CROCODILE SURVEYS ON DALUPIRI AND FUGA

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SUMMARY

Crocodile surveys were carried out on the islands of Dalupiri and Fuga, northern Philippines to verify recent reports of sightings, identify the species involved and gather data on crocodile abundance and distribution. The occurrence of the critically endangered Philippine crocodile *Crocodylus mindorensis* was confirmed on Dalupiri. Track searches and spotlight searches on the island revealed presence of a female adult, a juvenile and a hatchling along Caucauayan Creek. On Fuga, crocodiles have not been sighted by local residents during the past decade. There is potential for conservation of the wild population of Philippine Crocodiles on Dalupiri with the presence of suitable habitat, reproducing crocodiles and positive community attitudes although the population size is probably extremely small. Further information and education activities, monitoring of the crocodile population and of habitat changes and stakeholder consultations are recommended.

BUOD

Isang pag-aaral ng mga buwaya ang isinagawa sa mga isla ng Dalupiri at Fuga upang mapatotohanan ang mga naiuulat na mga buwaya doon, malaman kung anong species ito, at mangalap ng datos ukol sa kanilang dami at mga lugar kung saan sila matatagpuan. Napatotohanan namin na mayroong Philippine Crocodile Crocodylus mindorensis o "bukarot" sa Dalupiri, isang species na lubhang nanganganib mawala sa mundo. Sa pamamagitan ng paghahanap sa kanilang mga bakas at pag-aninag sa kanilang mga mata sa gabi gamit ang flashlight, tatlong bukarot ang aming nabilang sa Sapa ng Caucauayan. Sa isla ng Fuga, napag-alaman naming wala nang nakikitang buwaya ang mga tao doon sa nakalipas na dekada. May pag-asang maiwasan ang pagkaubos ng mga bukarot sa Dalupiri dahil mayroong positibong pananaw ang mga tao sa mga ito, may angkop na tirahan sila dito, at patuloy ang kanilang natural na pagdami. Iminumungkahi namin ang pagpapalawak ng kaalaman ng mga tao tungkol sa Philippine Crocodile at patuloy na pag-aaral at pagsubaybay sa populasyon nito at sa mga pagbabago sa kanilang kapaligiran. Iminumungkahi din namin ang patuloy na pag-sangguni sa komunidad at mga kinauukulan hingil sa pangangalaga ng bukarot.

INTRODUCTION

Two crocodile species occur in the Philippines - the Philippine Crocodile *Crocodylus mindorensis* and the Estuarine or Salt-water Crocodile *Crocodylus porosus*. The Philippine Crocodile, a species endemic to the Philippines, is critically endangered (IUCN 2004). The species is currently known to occur only in small populations in Luzon, Mindanao and perhaps Negros (Van Weerd and Van der Ploeg 2003). The best available estimate of its population in the wild is less than 100 mature individuals (Ross 1998). The Estuarine Crocodile, on the other hand, ranges from South Asia to Australia and is not globally threatened with safe populations in Australia and New Guinea. In the Philippines this species is however threatened with local extinction; its Philippine population is listed in CITES Appendix I (UNEP-WCMC 2005). Both species are protected under the Wildlife Act which came into force in 2003.

Crocodiles have been sighted on Dalupiri Island of the Babuyan group of islands as early as 1989 but they were not identified (Ross 2005). More recently, Oliveros *et al.* (2004) sighted a crocodile on the island but they were uncertain whether the animal was a Philippine Crocodile. They also received reports of recent crocodile sightings on the neighboring island of Fuga.

We conducted a brief survey in May 2005 to verify the identity of extant crocodiles on Dalupiri Island, and to verify the presence and identity of crocodiles on Fuga Island. In addition, we investigated the abundance and distribution of crocodilian populations in both islands. We carried out a second crocodile survey in August 2005 on Dalupiri Island. The May 2005 team consisted of team members from Isla Biodiversity Conservation, the Mabuwaya Foundation and the Palawan Wildlife Rescue and Conservation Centre (PWRCC, formerly known as the Crocodile Farm Institute of Palawan). In August 2005, team members from Isla, Mabuwaya and the Department of Environment and Natural Resources – Region 2 participated. We report the results of the May and August 2005 surveys here.

