A REVIEW OF SEA TURTLE SATELLITE TRACKING IN MALAYSIA

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INTRODUCTION

Malaysian beaches support nesting green turtles *Chelonia mydas* which nest in large numbers (1,000s) and the hawksbill *Eretmochelys imbricata* with more moderate nesting numbers (low 100s; deSilva, 1982; Siow & Moll, 1982; Chan, 1991). Malaysia used to host one of southeast Asia's largest leatherback *Dermochelys coriacea* populations with upwards of 10,000 nests deposited in the 1950s at Rantau Abang, Terengganu (Chan & Liew, 1996). These numbers declined to some 10 per year by 2000 (Chan & Liew, 1996) and the population went functionally extinct in Terengganu in 2010 (DOFM, unpubl. data). Solitary nesting olive ridley turtles *Lepidochelys olivacea* now nest extremely infrequently in Malaysia (Chan, 1991, 2006), with occasional nesting events occurring on Penang Island, the Turtle Islands Park in Sabah and the Talang-Satang National Park in Sarawak (see Figure 1 for locations).

Green turtles nest predominantly at the Turtle Islands Park and on Sipadan Island off Sabah; at the Talang-Satang National Park in Sarawak; and at numerous beaches in peninsular Malaysia including Ma'Daerah, Redang Island

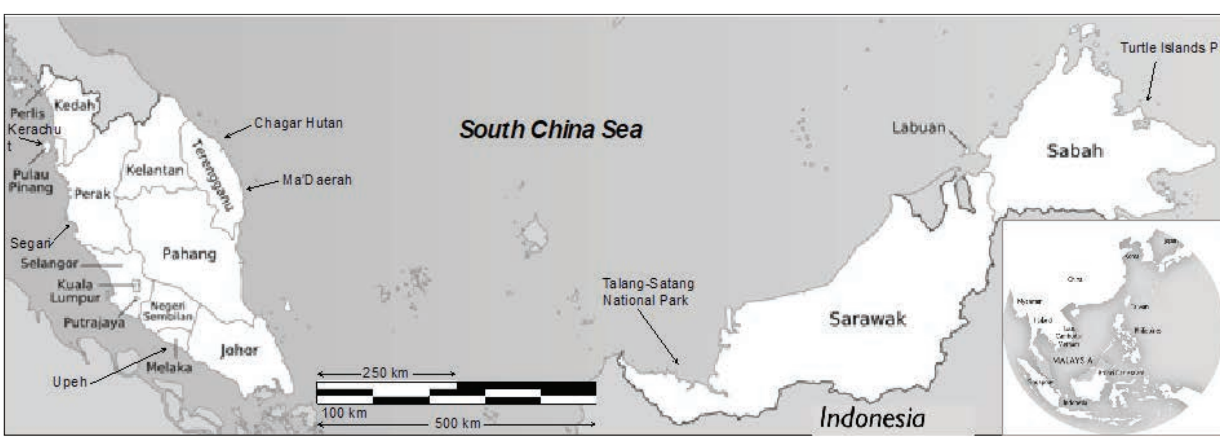

Figure 1. Map of Malaysia highlighting the States and geographical separation of Sabah and Sarawak, along with deployment sites of satellite-tracked sea turtles.

and Setiu in Terengganu, and Segari in Perak (see Figure 1 for locations). Hawksbills nest predominantly at Gulisaan Island (Turtle Islands Park) in Sabah and on Upeh Island and several mainland sites in Malacca. Chagar Hutang also hosts a small number of hawksbills that frequently breed each 2-3 years (Chan & Liew, 1999; Chan, 2013; see Figure 1 for locations). Hawksbill nesting elsewhere in the country is only occasional and widely distributed.

Malaysia is geographically divided by the South China Sea, with peninsular Malaysia States comprising the peninsular extending south of Thailand and ending at the Singapore border, with the two Borneo States of Sarawak and Sabah lying to the east, some 580km at the nearest point between Johor and Sarawak, and some 1600km at the furthest point between Kelantan and Sabah (Figure 1). The physical separation has resulted in marked and often intriguing differences in migration paths by some of the tracked turtles. Particularly, the narrow Malacca Straits separating peninsular Malaysia from Indonesia becomes a physical barrier to widespread oceanic dispersal, and interestingly the narrow Balabac Straits separating Sabah from the western reaches of the Philippines, which may have otherwise been an impediment to widespread movement, are a conservation bottleneck with green turtles regularly traversing the straits in each direction.

