

IRRAWADDY DOLPHINS (*ORCAELLA BREVIROSTRIS*) IN SOUTHERN LAO PDR AND NORTHEASTERN CAMBODIA

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ABSTRACT

The presence of the Irrawaddy dolphin *Orcaella brevirostris* in the Mekong, Sekong, Sesou, Sekhaman, Senamnoi, Sekampoh, and Sepian Rivers in Southern Lao PDR, and the Mekong River in North-eastern Cambodia, was documented between December 1991 and March 1994. Information on dolphin feeding and seasonal migratory behaviour has been collected. Anecdotal reports from villagers imply that populations have greatly declined in recent years. Many villagers in Southern Laos and Cambodia believe dolphins are reincarnated humans, and the species is highly respected by local people, who never eat the meat of dolphins and only very rarely harm them intentionally. Nevertheless, several sources of anthropogenic mortality have been identified. These include animals being killed in gillnets, by explosives used for fishing by Cambodians in portions of the Mekong and Sekong Rivers shared between Laos and Cambodia, and being shot by soldiers or villagers unfamiliar with them. Many were probably killed during United States aerial bombing raids over the Sekong River during the Indochinese War. Decreases in fish catches also indicate a reduction in available prey. Large-scale dams proposed for the Mekong and Sekong Rivers threaten the species in Laos and Cambodia, as well as many species of migratory fish. A community-based research project has been set up in Southern Laos to investigate traditional fisheries, fish and dolphin ecology and biology, and other environment and socio-economic issues of significance to the fishing villages where work is continuing.

INTRODUCTION

Irrawaddy dolphins *Orcaella brevirostris*, which reach about 2.5 m in length, are distributed from the Bay of Bengal east to New Guinea, and from northern Australia through the South China Sea (LEATHERWOOD ET AL., 1984; MARSH ET AL., 1989). A brief review has been given in BAIRD ET AL. (1994). There have been numerous sightings, but no systematic surveys for this species have been conducted. Included in the habitat of this cetacean are the large river systems of the Irrawaddy, Mahakam, and Mekong. In Kalimantan, Indonesia, they are found in lakes at least 200 km up the Mahakam River (TAS'AN ET AL., 1980; TAS'AN & LEATHERWOOD, 1984). This species has been seen almost 1300 km up the Irrawaddy River in Burma, but apparently does not occur in the Salween and Sittang, the other large rivers in the country (U TIN THEIN, 1977). In Thailand, the species was previously known to enter large rivers, including the Chao Phraya (LEKAGUL & MCNEELY, 1977) and the

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Chanthaburi River, as reported by Chanthaburi residents living along the river. It is possible that pollution and heavy river traffic on the Chao Phraya River and dams on the Chanthaburi River have resulted in the dolphins' disappearance from these rivers in recent years. Irrawaddy dolphins are also found in brackish estuaries and salt-water coastal waters in many Asian countries, including Thailand, where they are often referred to as "pla loma hooa baht" because their snouts are rounded like a monk's bowl ("hooa baht").

In Indochina, LLOZE (1973) documented the presence of Irrawaddy dolphins in the Vietnamese and Cambodian portions of the Mekong River. Recent summaries of dolphins (KLINOWSKA, 1991; MARSH ET AL., 1989) do not include Lao PDR in the known distribution of the species. CHAZEE (1990) reported on a river mammal present in Southern Lao PDR, downstream of the Mekong's Khone Waterfalls, and also in the Sekong and its tributaries, the Sekhaman and Senamnoi. The villagers called the animal "pa kha", which is the local Lao Loom word for dolphin. CHAZEE (1990) reported that the animal is not intentionally hunted, but is occasionally caught accidentally in nets used for fishing, sometimes resulting in mortality. He suggested that the animal was marine in origin, but concluded, based on certain characteristics that he did not elaborate on, that it was a sirenian, not a cetacean. This observation was incorrect, and the mistake in identification may have been based on information Chazee collected regarding the Lao Theung ethnic group's belief that "Pa Kha" eat grass, as sirenians do. In April 1992, Lao Theung people in Sekong Province reported having previously observed dolphins feeding on submerged vegetation near the edges of rivers. The dolphins were probably feeding on small cyprinid fishes that sometimes stay amongst submerged vegetation. The mistaken identification may also have occurred because the head and body of the Irrawaddy dolphin resembles that of a sirenian. The species does not have a pointed snout typical of many other species of dolphins.

