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THE SEA TURTLES CAPTURED BY COASTAL FISHERIES IN THE NORTHEASTERN SULU SEA, PHILIPPINES: DOCUMENTATION, CARE, AND RELEASE

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***Abstract.*—This paper presents the first substantive data on sea turtles in the northeastern Sulu Sea. Working with fishers and government, the Southeast Asian Fisheries Development Center (SEAFDEC FishWorld) documented 109 juvenile and adult sea turtles captured or stranded around Panay and Guimaras Islands, Philippines from 2001 to mid-2011. These included 65 Green Turtles (*Chelonia mydas*), 15 Hawksbill Turtles (*Eretmochelys imbricata*), 24 Olive Ridley Turtles (*Lepidochelys olivacea*), three Leatherback Turtles (*Dermochelys coriacea*), and two Loggerhead Turtles (*Caretta caretta*). From the four fishing villages within 1 km of FishWorld came 29 Green Turtles, eight Olive Ridleys, and one specimen each of the three other species. Approximately 77% of the Green Turtles were caught in nearshore fish corrals, mostly between October and May; whereas, 75% of the Olive Ridley Turtles were caught in offshore gill nets and long lines between April and October. Seventy-nine captured turtles were released, 73 of them with inconel flipper tags. Several turtles died from entanglement, serious injuries, slaughter for market, or diseases. An Olive Ridley Turtle and three Green Turtles were seen nesting at three beaches in southern and western Panay. Nesting of Hawksbill Turtles has been recorded at secluded beaches in Lawi, Guimaras about every three years; several batches of hatchlings have been raised by local residents before being released. Size-specific growth rates of Green Turtles and Hawksbill Turtles were highest among post-hatchlings and decreased sharply with size among juveniles and adults.**

Key Words.—bycatch; *Chelonia mydas; Lepidochelys olivacea; Eretmochelys imbricata;* tagging

INTRODUCTION

Sea turtle conservation requires a cooperative international approach to management planning that recognizes interconnections among habitats, sea turtle populations, and human populations, while applying the best available scientific knowledge (Eckert et al. 1999). In developing countries, biodiversity research and conservation are often of low priority; thus, there are huge gaps in scientific information and conservation success. Seale (1911) first reported the capture and killing of sea turtles in the Philippines for eggs, meat, and tortoiseshell; 70 y later, turtle fortunes had not changed (Alcala 1980). Even now in the CITES era, sea turtles continue to be hunted ruthlessly (World Wildlife Fund 2005; Chen et al. 2009; Renato Cruz, unpubl. data). There is little published data on sea turtles in the Philippines (Alcala 1980; Trono 1991; De Veyra 1994), and no entries at all in global maps of sea turtle bycatch (Wallace et al. 2010).

Protection and conservation of sea turtles (collectively called 'pawikan') in the Philippines was made the responsibility of Task Force Pawikan in 1979, and is now done by the Pawikan Conservation Project of the Department of Environment and Natural Resources (DENR-PCP; Trono 1991; Cruz 2004; World Wildlife Fund 2005). DENR cooperates with the Department of Agriculture Bureau of Fisheries and Aquatic Resources (DA-BFAR) to protect, conserve, and manage aquatic resources. Some regulatory functions of these agencies are shared with local government units and with the Coast Guard and National Police. More fishers and fishing villages have become aware of the laws to protect and conserve endangered animals, and of the penalties for taking them. Many of the captured or stranded sea turtles are now reported to DENR or DA-BFAR, to local government officers, the media, and FishWorld, the museum-aquarium-visitor center of the SEAFDEC (Southeast Asian Fisheries Development Center) Aquaculture Department in Tigbauan, Iloilo, Philippines (Fig. 1). Since opening in July 2000, FishWorld has received reports and specimens of sea turtles, Whale Sharks (*Rhincodon typus*), a Megamouth Shark (*Megachasma pelagios*), Dugongs (*Dugong dugon*), and several species of dolphins and small whales from around Panay and Guimaras. The sharks and mammals reported to us were mostly dead, but many sea turtles survived capture and were studied as much as possible to obtain scientific data in support of conservation.

This paper presents the first substantive data on sea turtle natural history and human interactions in the