METHODS

Study area

Dalupiri Island (Figure 1A), situated 40 km north of Luzon, occupies an area of 50 km^2, most of which is grassland and scrub. Forest grows along gullies, streams and in the north-western region of the island. The island is privately-owned and is used as a ranch for around 1,700 heads of cattle. We visited Dalupiri on 14-18 May and 21-28 August 2005.

Fuga Island (Figure 1B), which lies southeast of Dalupiri and is situated 25 km north of Luzon, is likewise privately owned. Acquired by its present owners in 1990, the island was once envisioned to be an investment hub like Hongkong in northern Philippines where investors could benefit from certain tax exemptions and fiscal incentives granted by the Cagayan Special Economic Zone Act of 1995 (Lopez 1996). However no major infrastructure projects on the island have so far been undertaken. Most of the island's area of 100 km^2 is covered by lowland forest and grassland with several creeks along its coast. We visited Fuga on 19-21 May 2005 and conducted interviews with residents of the villages of Modoc, Sarongan, Bubog and Simmabang.

On Dalupiri Island, we surveyed Cabitangaan Creek, Nipa Creek, Caucauayan Creek, Purdos Creek, Manolong River, Nagkoralan Creek and Bumaro Creek. Table 1 shows the average width, depth and temperature in these sites in August 2005.

Table 1. Sites visited on Dalupiri Island (range of measurements are in brackets)

	Average width (m)	Average depth (cm)	Average temperature (°C)
Cabitangaan Creek (n = 1)	5.0	54	29
Nipa Creek (n = 6)	6.9 (3.4 – 17.1)	58.3 (40 – 71)	28.3 (28-29)
Caucauayan Creek (n = 6)	5.7 (4.1 – 10.6)	148.8 (26-467)	30.0 (30-30)
Purdos Creek (n = 5)	3.2 (2.0 – 4.4)	26.0 (19 – 30)	28.6 (28-29)
Manolong River (n = 6)	4.3 (3.0 – 5.0)	62.3 (39 – 83)	29.0 (29-29)
Nagkoralan Creek (n = 2)	9.5 (8.7 – 10.3)	83.0 (47 – 119)	28.0 (28-28)
Bumaro Creek (n = 7)	3.5 (1.3 – 5.8)	49.3 (8 – 107)	-