In this paper we report on observations made during our preliminary surveys of portions of the Mekong and Sekong Rivers in southern Lao PDR and northeastern Cambodia, emphasizing verbal reports and perceptions of local people about dolphins, and first hand observations of dolphin distribution, food habits and mortality. A brief summary of our survey has been given by BAIRD ET AL. (1994); the present account provides many more details.

METHODS

Surveys were conducted during December 7–15, 1991, and March 27–April 10, 1992, in the southern Lao provinces of Sekong, Attapeu, and Champasak. Local Lao Loom and Lao Theung people in 34 villages situated along the Sekong River between Sekong and the Lao/Cambodian border in southern Attapeu Province were systematically interviewed during August 1992. Work was done in Champasak Province between January 1993 and March 1994, and in Sekong and Attapeu Provinces during August 5–15, 1993. The Mekong River in North-eastern Cambodia was surveyed in March 1993. In all cases, except in Cambodia, rivers were travelled by boat and observations of dolphins, fish and their relationships to

local people were recorded. During the survey done in Cambodia, boats, trucks, and a helicopter were used to travel along the Mekong River north from Phnom Penh to the Lao and Cambodia border, passing the provinces of Kampong Cham, Kratie and Stung Treng. It took one week to complete the round-trip journey. Discussions with villagers living along river shores were used to collect information on both historical observations and the current presence of dolphins and various fish species. Instances of dolphin mortality in Southern Laos have been recorded since December 1991, based on observations and credible reports from local people and government officials. Full necropsies were performed on three dead animals in 1993. Skin, blubber, muscle, and liver samples were collected for genetic analysis from three dead animals in 1993 and blubber and skin samples were collected from three other animals in 1992. Between January 1993 and March 1994, the dolphin population in the portion of the Mekong River bordering Laos and Cambodia near the Lao villages of Hang Sadam and Hang Khone was estimated based on numerous daily observations by the authors. In April 1993, each of the 120 Lao families living in the villages of Hang Sadam and Hang Khone were systematically and individually interviewed by the authors and other staff members of the Lao Community Fisheries and Dolphin Protection Project. Information on the feeding habits and seasonal migrations of the dolphins has also been collected through villager interviews, observations of dolphins in the field, and inspection of remains of dolphin prey collected along the Lao/Cambodia border in Southern Champasak Province, Lao PDR.

RESULTS AND DISCUSSION

Distribution of Dolphins in Lao PDR and Northeastern Cambodia

Irrawaddy dolphins were sighted by the authors in the Mekong River, but not the Sekong, Sekhaman, Senamnoi, Sesou, Sepian or Sekampoh Rivers. However, villagers related numerous accounts of dolphins in the Sekong and its larger tributaries in southern Laos. In addition, a skull of a dead dolphin was recovered near Sekong town, which is next to the Sekong River, in December 1991, and a photograph of a dead dolphin found in the Sesou River taken in 1984 was obtained from the Lao government.

Sightings during the surveys and reports from villagers indicate that there are two main areas in Lao PDR inhabited by Irrawaddy dolphins. The first is in the southern-most section of the Mekong River in Champasak Province, along the Cambodian border. The other is in the Sekong River, itself a tributary of the Mekong, and some of its larger tributaries in the provinces of Sekong and Attapeu. Many, if not all, of the dolphins present in Lao PDR probably spend at least some of their time in Cambodia. Locals report that for the last few years dolphins have been observed only in the Sekong River in Lao PDR during the high-water monsoon season, before travelling down the Sekong River to Cambodia when water levels begin to go down. In the Mekong River of Lao PDR, the dolphins are only found along a portion of the river bordering Cambodia.

The great Khone rapids and waterfalls are just north of the villages of Hang Khone and Hang Sadam, which are situated on islands in the Mekong River just across from Cambodia at the southern-most point of Lao PDR. They appear to act as a natural barrier for the dolphins, and dolphins are not believed to inhabit the Mekong River above the waterfalls. However, a number of locals from Don Dtan Village just north of the rapids and waterfalls reported having once seen a group of dolphins near their village in the 1960s during the high-water season. The dolphins were observed daily by the villagers for about one month before apparently returning south to the Hang Khone/Hang Sadam area. The dolphins probably travelled up "Hoo Sahong" channel, which is one of the few Mekong River channels in the falls area that migrating fish can easily ascend. Irrawaddy dolphins, which are apparently the only species of cetacean found in Lao PDR and Northeastern Cambodia, are not known by villagers living north of Don Dtan Village.