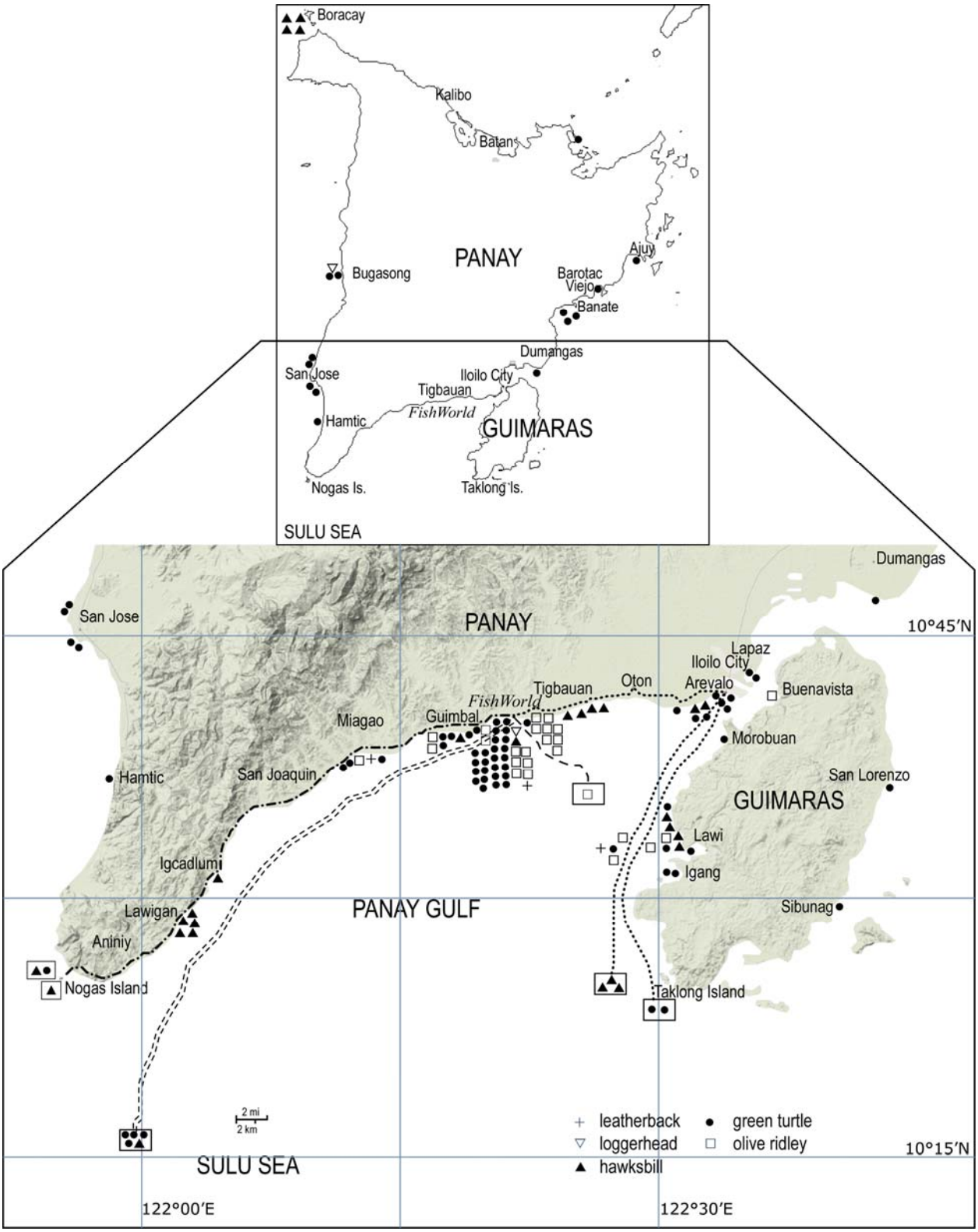

FIGURE 1. Panay Island and Guimaras Island at the northeastern Sulu Sea, Philippines. Different symbols show five species of sea turtles documented by SEAFDEC FishWorld in 2001–2011. Lines show the tracks of vehicles and boats that released 14 sea turtles at offshore locations indicated by rectangles with turtle symbols inside. Lawi, Guimaras is a Hawksbill nesting site. Boracay Island north of Panay was also a Hawksbill nesting site in 1997 when four hatchlings were caught by a local resident at the beach.

northeastern Sulu Sea, Philippines including: (1) species, sizes, and occurrence; (2) bycatch in coastal fishing gears; (3) deaths, injuries, barnacles, and buoyancy problems; (4) tagging, release, recapture; (5) food and growth; and (6) nesting. These data were generated by FishWorld working with local fishers and government personnel, an example of community cooperation in field research and conservation, and could be the springboard for more rigorous research according to methods prescribed by Eckert et al. (1999).

MATERIALS AND METHODS

Study area and fishing gear.—In the southwestern Sulu Sea lie the Turtle Islands, home to large aggregations of nesting Green Turtles (*Chelonia mydas*) and protected by Malaysia and the Philippines (Trono 1991; Cruz 2004; World Wildlife Fund 2005). Some of these turtles forage in the northeastern Sulu Sea, around Panay, Guimaras, and other islands (Fig. 1). The southern and western coasts of Panay are mostly black sandy beaches that grade quite steeply into the deep waters of the Sulu Sea. The coasts of Guimaras are mostly rocky cliffs, interrupted by short stretches of white sandy beaches, and fringed with sea grass beds, mangroves, and coral reefs. The study area experiences fine weather from October to April; by contrast, the southwest monsoon from June to September is characterized by heavy rain, strong winds, high waves, and typhoons.

