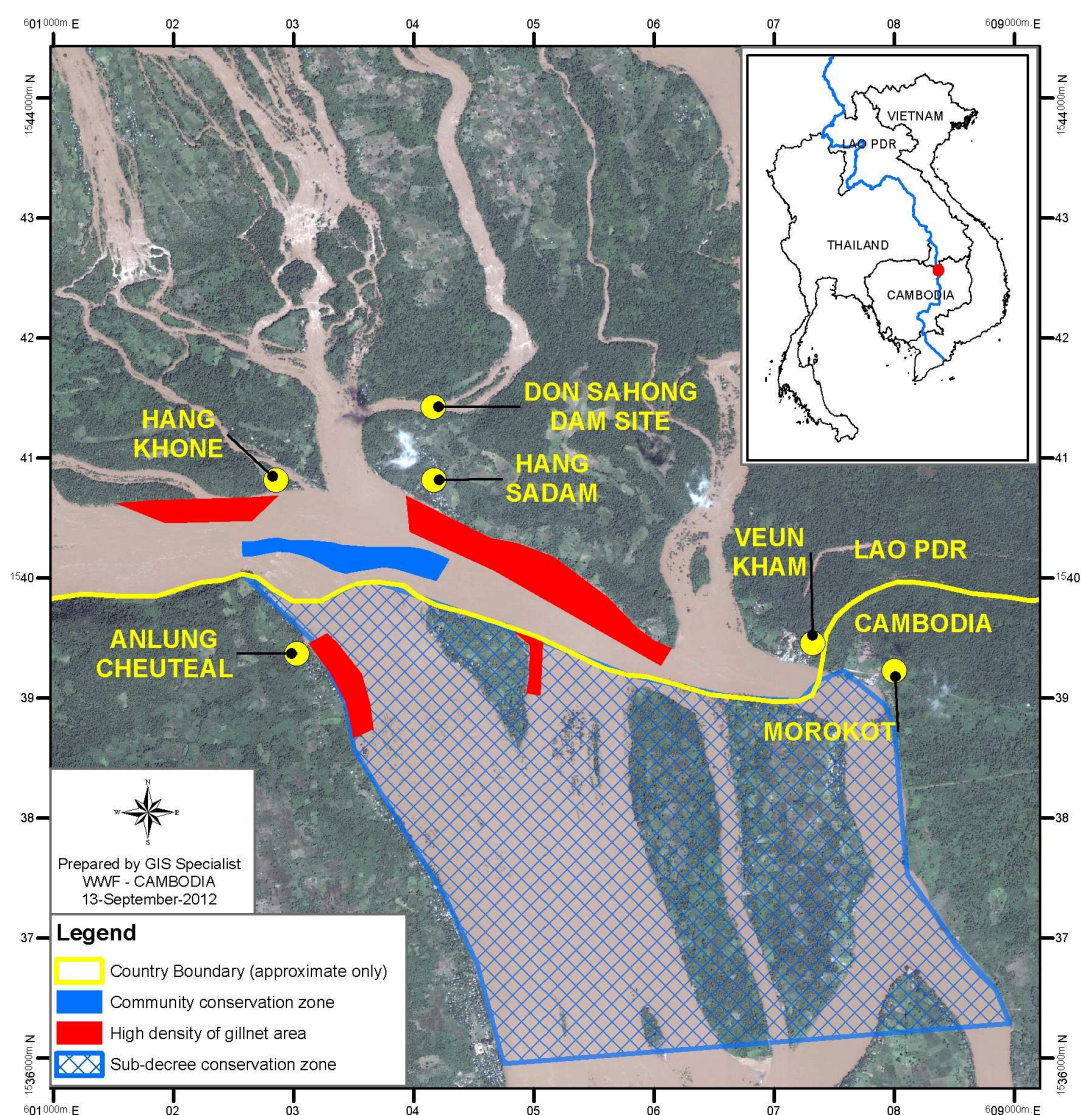


Figure 1. The trans-boundary dolphin pool and surrounds, showing areas of high gillnet use (red), villages (yellow dots), and conservation zones on both sides of the border (solid and hatched blue). Site for the proposed Don Sahong dam is also shown (yellow dot). Dolphins are most frequently found in the ~1km² deep water pool between Hang Khone, Hang Sadam, and Anlung Cheuteal, approximated on the Lao side by the community conservation zone. This area is the only location where dolphins occur in Laos. Inset: location of the map within mainland Southeast Asia (red dot) and Mekong River mainstream (blue). *NB: International borders are indicative only; they do not represent an opinion on the location of any borders in either the main or inset maps.*