In the Sekong River, which flows through the Lao provinces of Sekong and Attapeu before entering the Mekong River in the North-eastern Cambodian province of Stung Treng, Irrawaddy dolphins were reportedly once very common within a 200-km section of the Sekong River from at least 60 km north of Sekong town to the Cambodian border in Southern Attapeu Province. They were also common in the Sekong River's larger tributaries in Attapeu Province, including the Sekhaman, Senamnoi, Sesou, Sepian and Sekampoh Rivers.

In August 1992, villagers in 34 Lao villages situated along the Sekong River from Sekong south to the Lao/Cambodian border were interviewed regarding dolphins and the socio-economic situation in the villages. Virtually all adults were familiar with the dolphins. While the dolphins apparently used to be seen all year round in many parts of the Sekong River in Laos, they are now only seen in some years, and mainly during the monsoon season (June to November) when the river rises.

In Cambodia, interviews with villagers, Fisheries Department officials, boat owners, and UNTAC (United Nations Transitional Authority in Cambodia) river patrol personnel, indicated that the largest concentration of dolphins in the Mekong River in Cambodia exists in the provinces of Kratie and Stung Treng, which are also two of the most remote and least populated provinces. Although more people live in Kratie, only 60,000 people live in the whole of Stung Treng Province. Dolphins are also occasionally seen in the Tonlesap River (KLINOWSKA, 1991), and one animal was observed and filmed in the Pasak River in 1993 (SANITHON HUTAKOM, pers. comm., 1993). Although no dolphins were seen during the Cambodian survey, most villagers interviewed knew of them and said they are at least occasionally found in most parts of the Mekong River north of Phnom Penh. However, most people south of Kratie said dolphins are only rarely seen, and then mainly in the monsoon season. Villagers identified five deep water pool areas in an approximately 200-km section of the Mekong River between Kratie and the Stung Treng/Lao border where dolphins are said to live in considerable numbers on a regular basis. In order of importance as dolphin habitat in terms of numbers of dolphins normally seen by villagers, these pools are at Khoopee, Goi Hep, Hang Khone (Lao/Cambodian border), Siem Bok, and Gawtawmpbawng island. These deep water pools are apparently the preferred habitat of the dolphins, especially in the low-water dry season between December and May. Lao and Cambodian villagers have also

reported that dolphins inhabit the Cambodian part of the Sekong River and the Sesan River in Cambodia.

Local Perceptions of Dolphins

Villagers in Cambodia and Lao PDR believe that dolphins are friends of humans. Although not observed by the numerous villagers interviewed in Champasak, Sekong or Attapeu Provinces, most people believe dolphins have saved people from harm when boats have been overturned or people have been attacked by crocodiles.

Many Lao people who have heard of dolphins but never seen them believe that they have breasts and vaginas like human women. Although dolphins do have mammary glands, they are small and situated on the lower body, which does not fit with the image Lao people have of large breasts on the upper half of the body, like humans.

Locals also have a traditional fable in which dolphins and river terns are said to have been reincarnated from humans who died after falling down one of the great waterfalls called Sompamit or Lee Pee. River terns are often seen diving for fish near dolphins during the dry season, and some villagers believe dolphins chase fish to the surface so that the fish-eating birds can easily catch them.

Unlike ethnic Cambodians and Laotians, who have never been known to eat dolphin meat, the Cham Muslims who live along the Mekong River in Cambodia and Viet Nam sometimes hunt and eat dolphins. This was confirmed through numerous interviews with Cambodian and Vietnamese Chams as well as villagers along the Lao/Cambodian border. All Laotians think highly of dolphins, and villagers don't want to see them disappear. However, they believe they are rapidly nearing extinction.

There is virtually no trade in dolphins in Lao PDR or northeastern Cambodia. However, a fish trader reported that in 1992 he bought a dolphin from local Lao fishers at Hang Sadam Village. The dolphin died after being accidentally entangled in a gillnet. He put the animal on ice and transported it from the Lao/Cambodian border village of Wern Kham to the Lao/Thai border. Thai fish buyers refused to buy it and the animal was discarded. The trader now refuses to buy dolphins.

In another case, some Cambodians managed to live-capture a juvenile dolphin in 1992. They brought the animal to the village of Wern Kham, its tail tied to a heavy rope, and tried to sell it there. However, nobody wanted to buy it. After three days, the dolphin died and was left to float down the Mekong River.