The waters around Panay and Guimaras teem with fish and fishing gear. Stationary bamboo fish corrals have large impounding areas in 10–20 m deep water and long leader walls perpendicular to the beach. Fishes and sea turtles swimming along the shore are blocked by the leader and guided into the impounding area. The turtles are not harmed until the catch is hauled out and they are landed and tied up on shore for a few days (fishers often wait to get a good catch before they let a turtle go). Set nets (monofilament *otoshi-ami*) are used in deeper water along western Panay. The strong tidal currents in Iloilo Strait support a fishery using large fixed filter nets that catch and kill Dugongs, Whale Sharks, and sea turtles (Bagarinao 2008). These stationary fishing gears are operated during the northeast monsoon and are destroyed by the southwest monsoon. Gill nets, long lines, skimming nets, and beach seines are ubiquitous around Panay and Guimaras Islands and operated nearly every day, weather permitting. These movable gears entangle, hook, and drown sea turtles.

Documentation of turtles.—At first, live turtles would be brought to FishWorld under the mistaken idea that they would be bought for exhibit. At FishWorld, we advised the fishers that turtles are endangered animals, protected by law, and cannot be caught, kept, sold, or bought. Additionally, those captured or stranded must be reported to the DENR, to local government officers or the police, and to FishWorld for documentation. We heeded all reports of sea turtles and rushed to capture sites within 1–2 h travel. When the turtles were farther away, we coordinated with government staff to document them, release the healthy ones, and bring only the sick or wounded to FishWorld.

Documentation involved visiting the site of capture or stranding, taking photographs of the turtles and people, and recording the locality, date and time, fishers and fishing gear involved, and the species and condition of the turtles. We at FishWorld identified species based on Márquez (1990). We measured turtles for curved carapace length (CCL; the dimension given throughout this paper) and curved carapace width. Specimens with short tails that did not extend much beyond the carapace margin were considered females and those with long tails, males. We examined turtles for tags, markings, mutilations, injuries, barnacles, leeches, tumors, and diseases. Fishers and other local residents were interviewed as well.

Tagging and release of turtles.—The DENR-PCP provided FishWorld with serial-numbered inconel tags (National Band and Tag Co., Newport, Kentucky, USA), which we clipped between the flattened scutes at the posterior edge of the front flippers of live turtles. The PCP tag bears the instruction "Do not remove; Report to PCP-DENR Quezon City, Phil 1100" so FishWorld did not receive any tag recovery information. Aside from the tags, we gave turtles names, usually after the fishers who caught them, or the localities where they were caught (Bagarinao, T.U., E.F.C. Doyola-Solis, and J.E. Fernando-Teves. 2010. The Pawikan Album. The Sea Turtles Captured around Panay and Guimaras Islands, Philippines. SEAFDEC Aquaculture Department, Iloilo, Philippines.) to engender protectiveness towards turtles. We released turtles as soon as possible, mostly at the beaches where they were landed, but some were held for a few days or weeks of feeding and care before release.

Care, feeding, and growth monitoring.—We usually kept injured, weak, or sick turtles singly in seawater tanks (water volume 1–10 m^3) at water temperatures of 26–29° C and salinity of 33–35 ppt. We aerated and replaced standing water 1–2 times per week. We cleaned turtle wounds with povidone iodine solution and coated with topical antibiotic and petroleum jelly. Barnacles were pried out and the attachment areas cleaned. We gave emaciated, weak, or non-feeding turtles injections of vitamin B complex 1–2 times per week. We gave diseased turtles injections of the antibiotic enrofloxacin and vitamins A, D, and E.

TABLE 1. Frequency and curved carapace length (CCL) of juvenile and adult sea turtles captured along the coasts of Panay and Guimaras Islands, Philippines and reported to SEAFDEC FishWorld in 2001–2011. Results for 2011 are only until May, which coincides with the beginning of the southeast monsoons.

		Green Turtle		Olive Ridley		Hawksbill		Leatherback[a], Loggerhead[b]	
Year	All Species	n	CCL range (cm)	n	CCL range (cm)	n	CCL range (cm)	n	CCL range (cm)
2001	3	1	103	1	47	1	20		
2002	4	1	70	2	56–58	1	30		
2003	6	5	43–80	1	48				
2004	8	5	42–81	2	55–64			1[a]	~150
2005	12	6	61–85	1	53	3	27–30	1[a], 1[b]	128
2006	21	16	43–107	4	50–69	1	89		
2007	9	6	46–107	2	51–53			1[b]	77
2008	7	4	64–97	3	55–65				
2009	18	9	41–108	1	50	7	41–52	1[a]	–
2010	10	6	49–95	3	48–58	1	63		
2011 (12 May)	11	6	30–82	4	34–68	1	39		
All	109	65	30–108	24	34–69	15	20–89	3[a], 2[b]	

We gave the turtles held in FishWorld tanks fresh or frozen fish (various species, soft-spined, not so scaly, whole but bite-sized) and the farmed Red Seaweed *Gracilaria bailinae* with soft thalli. Occasionally placed in the tanks were beach seaweeds, large snails, clams, sea stars, sponges, jellyfish, and a lobster. We force-fed turtles that failed to eat for more than a week by funneling fish into the esophagus.