Sekong River sub-basin

The Sekong River is a major tributary of the Mekong River flowing from Southern Laos to join the Mekong in Stung Treng in Cambodia. Within the Sekong itself, dolphins were historically reported upstream of Kaleum Town in Sekong Province, almost 300 km upstream of the confluence with the Mekong and 200 km north of the Laos–Cambodia border. Elsewhere, dolphins are reported from the Xepian, Xenamnoi, and Xekhaman Rivers – tributaries of the Sekong (Baird & Mounsouphom, 1994; 1997). Baird and Mounsouphom (1994; 1997) provide detailed accounts of recent-historic dolphin distribution based on interviews in the area. Many of these rivers are quite shallow, and dolphins were mostly reported during the higher water levels of the wet-season, though year round in some places. By the early 1990's however, it was clear that records from the Sekong sub-basin were increasingly scarce (Baird & Mounsouphom, 1997). Conflict during the America–Vietnam war, resulting in the bombing of rivers by American aircraft may also have contributed to dolphin declines in the Sekong. Dolphins are no longer believed to use the Sekong sub-basin even seasonally (Davies *et al.*, 2006), and almost certainly no resident groups remain. The only known recent reports (within 15 years) from the Sekong are from 2006 when a small group was seen and one animal may also have been shot (V. Cowling, WWF-Greater Mekong Programme, *pers. comm.* 2012). Follow-up surveys to uncover any recent evidence of dolphin occurrence in the Sekong sub-basin should be a priority, though their presence is now extremely doubtful.

Abundance

No historic estimates of the size of the dolphin population in the trans-boundary pool exist, however, within living memory, as many as 40–50 dolphins may have used area (K. Chantaboualy, Hang Sadam Village, *pers. comm.*, 2012; Phoy V., AnlungCheuteal Village, *pers. comm.*, 2012). Although the pool appears relatively small to support such a population even for part of the year, the vast migrations of fishes through the falls could easily support such numbers of dolphins (Daconto, 2001; Poulsen *et al.*, 2002). It is believed dolphins previously used a larger portion of the surrounding area; moving around channels and closer to waterfalls, but it is impossible to verify the accuracy of these reports today. Since conservation attention began to focus on these trans-boundary dolphins in early 1990's, a minimum of 17 dolphins were reported present in 1993 (Baird *et al.*, 1994; Stacey & Hvengaard, 2002), and local reports suggest that around 25 animals were resident in the area (K. Chantaboualy, *pers. comm.* 2012).

Photographic-identification (photo-ID) was first attempted in Laos in 1993, but met with little success due to poor equipment (Stacey & Hvengaard, 2002). Beasley (2007; Beasley *et al.*, 2012) found 10 individuals present in 2004 (Fig 2). Given the significant effort Beasley devoted to photo-ID animals in this small area (Beasley, 2007), it is very likely that she captured all animals in the site at that time. It is not clear the number of individuals present in 2005–2006, though two animals were known to die in 2006 (see *Mortality*, below). In 2007, only eight animals were recorded in the trans-boundary pool. This comprised six clearly marked individuals, as well as two distinct though 'unmarked' individuals believed to be sub-adults/older juveniles. In 2008 all individuals known from 2007 were also recorded. In 2009, one of the unmarked animals was no longer recorded (believed dead), however all others were. These animals were all again recorded in 2010 and 2011, totalling a population of seven in those years. In 2012–2013, despite considerable survey effort in the area, one marked individual was not detected and is almost certainly dead. This brings the total number of Irrawaddy dolphins currently using the trans-boundary pool down to six individuals (Fig. 2).