Legal Status of Dolphins

In Laos, where Irrawaddy dolphins are officially designated as a "fish species", they are fully protected by law, and the hunting, capturing and trading of Irrawaddy dolphins (the only species of cetacean reported from Laos) is illegal and punishable by fines ranging from 50,000 to 500,000 kip (US\$ 65 to 650) and/or 3 months to one year imprisonment (ANON.,

1991a). In 1991, some Laotians were arrested for shooting four dolphins in Sekong (ANON, 1991b). In Cambodia, there does not appear to be any specific legislation designed to protect dolphins.

Dolphin Behavior

Between January and July, 1993, the dolphin population in the deep water pools in front of the villages of Hang Khone and Hang Sadam, Champasak Province, was observed for at least a few hours a day approximately 6–8 days a month. It appeared that there were three or four groups of dolphins with 2–8 members per group in the area during the whole time. In one case a group of approximately 17 animals was seen, probably a temporary aggregation of the smaller groups (Pam Stacey, pers. comm., 1993). Probably not more than 30 dolphins were in the area at any one time. It appears that the dolphins tend to move around the deep pool area within an area less than 1 km long and 0.5 km or less wide for hours at a time during daylight hours (Fig. 1). They are only rarely seen outside of the deep water area.

In May 1993, the depth of the water in the deep pool area in front of Hang Khone and Hang Sadam was measured at 30 different spots throughout the area where the dolphins are commonly seen. The pools were found to be approximately 10–30 m deep. During the monsoon season water levels rise from 10–20 m.

During the monsoon season of 1993, the dolphins in the area could still be seen, but they often appeared to disperse into other areas outside the deep pools, and on some days they could not be found at all. The deep pool area has a very rocky bottom, with some large rocks becoming exposed in the dry season. The deep water area is surrounded by seasonally flooded forests. Because the water was very murky, especially during the monsoon season, observing the dolphins' underwater movements was not possible, but it appeared that the animals travelled to one part of the pool, fed for a number of minutes, and then travelled to another area to feed some more. When not feeding, the dolphins usually surfaced three or four times in short succession before disappearing underwater for 30 seconds to one minute. They tended to surface more frequently while feeding.

Dolphin Feeding

Although it is difficult to determine all the species of fish that the dolphins feed on, it is noteworthy that large numbers of small cyprinids, including *Cirrhinus* sp. (pa soi hooa lem in Lao), *Cirrhinus siamensis* (pa soi hooa po), *Lobocheilus melanotaenia* (pa lung khon), *Crossocheilus* cf. *reticulatus* (pa dawk toi), *Paralabuca* cf. *typus* (pa dtaep), and other species are very abundant in and around the deep water areas during the dry season, when the dolphins are probably more abundant in the deep water Hang Khone and Hang Sadam area. Villagers catch *Cirrhinus* sp., *Cirrhinus siamensis*, *Lobocheilus melanotaenia*, *Crossocheilus* cf. *reticulatus* and other small species in large quantities using castnets and small mesh gillnets (2.5 or 2.8 cm). After water levels rise in July, these species of fish cannot be found in the



Figure 1. An Irrawaddy dolphin surfacing in a deep water pool along the Lao-Cambodian border, and across the Mekong River from Hang Khone Village.



Figure 2. The remains of a *Bagarius yarrelli* catfish preyed upon by dolphin(s) and found floating near Hang Khone village, Lao PDR, in October, 1993. The head weighed 3 kg.



Figure 3. An Irrawaddy dolphin that died after becoming entangled in a large-mesh gillnet near Hang Sadam Village, April 1992.



Figure 4. The skull and bones of an Irrawaddy dolphin, Wern Kham village, Lao PDR, April, 1992.

area. There is significant evidence, based both on fish catch monitoring and villager interviews, that these small cyprinids migrate south, entering flooded streams in Cambodia to spawn. We found that the females of these species were full of eggs at Hang Khone in late June.

As the water levels rise, the small cyprinids travel south from Hang Khone and Hang Sadam, and the dolphins become much more difficult to observe. At this time the dolphins seemingly begin to disperse, apparently following and feeding on fish in some of the larger tributaries of the Mekong and Sekong River. Villagers reported that a dolphin became stranded in shallow water in the Sesou River (a tributary of the Sekong River in Attapeu Province) in 1984 after apparently penetrating far up the river. The dolphins can again be easily observed in the Hang Khone/Hang Sadam area when water levels begin to go down in October and November. This coincides with the time of year many fish species leave the streams and return to the mainstream Mekong River.