To begin to understand growth rates, we measured turtles when they arrived at FishWorld, when they left, and sometimes in between. We also made visits to measure Hawksbill (*Eretmochelys imbricata*) post-hatch and captive juveniles in Lawi, Guimaras, and of Green Turtle post-hatch in San Jose, western Panay. The Lawi ecotourism facility keeps sea turtles in 4 m^3 net cages in a shallow marine cove on a diet of fish, occasional jellyfish, and net biofoulants.

RESULTS

Turtle species, sizes, and occurrence.—FishWorld documented 109 sea turtles belonging to five species in 2001–2011 from around Panay and Guimaras Islands (Table 1; Fig. 1). The species and numbers recorded were *Dermochelys coriacea* (Leatherback; n = 3), *Caretta caretta* (Loggerhead; n = 2), *Eretmochelys imbricata* (n = 15), *Lepidochelys olivacea* (Olive Ridley n = 24), and *Chelonia mydas* (n = 65). Green Turtles accounted for 60% of all captures. Only 3–21 individuals were recorded per year according to reports received at FishWorld.

Green Turtles ranged in size from 30–108 cm and averaged 71 ± 20 cm CCL (mean ± SD, n = 55; Fig. 2). Hawksbills ranged in size from 20–89 cm and averaged 46 ± 17 cm (n = 9), whereas Olive Ridleys were 34–69 cm and 56 ± 8 cm (N = 23). Most specimens > 50 cm with short tails were considered females. Leatherbacks were the largest turtles (128–150 cm CCL).

Of the 109 turtles, 40 were captured at four fishing villages within 1 km of FishWorld, including 29 Green Turtles, eight Olive Ridleys, and one specimen each of the three other species (Fig. 1). Another 33 came from within 1–25 km east and west of FishWorld, along the southern Panay coast. Farther west, six Hawksbills and seven Green Turtle were reported, the latter including two nesting females, and two sick ones. Further east, eight Green Turtles were reported, including three that were slaughtered. Eleven Green Turtles, five Olive Ridleys, three Hawksbills, and a Leatherback were caught from Iloilo Strait and around Guimaras Island (Fig. 1).

Turtles as bycatch in coastal fishing gear.—Sea turtles are not directly hunted around Panay and Guimaras, but many are taken as bycatch in various fishing gear and are opportunistically landed, eaten, or sold by fishers unless otherwise deterred. Of the Green

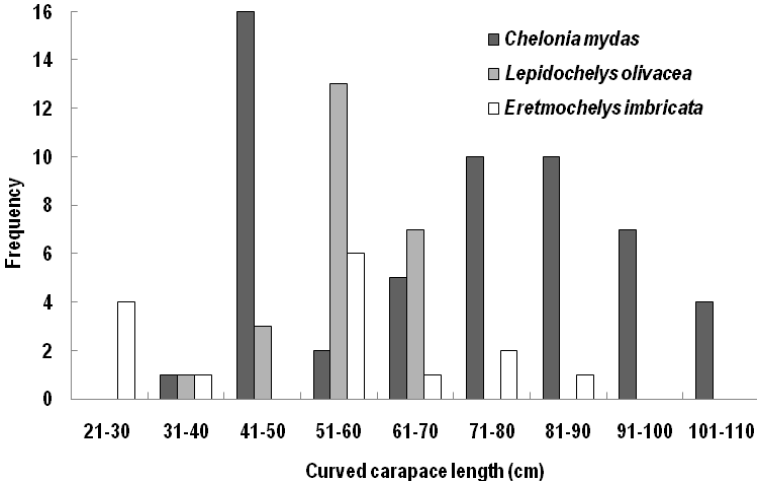

FIGURE 2. Size composition of sea turtles captured, stranded, or seen around Panay and Guimaras Islands, Philippines in 2001–2011.

Turtle bycatch, 77% were caught in nearshore fish corrals (Table 2), indicating a propensity to enter shallow waters, perhaps in search of food or nesting sites. In contrast, 75% of Olive Ridleys were caught in offshore gill nets and long lines (Table 2). Whereas 83% of Green Turtles were caught between October and May, 83% of Olive Ridleys were caught between March and October (Fig. 3). Hawksbills were caught by various gear sporadically over the year. The rare Leatherback and Loggerhead Sea Turtles were caught by gill nets in March–May.