No new animals have been recorded in the area since 2007 (Ryan *et al.*, 2011; WWF *Unpublished data*). Forty separate days have been spent searching the area under formalized photo-ID protocol between April 2007 and March 2013; while dozens of days of informal observation through this time also failed to find new animals. Given the initial rapid accumulation of new individuals in 2007 (all were found in the first two days), and extended efforts, it is extremely unlikely that any individuals have been missed. Although it is typical to pair photo-ID methods with mark-recapture type analyses, with such a small population, such analysis is not only unnecessary but would blur an otherwise very clear picture. Considerable effort has been put into surveying the area and only six individuals can now be found – we can be confident that these are the only dolphins remaining in the area.

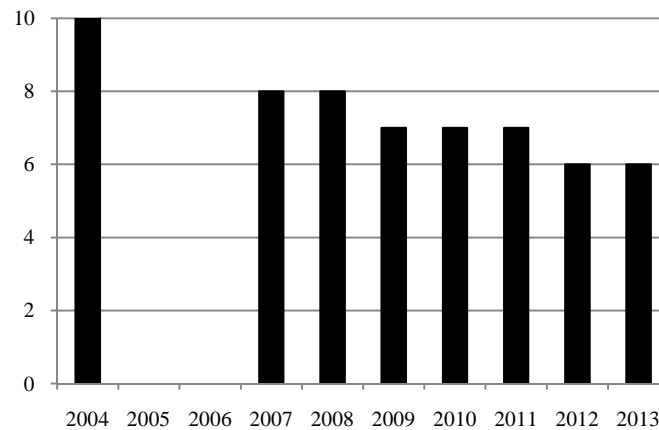


Figure 2. Population of Irrawaddy dolphins in the trans-boundary pool from 2004–2013 based on number of photographically-identified individuals each year.

Mortality

From 1991 to 1997, at least 26 dolphins died in and around the trans-boundary pool (Baird & Mounsouphom, 1994; Baird *et al.*, 1994; Baird & Mounsouphom, 1997; Fig. 3). Six dolphin deaths are also known in the Sekong sub-basin between 1989 and 1997 (Baird & Mounsouphom, 1994; Davies *et al.*, 2006). Gillnets were identified as the main source of mortality, however many uncertain cases were also believed to be due to the use of explosives for fishing. Several animals were shot or died in fish traps, while the cause of other deaths is unknown.

From 2001 to 2006, eight dolphins died either around the trans-boundary pool, or were recovered downstream of the pool and almost certainly originated there (Gilbert & Beasley, 2006; Beasley, 2007; WWF *Unpublished data*; Fig 2). These included one juvenile possibly hit by a boat, and a perinate calf, for which the cause of death was not clear. The other deaths were all adults. Gillnets were recorded or implicated in three of the adult deaths, one was reported to have been shot by a Lao policeman, and the cause of death of the other two is unknown. In addition, body parts of four dolphins were recovered in 2001; two of which were believed to have died within the preceding year, and two of which were considerably older and may have been from previously recorded mortalities. One additional dolphin may have been shot in the Sekong River in 2006, though this remains unconfirmed (V. Cowling, WWF-Laos, *pers. comm.*, 2012).

Since the end of 2006, no carcasses have been recovered around the pool and there are no reported mortalities. This appears to be good news, but it is not without caveat. With the population so reduced fewer dolphins are expected to die. Strong-handed control on gillnet fishing since 2006 on the Cambodian side very likely also reduced willingness to report dead dolphins for fear of retribution or punishment (especially reporting any dolphins caught in gillnets). Further, evidence from ongoing population studies suggests two animals have died since 2007 (see *Abundance* and figure 2, above). The lack of records is certainly not evidence that no animals have died in the area since 2006. It is an error to interpret the number of carcasses recovered as the exact total number of deaths, as it is unlikely that all dead animals will be found (e.g., Williams *et al.*, 2011). The area around the pool is well inhabited and any carcasses to strand nearby would likely be found. However, the area immediately downstream is sparsely populated and highly complex, so carcasses that drift downstream are much less likely to be found. We should therefore interpret recorded deaths as no more than a minimum estimate. At least 34 dolphins died in the trans-boundary pool area over the past two decades, or nearly two per year (Fig. 3). In addition to potential difficulty finding some carcasses, there is a recording gap from 1997–2001, so the total number is almost certainly higher.