Although Lao villagers in the area believe that small fish make up an important part of the dolphins' diet, they also claim that dolphins feed on most other species of scaled and non-scaled fish as well. While locals claim that small cyprinids are eaten whole, they also report that only the lower halves of many larger species of fish, some reaching over a meter long, are preyed upon by the dolphins. Villagers often find the upper halves of big fish, from the dorsal fin to the head, floating in waters that dolphins inhabit. They sometimes retrieve and consume these upper halves of fishes, if they are still fresh. Over half of the 120 households at the villages of Hang Khone and Hang Sadam surveyed in May 1993 claimed they had seen or personally retrieved "dolphin prey leftovers" in the past, and almost every household claimed that dolphins only eat the lower halves of large fish, because many species have long hard dorsal and pectoral spines.

In November 1993 a head and upper body of a large catfish, *Bagarius yarrelli* (pa khae), was found floating in deep waters in front of Hang Khone (Fig. 2). The lower body right up to the dorsal and pectoral fin spines had been totally eaten by a predator, presumed to be a dolphin. The remaining part of the fish weighed 3 kg, and the whole fish probably weighed at least 10 kg. Soon after, a large *Kryptopterus apogon* (pa sangooa) was retrieved from the same area. In December, the head of a *Pangasius hypophthalmus* (pa sooay khaew) was retrieved. The head and upper body of the fish, from pectoral spines up, weighed 1 kg. In February 1994, another *Bagarius yarrelli* head was found, weighing 1.2 kg. During the same month, a head of a large *Mystus microphthalmus* (pa kheung) was found by villagers, but was not seen by the authors. In all cases, the lower body, right up to the spines, was totally consumed. The heads were totally intact, and there were no bite marks on the fish above the pectoral fins. Dolphins probably ate the lower halves of all these fishes, since few if any other species would be capable of catching and consuming such large fish. Remains of *Bagarius yarrelli*, *Mystus microphthalmus*, and *Cosmochilus harmandi* were also been retrieved by the authors in 1994.

Villagers claimed that over 20 years ago dolphins were sometimes seen killing large *Pangasius sanitwongsei* (pa lerm) "with a slap of their tails". According to many villagers at

Hang Khone, the dead fishes were not eaten by the dolphins after being killed. These fish often weighed over 100 kg. The locals, after seeing the dead pa lerm floating in the water, would go out and get the fish to eat themselves. The motive for the dolphins' apparent attacks on pa lerm are unknown. Since large *Pangasius sanitwongsei* are now extremely rare in the Mekong River (none weighing over 1 kg were caught in Hang Khone/Hang Sadam in 1992 or 1993), it seems unlikely that there will be opportunities to observe such encounters in the foreseeable future.

Dolphin Births

When asked about the time of year dolphins are born, 10% of the 120 household representatives interviewed in Hang Sadam and Hang Khone claimed that dolphins are born in the dry season months of April or May. A dead newly born dolphin was recovered near Hang Khone Village in May 1993 by the authors.

A Hang Khone local who is very familiar with the dolphins claimed, and was backed up by a number of witnesses, that he saw a dead newly-born dolphin over 10 years ago in the dry season. He took his long-tailed boat out to take a closer look. When he got a few meters away from the dead dolphin, a number of adult dolphins started swarming around his boat, presumed by the villager to be trying to keep him from getting close to the dead dolphin. He claimed that the dolphins got so close to the boat that they almost capsized it so he gave up trying to look at the dead dolphin and returned to shore.

Threats to Dolphins

In Laos and Cambodia, villagers have indicated that dolphin populations have declined significantly in the past few decades. Dolphins are no longer, or only very rarely, seen in many areas in both countries where they were once apparently common. Several sources of mortality have been identified: bombs dropped in the Sekong River during the Indochina War, explosives used by Cambodians to catch fish, being shot by soldiers and villagers, and becoming accidentally caught and killed in large-mesh gillnets (Figs. 3 and 4).

The aerial bombing of the Sekong River by the United States Air Force during the Indochinese War apparently greatly affected the river, killing both fish and dolphins in large numbers. However, most locals living along the Lao/Cambodian border believe that the heavy use of explosives to catch fish by Cambodians is the main reason for decreasing dolphin and fish populations in the Mekong River. In Cambodia, the bombing began in 1979 after Vietnamese soldiers arrived in the area with the fall of the Khmer Rouge. Since then, explosives have been used for fishing between December and June each year, when water levels are low. A variety of types of explosives are used, some consisting of the insides of land mines put in soda pop cans. This method is both destructive and wasteful, as many fish float to the surface only after becoming rotten, or just sink to the bottom. In early 1993, 10-20 blasts were heard each day across the Mekong River from Hang Khone. By July 1993,

however, explosives fishing had stopped because of rising water levels and the lack of migrating fish, which are often specifically targeted by explosives fishers.