Turtle deaths, injuries, barnacles, and buoyancy problems.—Encounters with fishing gear and people killed several of the turtles reported to FishWorld. Two Green Turtles were found butchered and sold for USD $1.25/kg in a market in eastern Panay; a third one was rescued by the police. Among the dead turtles, one had a fractured skull, one had a broken neck and bashed tomium, one had deep holes in the carapace, and two had punctured hind flipper bases. Several live turtles had impacted or mutilated carapaces and torn or rope-constricted flippers. Other large turtles were fouled with barnacles, mostly *Chelonibia testudinaria*, but also a few stalked and boring barnacles.

A very emaciated Olive Ridley was found floating off Guimaras and brought to FishWorld, where it was fed but died after 20 d. Seven Green Turtles were found floating near shore, unable to submerge or dive. Four of these died soon after capture; one had a fractured skull, another had holes in the carapace, but two had no external injuries. One had fibropapillomatosis (Aguirre and Lutz 2004), another developed shell rot (Wallach 1975), but both survived. The latest one had a badly damaged carapace and tomium, had to be force-fed, but recovered from the buoyancy problem.

TABLE 2. Number of sea turtle bycatch in different fishing gear around Panay and Guimaras Islands, Philippines reported to SEAFDEC FishWorld in 2001–2011.

	Frequency					
Fishing gear	**Green Turtle**	**Olive Ridley**	**Hawks-bill**	**Leather-back**	**Logger-head**	**Total**
Fish corral	37	2	3			42
Beach seine	3	1				4
Set net	3				1	4
Filter net	1					1
Gill net	4	10	2	3	1	20
Skimming net		1	4			5
Multi-hook long line		5				5
Single-hook long line		1	5			6
Total	48	20	14	3	2	87

Turtle tagging, release, and recapture.—Ten Green Turtles, three Olive Ridleys, and a Hawksbill documented by FishWorld already had tags (Table 3), but hardly any information on where and when they were first captured and tagged. We tagged and released 34 other Green Turtles, 17 Olive Ridleys, a Loggerhead, three wild Hawksbills, and four captive Hawksbills. Seven other Green Turtles, two Olive Ridleys, a Leatherback, and eight Hawksbills were released without tags. Of the live captured turtles, 65 were released from the beach but 14 turtles were taken by outrigger motorboats and released offshore (Table 3; Fig. 1) in the hope that they would head out to the open sea and away from coastal fishing areas.

The turtles we tagged may have been recaptured but, if so, FishWorld was not informed. However, a newspaper

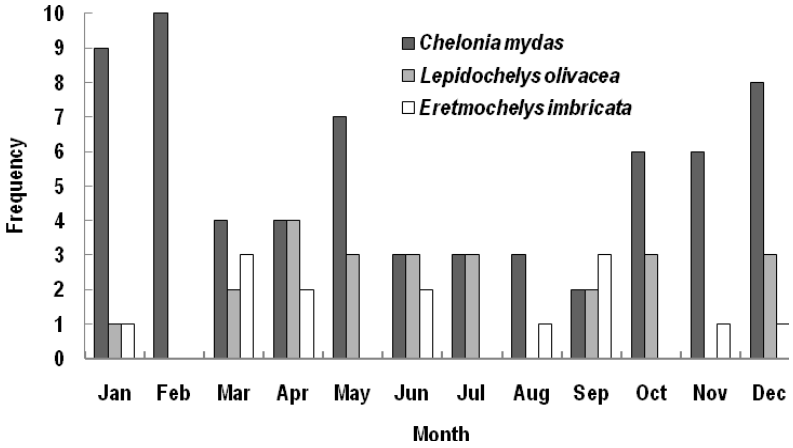

FIGURE 3. Monthly occurrence of sea turtles in coastal fishing gears around Panay and Guimaras, Philippines in 2001–2011.

reported that Green Turtle P21381 (with a second tag RP300B) was recaptured in a fish corral in Barotac Viejo, eastern Panay (Fig. 1). This Green Turtle was tagged and released by FishWorld off Taklong Island in May 2004 and evidently moved northeastward and was captured and tagged a second time along the way. Green Turtle PH8513 released near FishWorld on 4 May 2010 was found dead onshore about 1 km westward 4 mo later. Olive Ridley PH8515 released in Lawi on 7 December 2010 was recovered dead about 32 km away 18 d later. A Hawksbill with an improvised plastic tag traveled about 100 km northeastward along southern Panay and was caught in a fish corral 4–5 mo later, when it was tagged PH8509.

Food and growth.—The large Green Turtles held in FishWorld tanks showed a large appetite for *Gracilaria balinae*, and the beach seaweeds *Sargassum*, *Ulva*, and *Padina*, but accepted fish in small amounts. The smaller Green Turtles < 45 cm CCL ate more fish and less *Gracilaria*. The Hawksbills ate fish (various species of *Sardinella, Dussumieria, Herklotsichthys, Cubiceps, Pennahia, Upeneus, Leiognathus*; crude protein approx. 60% of dry mass), the fleshy garden snail *Achatina fulica*, but very little *Gracilaria*. Olive Ridleys took 1–2 weeks to start feeding in the tank, but ate fish almost exclusively. The turtles did not consume the other invertebrates in the tank.