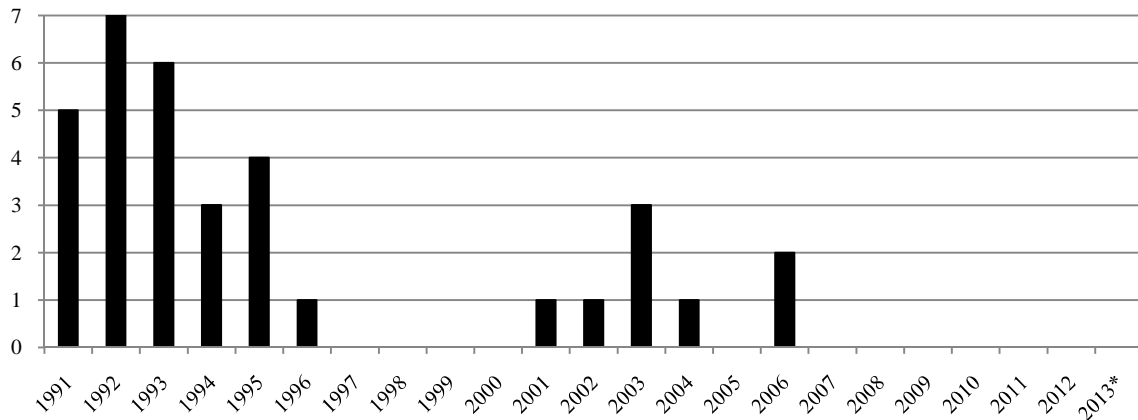


Figure 3. Number of reported/recorded deaths around the trans-boundary pool from 1991–2013. (*2013 is only until May 2013). 1997–2000 shows a gap in effort to record mortalities, rather than a decrease in mortalities. NB: *Baird and Mounsouphom (1994) report six deaths in the 16 months leading up to April 1992. This figure reports these data averaged over the 16 months, rounding to five in 1991 and one in 1992 (an additional six were reported for the remainder of 1992, totalling seven for the year).*

Ongoing threats

Despite the significance of the trans-boundary dolphins for local communities and tourism, they face significant threats at the site – in particular, intensive use of gillnets in some parts of the pool, and apparently increasing and illegal use of explosive fishing. Boat traffic is increasing and is a source of disturbance to the dolphins, especially due to tourism in the dry season. Infrastructure projects in and around the pool could also be highly detrimental, in particular the proposed Don Sahong dam may directly cause the extirpation of dolphins in Laos.

Fishing

Catching dolphins is illegal in both Cambodia and Laos. On the Laos side in the deep-water area there is a community-mandated protected area where gillnet fishing is banned (Fig. 1). On the Cambodian side there is a larger nationally decreed protected area for dolphins, where gillnet fishing and a range of other activities are banned (Fig. 1). Despite patrolling by the community fishery group in Laos and River Guards in Cambodia, these efforts are frequently ignored. In repeated visits to the site from January–April 2012, systematic observations regularly counted over 100 separate gillnets in and around the deep pool area and up to 188 on one occasion. The majority of nets were concentrated around the south of Hang Sadam, where dense rows of nets were strung out in shallow water perpendicular to the shore (Fig. 1). Higher densities were also recorded in shallow areas west of the dock at Ban Hang Khone, and in shallow water in front of the village at Anlung Cheuteal (Fig. 1). Gillnets were also observed scattered around other parts of the area on both sides of the border. The presence of gillnets in close proximity to areas very regularly used by the trans-boundary dolphin group is a very grave concern. Gillnets are a well-known threat to small cetaceans worldwide (Reeves et al., 2013). Even if nets are not in the areas most often used by dolphins, it is almost certain that with so many nets, animals will occasionally become entangled. With such a small population as this, the risk of entangling dolphins is incompatible with the goal of their long-term survival in the pool.