Lao villagers living near the Cambodian border claim that soldiers from the Cambodian People's Armed Forces (CPAF) promoted explosives fishing and sold explosives to fishers before the new Cambodian government was established in late 1993. Although the new Cambodian government formally prohibits explosive fishing and has spoken out strongly against the method (CASEY, 1991), which is also very dangerous to the users themselves, explosives fishing was still widespread in Stung Treng in early 1994 due to a lack of effective law enforcement.

While the season of explosives fishing normally lasts from December to June, large-mesh gillnets have been responsible for dolphin mortality in other seasons. In May and June, 12–18 cm mesh mono and multi-filament nylon gillnets are used intensively to catch large migrating catfish *Pangasius krempfi*, *P. conchophilus* and *P. larnaudii*. Between November and early January, 18–25 cm mesh gillnets are intensively used for large migrating and spawning *Probarbus jullieni* and *Probarbus labeamajor*. Villagers from Hang Khone and Hang Sadam report that dolphins are mainly entangled in gillnets in these two seasons. In both seasons gillnets are placed near the surface in deep waters. The dolphins' tails tend to get entangled in the large-meshed nets, and they roll and turn, usually resulting in further entanglement and sometimes drowning.

Bamboo traps, hooks and lines are the main fishing gears used between July and October, when strong river flow makes use of gillnets impractical. During the rest of the year both large-mesh and small-mesh gillnets are set much deeper than during May-June or November-January, and apparently pose minimal threat to dolphins, who have only very rarely been known to become entangled in these deep set nets.

During a trip to the villages of Hang Khone and Hang Sadam in April 1992, it was reported that 6 dolphins had become accidentally entangled and died in gillnets used in the area during the 16-month period between December 1990 and April 1992. Villagers reported that in at least one case, a dolphin could have been released alive had fisherfolk been willing to cut the gillnet. Dolphins have been caught in gillnets for up to 3 days before drowning. However, villagers in the area are poor and cannot afford to damage their nets to release dolphins, even though they don't want dolphins to die. Most people interviewed said that Cambodian fisherfolk almost always try to release dolphins which become entangled in their gillnets alive, but are successful in releasing them alive only about half of the time.

Between May and December of 1992, villagers reported that six dolphins died in the Hang Khone-Hang Sadam area. The authors observed three of the carcasses. Some were caught and died in gillnets, but others are believed to have been killed by explosives used in fishing.

Between January and July of 1993, six more dolphins died in the Hang Khone/Hang Sadam area, including the adjacent Cambodian villages of Wern Yang and Don Langa. Two were young animals, including one that was probably not more than one week old. The

youngest dolphin had five distinctive vertical birth lines running across its body at regular intervals (Figs. 5–8). Three of the six dolphins, including the newborn animal, were recovered and necropsies were performed. One of the six dolphins had been intentionally killed with a knife by a Cambodian fisherman after the dolphin became entangled in a gillnet. Another two animals had died after being caught in Lao or Cambodian gillnets. The other three dolphins probably died after being blasted by explosives used in fishing. Dolphins caught in gillnets usually have cuts on their tails or other parts of their bodies caused by the nets. These marks can be easily observed if the animals are recovered soon after dying. None of these three dolphins had any marks of this kind on their bodies. They were all recovered soon after dying.

In February, a Laotian fisherman cut his gillnet to release a dolphin alive after the animal had become entangled in his net. The fisherman was later compensated for the damages done to his net by the Lao Community Fisheries and Dolphin Protection Project in accordance with the net compensation/dolphin release program established in cooperation between the project and Hang Khone and Hang Sadam villagers. Villagers on the Lao side of the border are well aware of the net compensation fund program, which they endorse.

Although gillnets are certainly a major threat to dolphins, it appears that dolphins are able to detect and avoid these nets most of the time, even in high risk periods. Dolphins are often seen swimming around large numbers of gillnets without becoming entangled in them. Villagers believe that dolphins become entangled mainly when they are actively chasing fish.

In recent years the number of large-mesh nylon gillnets used to target large fish in the Mekong River has greatly increased due to the high value of many foodfish species, increased fish marketing opportunities brought on by better road access to remote areas, access to ice, and the widespread introduction of motorized boats used to transport fish to buyers. Despite the increase in gillnet use in recent years, local people in the Hang Khone and Hang Sadam areas appear determined to reduce the number of dolphin deaths, and no dolphins were observed or reported to have died in the Hang Khone/Hang Sadam area between August 1993 and March 1994. The reasons for this apparent decrease in dolphin mortality cannot be determined, although villagers readily take credit for the improvement.