On a seaweed diet, two Green Turtles (82 cm and 89 cm CCL) grew 2.5 cm and 1.3 cm a year. On a fish diet, a 29 cm juvenile Hawksbill grew 19 cm, a 61 cm female grew 2.4 cm, and a 75 cm male grew only 0.8 cm in a year. For comparison, annual growth rates of 4.9 cm and 12 cm were estimated for two wild Green Turtles (42 cm and 49 cm CCL) that were recaptured months after release. In the Lawi net cages, two captured Green Turtles (44–45 cm) grew 3 cm, and two captive Hawksbills (43–47 cm) grew 3.5–6.3 cm a year. Six post-hatchling Hawksbills kept in a small pond in Lawi on a fish diet grew from 16.8 cm to 31.5 cm CCL between 28 August 2010 and 4 April 2011. Nine post-hatchling Green Turtles under similar conditions in San Jose grew from 5.4 cm to 9.3 cm to 14.1 cm in three months. Clearly, sea turtles grew fastest at the post-hatchling stage during the first year and slower with increasing size (Fig. 4).

Sea turtle nesting.—Along southern Panay, an Olive Ridley (69 cm CCL) was seen digging a hole at a beach in Guimbal on 30 October 2006 and a Green Turtle (64 cm CCL) laid 60 eggs at a beach in Miagao on 22 August 2008. Along western Panay, nesting of Green Turtles was observed at a beach in San Jose on 23 November 2007 and on 27 June 2010.

The white sand beaches of Lawi, Guimaras (Fig. 1) are known Hawksbill nesting sites. Nests with eggs were found at Sitio Lusay in September 1996 and at Punta Lawi in September 1999. Hatchlings were also found at Sitio Lusay on 10 and 27 September 2001 and at Punta Lawi on 26 November 2006. On 28 December 2009, a Hawksbill dug a nest under a *Pandanus* grove in Sitio Lusay, and hatchlings emerged on 25 February 2010.

The Green Turtles documented around Panay and Guimaras in 2001–2011 ranged from hatchlings to a 95 cm CCL male and a 108 cm CCL female and included three nesters. The Hawksbills ranged from hatchlings to an 89 cm CCL female and three nesters. The Olive Ridleys ranged from a juvenile to a 69 cm CCL nester.

DISCUSSION

The most important result of FishWorld's work is that many documented sea turtles were checked for health condition, treated where necessary or possible, tagged,

TABLE 3. Tagging and release of sea turtles captured around Panay and Guimaras Islands, Philippines in 2001–2011.

	Sea turtles with DENR-PCP tag numbers		
Disposition	**Green Turtle**	**Olive Ridley**	**Hawksbill**
Turtles with existing tags brought to FishWorld (n = 14); three were sick and died, 11 were released mostly from Tigbauan, Iloilo	RP5809 P18125 P19428 P21397* PH8313F PH8324F PH0542A PH0541A PH6944 PCP/EFPI PH0004C*	P21396* PH0022C P19447	P13290
Turtles tagged by FishWorld and released from southern Panay beaches soon after capture (n = 42); one was later recovered dead	P18303, P18304 P18305, P18306 P18309, P18310 P21383 P21526, P21528 P21530, P21532 P21539, P21540 PH8501, PH8504 PH8506, PH8508 PH8512, PH8513* PH8514, PH8516 PH8521, PH8523 PH8524 PH1039E	P18301, P18302 P18307, P18308 P21384 P21527, P21533 P21534, P21535 PH8503 PH8505 PH8507 PH8520 PH8522 PH8525	P21529 PH8509
Turtles released offshore from boats (n = 14)			
• between Panay and Guimaras 13 Nov 2001		untagged	
• off Taklong Island National Marine Reserve, southwestern Guimaras, 7 May 2004	P21381=RP300B** P21382		
• off Taklong Island National Marine Reserve, 28 Sep 2005			3 untagged juveniles
• from FishWorld about 75 km into the Sulu Sea, 15 Dec 2006	PH8313F, P21531 P21537, P21538		P21536
• at the seagrass bed of Nogas Island, off southwest Panay, 14 Dec 2009	PH8511		PH8510
• at the shoal south of Nogas Island, 18 Sep 2010			PH8513***
Turtles released from beach of Punta Lawi, Guimaras, 7 Dec 2010 (n = 6); one was later recovered dead	PH8518 PH8519	PH8515* PH0010C	PH006C PH0550A

Loggerhead PH8502 was released from Tigbauan, southern Panay on 5 May 2007.