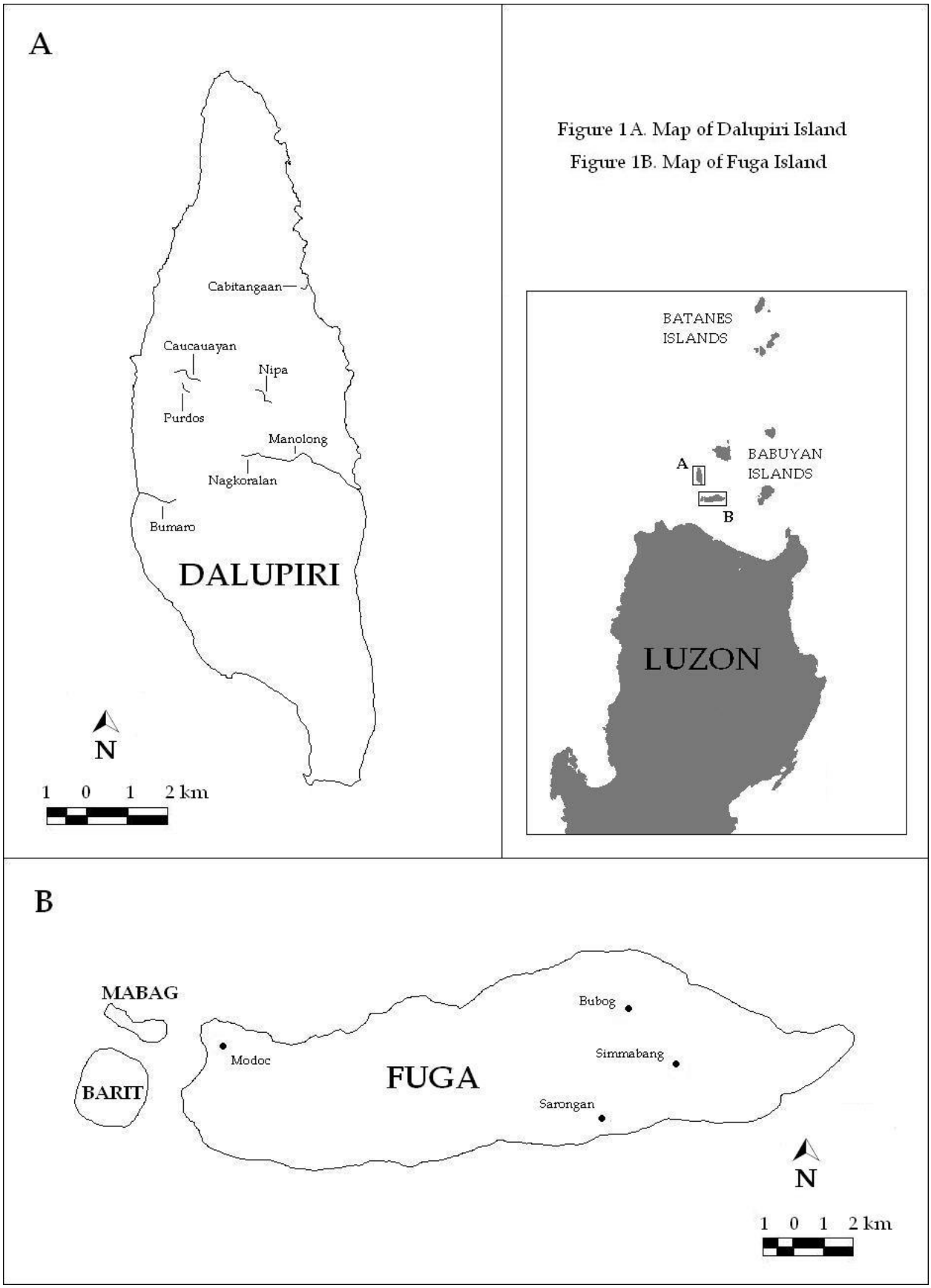

Figure 1A. Map of Dalupiri Island

Figure 1B. Map of Fuga Island

Cabitangaan Creek is a freshwater creek 250m long that runs mostly along a volcanic rock bed and drops 30m at a slope of 60° to the island's rocky eastern coast. A small pool 7 m long, 5 m wide and 54 cm deep along the creek is surrounded by thick *Pandanus* trees. Nipa Creek is located southwest of Cabitangaan near the island's center spine. Freshwater flows from the source all year round along limestone and sandy soil bed. The creek is dammed 400 m from the source and water is channeled through pipes that bring water to the grazing areas of ranch animals. The creek dries up 80 m downstream of the dam. Woody trees grow along the banks of Nipa Creek but *Pandanus* is dominant near the source. Caucauayan Creek lying west of Nipa Creek, runs mostly through limestone bed. Most of its length is lined with thick *Pandanus* trees; woody trees are also present. A 5-m long creek (named Purdos, but not to be confused with Purdos Creek below) feeds into this freshwater creek 40m downstream from its source. Water from Caucauayan Creek is diverted to 17 ha of rice fields by a concrete dam and waterway located 600 m from the creek's source. From the dam, water reaches only 30 m downstream. Purdos Creek is south of Caucauayan Creek and runs along a gulley. Woody trees are dominant along the banks of this shallow creek.