The Lao Loom people living along the Sekong and Mekong Rivers use a wide variety of fishing gears including various kinds of bamboo traps, castnets, hooks and lines, and gillnets to catch fish. Some villagers living along the Sekong River claim that dolphins are able to break away from small gillnets. In 1989 or 1990, a dolphin was reportedly caught and drowned accidentally in a falling-door bamboo fish trap, called a "June", near the village of Hang Ngow, Attapeu Province. This was the first time anyone had ever heard of a dolphin dying in a fish trap, which villagers do not consider to be dangerous to dolphins.

In 1990, two dolphins were shot by soldiers in Sekong Province. The soldiers were from another area and apparently were not familiar with dolphins. They apparently believed that the dolphins were serpents or crocodiles.

In 1991, villagers did not report seeing any dolphins in the provinces of Sekong or Attapeu. However, in April 1992, a dolphin was apparently released unharmed from a gillnet



Figure 5. Dead juvenile Irrawaddy dolphin floating in Mekong River, Hang Khone, Lao PDR, May, 1993.



Figure 6. Dead juvenile Irrawaddy dolphin near Hang Khone village, Lao PDR, May, 1993.



Figure 7. Staff of Lao Community Fisheries and Dolphin Protection Project moving a dead juvenile Irrawaddy dolphin using a small long-tailed boat, Hang Khone village, Lao PDR, May, 1993.



Figure 8. A dead juvenile Irrawaddy dolphin, its grey skin having already fallen off the body, May, 1993.

that it had become entangled in near Sekong town. Between July and October, 1992, two groups of dolphins, one with six individuals and the other with two, were sighted in the Sekong River in Attapeu Province. The dolphins had apparently migrated up the Sekong River from Cambodia. The group of six dolphins reportedly stayed near Attapeu town for about a month before going south, apparently back to Cambodia. The group of two dolphins travelled up the Sepian River from the Sekong River as far as Mai Village (about 60 km from the mouth of the Sepian River), where they were seen by a number of villagers. Villagers later reported seeing them travelling south back into the Sekong River and presumably back to Cambodia. In August 1993, a dolphin died in the Sekong River after becoming entangled in a gillnet near Dong Jan Village, which is about 15 km south of Sekong and not far from the mouth of the Senamnoi River.

There are several indications that the dolphins' food supply might be threatened. Fisherfolk living throughout the range of the dolphin in southern Laos claim fish catches have been declining significantly every year over the past few years. Many claim that catches have been reduced 20–25% per year. It is possible that this decrease in fish abundance has been partially responsible for the decline in dolphins. Villagers in Laos have related that they are concerned with the decrease in the numbers of dolphins and fish, which they attribute to explosives fishing and the blocking off of streams to catch fish in Cambodia and Laos. Overfishing and the introduction of modern fishing instruments, especially nylon gillnets, have also been cited as problems. Lao villagers are aware of many of the implications to the environment of unsustainable fishing practices, and lament the fact that future generations may not be able to experience the sight of dolphins and rare species of fish. The Lao Community Fisheries and Dolphin Protection Project has worked with Lao villagers in a number of communities to set up "no fishing conservation zones" in order to conserve fisheries resources. Locals have set up their own rules for managing these areas. Local people rely heavily on riverine fisheries for food and income, and decreases in fish catches are adversely affecting large numbers of people in northeastern Cambodia and southern Lao PDR. Therefore, most Lao fishers feel the need for conservation measures.

Irrawaddy dolphins are threatened and apparently already reduced in the Mekong River Basin. Any attempts to live-capture and enter any of the remaining Mekong River Basin population into captivity, however, would be misguided. Dolphins usually experience a high mortality rate once in captivity. Although breeding populations in the wild may already be very small, they may still be viable. The best conservation strategy is to try to reduce unnatural mortality in the rivers.