*Turtle died; **Turtle P21381 was recaptured, retagged RP300B, and released; ***Tag from recaptured dead Green Turtle reused for Hawksbill

and released back to sea. With little investment, we obtained data on 109 sea turtles that can help in the continuing effort to monitor the locations, risks and threats, health and diseases, and movements of these endangered animals.

Sea turtle natural history.—The relative capture frequencies of the five turtle species in the northeastern Sulu Sea in 2001–2011 are in accordance with their general abundance and distribution. Green Turtles are the most abundant sea turtles in the west central Pacific, and Olive Ridleys are uncommon around oceanic islands (Márquez 1990). Olive Ridleys in the Philippines form small rookeries in a few places facing the South China Sea (Cruz 2004). Hawksbills are fairly common in the Philippines, Leatherbacks are sometimes landed, but Loggerheads are rare (De Veyra 1994; Cruz 2004). The DENR-PCP has tagged more than 13,000 sea turtles since 1982, mostly Green Turtles nesting on the Turtle Islands, but tag recovery information has been scarce

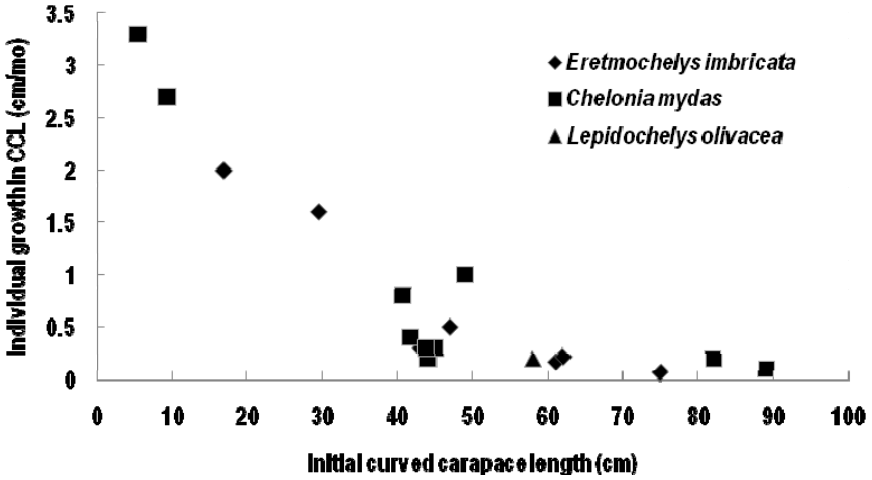

FIGURE 4. Individual growth rates of 13 juvenile and adult sea turtles and average growth rates of 15 post-hatchlings as a function of initial size under various conditions. Growth is expressed as increase in curved carapace length (CCL) in cm/mo.

(De Veyra 1994; Cruz 2004). Tagged nesters from the Sabah Turtle Islands have been recovered around several Philippine islands bordering the Sulu Sea, including one Green Turtle in western Panay, two in eastern Panay, and one in Guimaras; thus these islands are considered turtle foraging grounds (Cruz 2004).

Indeed, the waters around Panay and Guimaras are turtle foraging grounds, but some beaches are occasionally used for nesting. The waters from the Sulu Sea move with the high tides, once or twice a day, concentrating plankton and nekton, into the narrower and shallower Panay Gulf, Iloilo Strait, Guimaras Strait, and Cuyo East Pass. Sea turtles, Whale Sharks, and marine mammals follow their food and run into the multitude of fishing gear. Sea turtles then spend time in seagrass beds and coral reefs to forage. The key to sea turtle survival is the availability of both the underwater foraging habitats and the nesting beaches. Unfortunately, the coastal areas in the Philippines are heavily impacted by anthropogenic activities; as such, they are populated, exploited, disturbed, denuded, and polluted. Consequently, sea turtle habitats have been compromised.

Hawksbills found between Panay and Guimaras are probably members of a population resident in the northeastern Sulu Sea, some of which nest in Lawi, Guimaras. Alcala (1980) reported Hawksbill nesting at beaches in southern Negros, western Cebu, Sumilon Island, and Panglao Island, also facing the northeastern Sulu Sea. The Hawksbills were seen in shallow coral reefs, reef drop-offs, and channels between islands. These sightings occurred day and night, the turtles sometimes inactive or resting. Two individuals had seagrass, sponges, and the seaweeds *Eucheuma* and *Codium* in their stomachs (Alcala 1980). Similar behavior was seen in the Cayman Islands (Caribbean), where Hawksbills reside long-term and forage on sponges and jellyfishes (Blumenthal et al. 2009). In contrast, Green Turtles are generally considered herbivores, but they may be omnivorous during the neritic juvenile period and even beyond (Cardona et al. 2009).