Manolong River is Dalupiri's longest river, stretching 2.7 km from the island's center spine to its eastern coast through a deep gulley. Fresh water flows over sandy soil and limestone bed under woody trees that dominate in the gulley. Huge limestone boulders are common in the last 0.7 km section of river that touches the sea. A small patch along the river has been cleared and planted with coconut and other fruit crops. Nagkoralan Creek is one of the tributaries of the Manolong River. Its banks are very steep and its water heavily silted. Only a 300-m stretch of the creek was visited. Bumaro Creek is located on the western coast of the island. The creek flows along a gulley along limestone and sandy soil bed, gently cascading at a slope of 45° in the last 300m section that reaches the western coast. Woody trees are dominant along this creek.

Survey techniques

On Dalupiri Island, we searched for crocodile eye-shines at night using spotlights while during the day we looked for crocodile tracks and nests. In May 2005 trapping was conducted along Caucauayan Creek, where we set three baited cable snare traps for two nights. The maximum count in any one count effort on a particular site was taken as the final count. On Fuga Island, spotlight and track searches were not conducted because no recent crocodile sightings were reported by local residents.

Local residents were interviewed informally to collect information on their knowledge of crocodile abundance, distribution, and ecology. Information on local people's utilization of resources, their attitudes towards crocodiles and their beliefs was gathered as well. During the August survey, we collected interview data with the aid of a guide questionnaire from a total of twenty-three respondents from Dalupiri Island. The selection of the first eight respondents favored those: who were head of households, who were old residents (more than 45 years old) and who frequented rivers and creeks. The other fifteen respondents were chosen from household members who were available for an interview in the main village. The age of respondents averaged 46.6 years and ranged from 18 to 72 years. Seventeen (74%) respondents were male and 6 (26%) were female. Twelve (71%) male respondents relied on farming, ten (59%) on fishing and four (24%) were ranch employees (figures overlap because several

respondents indicated more than one way to generate income). Five (83%) of the six female respondents were housewives.

RESULTS

Dalupiri Island

Confirmation of species identity

An adult female crocodile was opportunistically captured along Caucauayan Creek (elevation: 132 m-asl) on 15 May 2005. The following measurements of the animal were taken: total length - 2.17 m; snout-to-vent length - 80 cm; skull (anterior tip of snout to posterior end of occipital scales) 31 cm; belly width – 39 cm; forelimb length – 9 cm; hind limb length– 20 cm. The animal's dorsal side was dark grayish brown while its ventral side was ivory. There were eight dark gray bands on its tail. The presence of six post occipital scales, 25 transverse ventral scale rows and its geographic location identifies the animal as a Philippine Crocodile *Crocodylus mindorensis*. This finding is further reported in Oliveros *et al*. (2005).

The female crocodile was carrying eggs and was estimated to be one to two weeks from laying them at the time of capture. The animal was immediately released after team members from the PWRCC cut tail scutes corresponding to an identification number of 12/3/3 and collected tissue samples from these scutes. Analysis of the tissue collected will provide more information on the relationship of the Dalupiri Philippine crocodile sub-population with conspecifics from other islands.

Abundance and distribution

Table 2 shows the results of the May and August 2005 crocodile surveys on Dalupiri Island as well as survey effort in each site. Apart from the captured adult female, tracks of a juvenile and a hatchling were found along the Caucauayan Creek in May 2005. The presence of a hatchling suggests that there is a breeding population on the island. No hatchlings, nests nor cracked shells, however, were found in August.

Table 2. Crocodile counts in May and August 2005

	May 2005			Aug 2005		
	Crocodile Counts	**Number of Spotlight Searches**	**Number of Track/Nest Searches**	**Crocodile Counts**	**Number of Spotlight Searches**	**Number of Track/Nest Searches**
Cabitangaan Creek	Not visited			-	-	1
Nipa Creek	-	1	-	-	1	1
Caucauayan Creek*	1 adult, 1 juvenile, 1 hatchling	1	1	1 adult, 1 juvenile	1	3
Purdos Creek	Not visited			-	1	-
Manolong River	-	1	-	-	-	1
Nagkoralan Creek	Not visited			-	-	1
Bumaro Creek	Not visited			-	-	1

* Six trap-nights were also spent in May 2005.