OTHER CONSERVATION CONCERNS

Irrawaddy dolphins inhabit some of the most vulnerable of aquatic habitats, including tropical, riverine, estuarine and coastal areas (KLINOWSKA, 1991). Large-scale hydro-electric dams proposed for the lower Mekong River, including ones at Stung Treng and Sambor, Cambodia, are a serious conservation concern. If constructed, either of these mainstream

dams would almost certainly adversely affect, if not devastate, populations of dolphins and migrating fish species in the area. Furthermore, large dams planned for the Sekong River and its larger tributaries in Lao PDR would both reduce dolphin habitat and probably devastate a number of fish species, including long-distance migratory species, such as *Labeo cf. pierrei* (pa wa sooang), *Mekongina erythrospila* (pa sa ee), *Cirrhinus molitorella* (pa gaeng), *Scaphognathops* spp. (pa pian), *Gyrinocheilus penmocki* (pa gaw) and many others (ROBERTS, 1993). Many Cambodian and Lao fishers interviewed reported having seen large schools of these species migrating down from the Sekong River into the Mekong River in December and January. Both wildlife and the livelihoods of local fishing communities would be jeopardized by these large-scale dams, if they are allowed to be built.

Increased motorized boat traffic in the Hang Khone/Hang Sadam area, brought on by increased trade and tourism, could disturb the dolphins, possibly causing them to leave the area. As boat traffic increases, boat monitoring and regulating may become an important issue in terms of dolphin conservation in the area.

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REFERENCES

- ANON., 1991 (a). Instruction on the Execution of the Council of Ministers' Decree No. 118/MCC dated 5/10/1989 on the Management and Protection of Wildlife, Aquatic Animals, Hunting and Fishing. Ministry of Agriculture and Forestry, Vientiane, Lao PDR.
- ANON., 1991 (b). Khao San Pathet Lao (official government English language Newspaper), "Men Arrested and Tried for Killing Rare Animals". Khao San Pathet Lao, November 11, 1991, Vientiane, 2 p.
- BAIRD, I.G., 1993. Wildlife Trade Between the Southern Lao PDR Provinces of Champasak, Sekong, and Attapeu, and Thailand, Cambodia, and Viet Nam. TRAFFIC South-east Asia Field Report #3, Kuala Lumpur, Malaysia. 34 pp.
- BAIRD, I.G., B. MOUNSOUPHOM AND P. STACEY, 1994. Preliminary surveys of Irrawaddy dolphins (*Orcaella brevirostris*) in Lao PDR and northeastern Cambodia. *Rep. Int. Whaling Comm.* 44: 367-369.
- CASEY, E. 1993. "Sihanouk wants fishing with explosives to stop." *Bangkok Post*, August 25, Bangkok.
- CHAZEE, L. 1990. The Mammals of Laos and the Hunting Practices. Unpublished manuscript, Vientiane, Laos.
- KLINOWSKA, M. 1991. Dolphins, Porpoises and Whales of the World—IUCN Red Data Book, IUCN, Gland, 429 pp.
- LEATHERWOOD, S., C.B. PETERS, R. SANTERRE, M. SANTERRE AND J.T. CLARK. 1984. Observations of cetaceans in the northern Indian Ocean Sanctuary, November 1980–May 1983. *Rep. Int. Whaling Comm.* 34: 509-520.
- LEKAGUL, B. and J.A. McNEELY. 1977. *Mammals of Thailand*. Association for the Conservation of Wildlife, Bangkok, 758 pp.
- LLOZE, R. 1973. Contributions a l'etude anatomique, histologique et biologique de l'*Orcaella brevirostris* (Gray, 1866) (Cetacea, Delphinidae) du Mekong. Ph.D. thesis, University of Toulouse. 599 pp.
- MARSH, H., R. LLOZE, G.E. HEINSOHN AND T. KASUYA. 1989. Irrawaddy dolphin *Orcaella brevirostris* (Gray, 1866). Pages 101–118 in S. Ridgway and R. Harrison (eds.) *Handbook of Marine Mammals, Vol. 4. River Dolphins and the Larger Toothed Whales*. Academic Press, London and San Diego.
- ROBERTS, T.R. 1993. Artisanal fisheries and fish ecology below the great waterfalls of the Mekong River in Southern Laos. *Nat. Hist. Bull. Siam Soc.* 41: 31-62.
- TAS'AN, I., A. SUMITRO and S. HENDROKUSUMO. 1980. *Orcaella brevirostris* (Gray, 1866) from Mahakham River. Publication of the Jaya Ancol Oceanarium, Jakarta. 60 pp.
- TAS'AN and S. LEATHERWOOD. 1984. Cetaceans live-captured for Jaya Ancol Oceanarium, Jakarta, 1974-1982. *Rep. Int. Whal. Comm.* 34: 485-489.
- U TIN THEIN. 1977. The Burmese freshwater dolphin. *Mammalia* 41: 233-234.