Destructive fishing with explosives, electrofishing and fish-poisoning are all reported to occur around Au Svay, just downstream of the trans-boundary pool in Cambodia, with the use of explosives reported to be particularly frequent (Chheng & So, 2011). Observations of unusually large numbers of freshly dead fish floating in the pool itself in early 2012 gives credence to local reports that the use of explosives is also increasing in the surrounding area upstream in Laos. Explosive fishing has already killed dolphins in the Mekong, and electrofishing and poisoning have high potential to do so. These destructive fishing practices are not only dangerous to the dolphins, unsustainable for fisheries, and extremely damaging to the local ecosystems, but they are a very serious danger to those who practice them—particularly the use of homemade explosives, which can explode in boats, injuring or killing fishermen. Several fishermen died using explosives in the area in 2012. Efforts to control these dangerous practices are not only critical to dolphins, but a humanitarian necessity also, requiring better education within local communities of the impacts and risks. Furthermore, illegal fishers pose a risk to public security, as they are reported to carry firearms and shoot at community patrols and river guards (V. Cowling, WWF, *pers. comm.*, 2013).

Boat traffic

Boat traffic at the site is significant and growing. Concern arose as early as the 1990's of the effect of boat traffic on dolphins in the area (Baird & Mounsouphom, 1994), and research at the site shows dolphins avoid motorized boats (Stacey & Hvengaard, 2002). In 1993, only around one quarter of the 40 boats on Hang Sadam were motorized. Today, at a conservative estimate at least 80% of the boats using the area would be motorized, and the total number of boats is much higher. Paddle boats are virtually only used for small excursions close to the river bank (such as checking gillnets), and thus the vast majority of boats approaching dolphins are those with motors (GER, *pers. obs.*).

As well as disturbance, fast-moving boats may strike dolphins, injuring or killing them. Though no dolphins are known to have been killed by boat strike in the Mekong, one individual at the trans-boundary pool was struck by a boat in 2012, causing large, deep wounds on the tail. The animal appears to have recovered, though a large deep scar remains visible. Further, on juvenile dolphin that died at the pool is suspected of having died from a boat strike (Beasley, 2007; WWF, *Unpublished data*)

Hydropower development

The proposed Don Sahong dam site lies just upstream of the trans-boundary pool (ICEM, 2010; Fig 1.). Of particular concern is the proposed excavation of 2.3 million tonnes of rock from the Hou Sahong Channel, directly adjoining the pool (Mega First Corporation Berhad, 2007). If the blasting associated with this excavation does not result directly in deaths or the dispersal of the dolphins away from the area, ongoing noise disturbance from turbine operation almost certainly would. The threat from the Don Sahong dam, as well as other dams, is discussed in detail elsewhere (see: Bezuijen *et al.*, 2007; Ryan & Goichot, 2011). The threat is not to be dismissed: the construction of a dam at Don Sahong dam is likely to cause the extirpation of the remaining dolphins in Laos.

CONCLUSION & RECOMMENDATIONS

Six dolphins remain isolated in the trans-boundary pool, and they are the only six dolphins in all of Laos. Significant threats continue around the site in the form of intensive gillnet use, destructive fishing, and unregulated boat traffic. Infrastructure proposals around the site are significant future threats. These threats are incompatible with the persistence of dolphins in the trans-boundary pool.

The future for dolphins in Laos is bleak, though not hopeless. That most of the threats occur on both sides of the Laos-Cambodia border makes it clear that both nations must respond with parallel actions and trans-boundary cooperation. Dolphins persist in Laos, but without urgent intervention in the trans-boundary pool and surrounding area, they will not persist for long. Actions are urgently needed to reverse the situation. Specifically, these actions are:

- a) Immediate banning of gillnets from all parts of the trans-boundary pool throughout the year,
- b) Concerted effort to end illegal fishing and the use of explosives in the area,
- c) Trans-boundary efforts to regulate boat traffic transiting the deep pool,
- d) Commitment not to build the Don Sahong dam, and
- e) Secure funding to support conservation efforts at the site, including effective enforcement of the above recommendations.

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