The set cable snare traps yielded no captures. No tracks or eye-shines were observed in the other sites surveyed. No nests were found along Caucauayan both in May and in August 2005. Our guide showed us a 2 m-diameter circular patch surrounded by grass along the northern bank of Cabitangaan Creek that according to our guide used to be a crocodile nest.

Conducting spotlight searches along Caucauayan Creek proved difficult because of the presence of dense *Pandanus* vegetation along some of its stretches. Observers inevitably create noise when surveying these areas and thus may have allowed crocodiles to avoid being counted. The thick vegetation, however, benefits crocodiles because it provides protection for themselves and their nest and eggs from grazing animals that drink from the creek.

Crocodile Movements, Prey and Predators

The crocodiles of Caucauayan Creek move along its entire length and even beyond to the rice fields where its water is diverted. In May, tracks of a juvenile were found near the creek's source and in August, tracks were also found on a wet rice paddy 800 m downstream. The deepest pool of the creek (4.7 m deep) seems to be favored by the adult crocodile. It was sighted here in 2004 (Oliveros *et al.* 2004) and again in August 2005.

Situated above the deepest pool of Caucauayan Creek is a nesting colony of Rufous Night-Heron *Nycticorax caledonicus* that is a possible source of prey for large crocodiles. We saw as many as six *N. caledonicus* nestlings and 10 eggs in May 2005 and two nestlings in August. Barred Rail *Gallirallus torquatus* and White-breasted Waterhen *Amaurornis phoenicurus* are also possible prey species. The diet of crocodiles along Caucauayan Creek probably includes animal species introduced to the island. Each year, an estimated 100 free-ranging cattle die on the island for various reasons including illness and injury as well as horses and water buffaloes. These animals are probably too big to be considered live prey by *C. mindorensis* but carcasses serve as food. Residents also report having seen mangled carcasses of dogs and goat along the Manolong River in the past, presumably attacked by crocodiles. Freshwater shrimps and eel were found in the creek, they certainly are crocodile prey and also offer a food source for smaller crocodiles. Studies in the Northern Sierra Madre, Luzon, of Philippine crocodile diets show that smaller crocodiles eat insects, snails, shrimps, small fish and snakes whereas prey size increases with crocodile size and includes civet cats, wild pig and water birds for adult crocodiles (van Weerd pers obs.). These prey items all occur along Caucauayan creek with the exception of civet cats and wild pig.

Crocodile hatchlings face threats from *N. caledonicus* and Water Monitor Lizards *Varanus salvator* that are common along the Caucauayan Creek.

Historical information

According to local residents, crocodiles were more wide-ranging and abundant on the island in the past. They report that apart from Caucauayan Creek, crocodiles were sighted along the Manolong River and the Creeks of Simasaya, Cabitangaan, Nagcaldingan, Nipa and Bumaro in the past. One resident showed us a tooth he took from a dead crocodile around 1989 at Makmak-ruoy at the northern tip of the island. According to residents, as many as ten adult crocodiles may have lived along the Manolong River at one time in the past.

During the 1970's and 1980's skin traders from Cavite province in Luzon visited Dalupiri and hunted crocodiles along Manolong River and Nipa Creek. Caucauayan Creek was not visited by these hunters, reports say. Our guide alone saw at least three animals taken from the Manolong River by the hunters and at least two from Nipa but more were likely captured. Ross (2005) reported seeing crocodiles along the Manolong River (Ross calls it "Manulong") in 1990 but there was no indication of the number nor species of crocodiles sighted.

It is now impossible to verify the identity of crocodiles that once existed in the other sites unless identifiable skeletal fragments are found there or skins taken from these sites are examined. However, the habitats along these other sites appear to have been suitable for *C. mindorensis* and we did not receive any reports of very large crocodiles occurring on Dalupiri from our respondents.