Size-specific growth rates were seen among Green Turtles and Hawksbills in this study: fast growth among (captive) post-hatchlings and slower rates among larger (wild) juveniles and adults. Growth rates of wild post-hatchling and small juvenile sea turtles have been reported rarely. Hawksbill hatchlings grew 3.6 cm to 33 cm in 16 mo in southern Negros (Alcala 1980). In the southern Great Barrier Reef, Green Turtles (39–11 cm CCL) grow at maximum rates of 2.1–2.4 cm/y until they are 60–63 cm CCL, and Hawksbills (39–85 cm CCL) grow at 1.7–2.2 cm/y until 60 cm CCL (Chaloupka and Limpus 1997; Limpus and Chaloupka 1997). In the Caribbean, Hawksbills (20–63 cm straightline carapace length) grow at 3 ± 1 cm/y (Blumenthal et al. 2009). Green Turtles show a post-pelagic recruitment size of approx. 35 cm CCL (3–5 y old), a growth spurt at 60 cm (14 y), and sexual maturity at 95–100 cm CCL (approx. 40 y; Limpus and Chaloupka 1997). Hawksbills recruit nearshore at > 35 cm, grow fastest at 60 cm, and reach sexual maturity at > 80 cm CCL (Chaloupka and Limpus 1997).

Turtle–fisheries interactions.—Our study provided evidence of turtle interactions with coastal fish corrals, gill nets, long lines, and filter nets. The number of turtles reported and documented during the study (109 in

10 y) is certainly just a fraction of the total sea turtle bycatch around Panay and Guimaras but the total is difficult to estimate. The capture frequency in this study is not much different from those seen by Alcala (1980) who estimated the sea turtle bycatch around southern Negros. Fishermen using gill nets in an area about 5 km^2 in Tanon Strait captured 11 turtles from March to November 1978. In Bais Bay, 14 turtles were captured from January to June 1977, and 25 turtles from January to October 1978. Over a 60 km coastal strip, 10 Hawksbills and nine Green Turtles were captured from December 1979 to July 1980. Sea turtles are caught not only in municipal fishing operations within 15 km of shore but also in commercial offshore trawls and drift nets.

Direct takes and bycatch of sea turtles in the Philippines are not well documented, but seem voluminous based on spot surveys and the occasional apprehension of poachers (Renato Cruz, unpubl. data). In November 2005, nine sacks of dried Hawksbill scutes from about 640 butchered turtles were found in a container van from Zamboanga allegedly bound for Vietnam. In September 2007, nine live nesters and 176 dead Green Turtles consisting of newly butchered carcasses, fresh meat, and dried meat were found in a Chinese vessel within the Turtle Islands Wildlife Sanctuary (Reference). In August 2008, 101 dead Hawksbills were found in a Vietnamese vessel off Cabaluan Island, Linapacan, Palawan (Renato Cruz, unpubl. data). Turtle poaching by foreign vessels provokes strong government reaction.

Since 1981, severe trade restriction of sea turtles and turtle products has reduced commercial demand and direct takes but sea turtles are still a substantial component of fisheries bycatch worldwide (Márquez 1990; Gilman 2009; Mancini and Koch 2009; Wallace et al. 2010). The bycatch in gillnet, longline, and trawl fisheries worldwide in 1990–2008 was about 85,000 sea turtles, but this was probably an underestimate by two orders of magnitude (Wallace et al. 2010). Artisanal fisheries involve more than 95% of the world's fishers, yet there is little data on artisanal fishing effort, catch, and bycatch in most countries (Moore et al. 2010). Closing this knowledge gap is difficult and expensive and various methods are being developed (Gilman 2009; Moore et al. 2010).

Reduction of sea turtle mortality in fisheries is an important component of conservation efforts. DENR-PCP and DA-BFAR can use the evidence from this study to determine possible interventions in fishing gear design, operation, or regulation, and about critical research to illuminate the problem. To minimize the bycatch, turtle exclusion devices have been developed for commercial trawls and circle hooks for long lines (Zulkifli et al. 2004; Gilman 2009). Similar modifications may be developed for the coastal fishing gears, which are highly variable and more numerous, but small-scale fishers may not be inclined to add to their operating cost.

Biodiversity conservation issues are addressed by government agencies, academia, and conservation organizations at various scales and levels of complexity and funding. Because sea turtles are shared resources, management and conservation must be carried out region-wide and worldwide (Eckert et al. 1999; Zulkifli et al. 2004; Gilman 2009). However, much can be done at the local community level as well, as the FishWorld experience has shown. FishWorld serves as a center for community involvement in learning about marine biodiversity and working for conservation. Public awareness and protectiveness toward sea turtles was developed through museum exhibits and first-hand encounters with the turtles. Publication of our research results is the next step forward. In the meantime, photographs of 68 sea turtles were published as an album (Bagarinao *op. cit*) to educate the public about sea turtles and the threats they face, build empathy for these endangered animals, and encourage changes in producer and consumer behavior in favor of turtle conservation.

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