Local Knowledge, Attitudes and Beliefs

The Caucauayan Creek is an important resource for local people. Interviews with local residents show that it is a source of water for drinking, washing and farm irrigation, as well as a source of freshwater shrimps and eels. The use of electro-fishing or poison-fishing was not reported along this creek. Despite their exhaustive use of creek resources none of the respondents reported any injury or deaths from crocodiles here or in the entire island in their living memory. There were no reports of any occurrence of hunting by local residents. Only visiting skin traders were known to have hunted crocodiles on the island a few decades ago.

Table 3 provides a summary of answers gathered from interviews of 23 local residents of Dalupiri Island. Most respondents (65%) are aware of the existence of at least one crocodile species locally known as *bukarot* (which is the Ilocano name for small freshwater crocodiles in Northeast Luzon, Estuarine crocodiles are known under the general name for crocodile: *buwaya*) It is worth noting that 6 of the 8 respondents who replied "None" have heard of the existence of the *bukarot* on the island. Those who knew two crocodile species (3 respondents) speak of the *bukarot* and the *buwaya*. One respondent said the *buwaya* has a larger body size while another said it had larger tail crests and could be found on Fuga Island. The third respondent did not know the difference between the two species.

Almost half of the respondents (48%) perceive crocodile numbers on Dalupiri to be decreasing while the rest of respondents do not know (43 %) or think it is increasing (9 %). A vast majority (74%) of respondents do not know that hunting, killing or collecting of crocodiles is prohibited by law. All six of those who thought these activities were prohibited were unaware of the applicable law. One of them said these practices were prohibited by the Department of Environment and Natural Resources (DENR) while another said the owners of the island prohibited these acts. One respondent suggested passing a local ordinance to protect the crocodiles of Dalupiri.

Table 3. Local knowledge and attitudes towards crocodiles (*n* = 23 respondents)

Questions	Answers
How many crocodile species do you know?	None – 8 (35%) One – 12 (52%) Two – 3 (13%)
What do you think is happening to crocodile population numbers on Dalupiri?	I don't know – 10 (43%) Increasing – 2 (9%) Decreasing – 11 (48%)
Is the hunting, killing or collecting of crocodiles prohibited?	Yes – 6 (26%) No – 17 (74%)
Do crocodiles have the right to live?	Yes – 22 (96%) No – 0 (0%) I don't know – 1 (4%)
Why do crocodiles have the right to live?	They provide water – 9 (39%) Ethical reasons – 8 (35%) No reason – 3 (13%) Other – 2 (9%)

Respondents overwhelmingly believe that crocodiles have the right to live. Those who said crocodiles have the right to live mostly cited their role in providing water (39%) and ethical reasons (35%). When asked how we could protect crocodiles, respondents gave various responses including: prohibit or refrain from hunting, killing, or disturbing crocodiles or their nests; refrain from cutting trees near creeks; and informing people about these measures.

A significant proportion (48%) of respondents believes that crocodiles play a role in providing water in the river. They have developed this belief from their observation of very low water levels along the Manolong River after crocodiles were no longer sighted on the river. Our guide also told us that decades ago when crocodiles were still hunted, the weather would turn bad as an omen every time a crocodile is captured. Though this is a bit contradictory with the previous belief (killing a crocodile would also provide rain and thus more water), it is clear that local residents link the presence of crocodiles to healthy ecosystem functioning.

Fuga and other islands

Interviews of residents of Fuga revealed that crocodiles were present on the island a few decades ago. According to local people, crocodiles were sighted at Kulangwan Creek, Cabarangbangan Creek, Lanig Ti Buwaya Pond and Kasoy Pond and Naguilian. However there have been no sightings of crocodiles on the island in the last decade. Hunting and habitat loss seem to be the main reason for the disappearance of crocodiles on the island. According to residents, two crocodiles were hunted and delivered to the former owner of the island. Another animal was killed by residents by poisoning its habitat about 20 years ago. Local people also reported an incident of human-crocodile conflict where a lady was bitten by a crocodile on the foot.

CO has visited the other islands of the Babuyan group as part of a general biodiversity survey and subsequent follow-up studies on the islands of Camiguin Norte and Calayan. There have been reports of the historical occurrence of *bukarot* on Calayan Island but according to local residents they have been killed and have disappeared decades ago. We have also heard of a story of a crocodile attack on Camiguin Island decades ago but there have been no reports of recent sightings.

DISCUSSION

The confirmed presence of *C. mindorensis* on Dalupiri is remarkable as it shows that this species was once widely distributed throughout the Philippine archipelago from south to the extreme north. Dalupiri has been separated from Luzon at least since the end of the Pleistoceine 12,000 years ago (Voris 2000) thus this finding demonstrates the success of *C. mindorensis* in moving considerable distances through sea and colonizing small isolated islands. The species has already been recorded in coastal waters in northeastern Luzon (van Weerd and van der Ploeg 2003) and has historically been found in islands such as Jolo and Busuanga (Ross 1982).

The surveys reveal the existence of a marginal population of Philippine crocodiles that is very fragile. Using conservative estimates of local residents of previous crocodile populations, the number of crocodiles on the island (possibly a combination of *C. mindorensis* and *C. porosus*) could have declined by as much as 85% in the last three decades.

The establishment of protected wild populations of the Philippine Crocodile is one of the objectives outlined in the species' National Recovery Plan (Banks 2005). Dalupiri could potentially be a site where this aim can be achieved. This privately-owned island's isolation and positive community attitudes and practices towards crocodiles currently offer some protection to the small population on the island. Access to the island is difficult and is controlled by the island's owners. The crocodiles of Caucauayan Creek are in no immediate danger of being hunted by local residents. There has been no recent history of hunting by local residents and they are likely to oppose or stop any hunting because of their belief that these animals are crucial to maintain water in the rivers.

Despite the absence of hunting on the island in the past decade, crocodile numbers have continued to decline. Habitat loss may be an important factor in this decline. Only a few small pools of stagnant water remain along the 0.7 km stretch (and a further 1.0 km upstream) of the Manolong River where crocodiles were sighted in the past even during the rainy month of August. Apart from the Manolong River, we observed diminished water levels along the Creeks of Caucauayan, Cabitangaan, Nipa, Purdos and Bumaro. Monitoring of crocodile numbers and its habitat is important for the long term survival of the crocodile population on Dalupiri Island. During our visits to the island, we have employed local field workers who we are training to conduct these monitoring activities in the future.

There is an incentive for the community and the private owners to conserve the freshwater habitats on Dalupiri Island. Ranch animals depend on these creeks for water. The Caucauayan Creek, in particular, provides water that the community relies on for food, sanitation and irrigation of their rice fields. A deterioration of these wetland habitats will have detrimental effects on the community's economy and health. A sustained information and education campaign that promotes the conservation and sustainable use of the island's wetland species and habitats is therefore recommended. This has been initiated through a film-showing and a brief open forum conducted at the main community center of Dalupiri Island in May. Posters produced by the Mabuwaya Foundation calling for Philippine Crocodile and wetland conservation were distributed to members of the community and barangay officials. The caretaker and owners of this privately-owned island expressed strong support for conservation

of crocodiles and the island's natural environment. Further consultations with the island's owners and residents are vital in developing and implementing conservation strategies for the Philippine Crocodiles of Dalupiri Island.

Apart from the Philippine Crocodile, Dalupiri harbors other threatened species like the Philippine Duck *Anas luzonica* (Oliveros *et al*. 2004), the endangered Ryukyu Flying-Fox *Pteropus dasymallus* (Heaney *et al*. 1998) and Jareck's Wolf Snake *Lycodon chrysoprateros*, known only from this island (Ota and Ross 1994). The last two are of particular concern because they are very poorly known and their ranges are very small. Research on the conservation status of these species is also important.

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Counter clockwise from upper left: Dorsal side of head and neck of Dalupiri crocodile; crocodile underparts showing 25 ventral scale rows; Nipa Creek; one of few remaining puddles along Manolong River; old crocodile nest along Cabitangaan Creek; Caucauayan Creek. Photos by C. Oliveros and R. Manalo.