The State of Sarawak in Malaysia holds a prominent place in the history of tracking turtles, dating back 65 years when in 1952 John Hendrickson undertook some of the world's very first efforts at tracking green turtles using copper tags drilled on to the rear edge of the carapace off the Talang Talang and Satang Islands (Hendrickson, 1958). Subsequent to these (mostly failed) efforts, Hendrickson moved on to using 'Hasco' Monel cattle ear tags (Hendrickson, 1958), in what later developed into the most common flipper tagging method in use across the world today. Those same flipper tagging techniques are now commonplace at key rookeries in Malaysia, including the Turtle Islands Park in Sabah (Basintal & Lakim, 1993), the Sarawak Turtle Islands (Tisen & Bali, 2000), at Redang Island in Terengganu (Chan & Liew, 1999), and across all major nesting sites in peninsular Malaysia (Sukarno *et al.*, 2007).

Despite multiple decades of flipper tagging involving thousands of sea turtles, little has been revealed about the long-distance migrations and linkages between nesting and foraging grounds with conventional flipper tags. Tag returns from the Turtle Islands Park and from

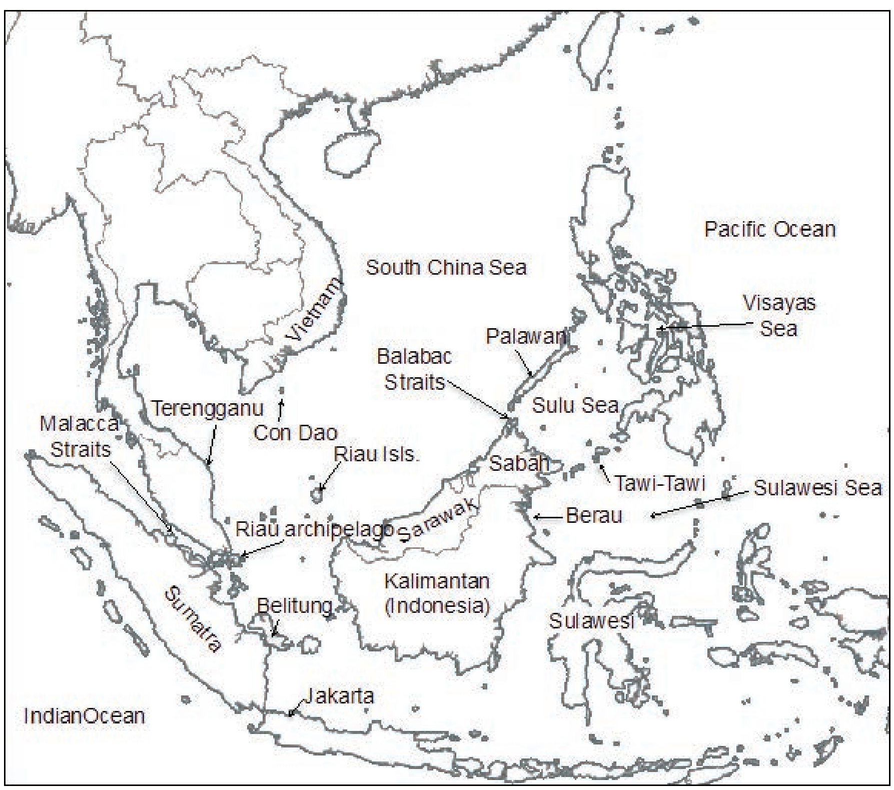

Figure 2. Map of area surrounding deployment sites of satellite-tracked sea turtles in Malaysia.

the Philippines Turtle Islands Heritage Sanctuary, jointly designated as the Turtle Islands Heritage Protected Area (TIHPA; MoU TIHPA, 1996) have been recovered from Tawi Tawi, Negros Occidental and Mindoro in the Philippines and from the Berau area in Indonesia (Ramirez de Veyra, 1994; Sagun, 2004). But recoveries are rare. Some 5,000 turtles are tagged annually on nesting beaches in Malaysia and several hundred are tagged as foraging turtles (Basintal & Lakim, 1993; Bali & Ganyai, 2007; Isnain, 2008; Pilcher, 2010), but other than the occasional tag returns and encounters of a handful of tagged Malaysian turtles, flipper tagging has not demonstrated the ability to provide robust information on post-nesting migrations and movements of foraging turtles.

Information on location, spatial extent and condition of feeding grounds, along with linkages between nesting and feeding grounds, population demographics at feeding grounds and spatial and temporal habitat use are all considered among the top research priorities for sea turtles at present (Hamann *et al.*, 2010, NRC, 2010). The advent of rapidly developing technology, satellite tracking is now able to respond to many of these information needs (Godley *et al.*, 2008). The international linkages that are determined using satellite tracking can highlight the need for international cooperation (Blumenthal *et al.*, 2006) although caution should be exercised in the deployment of small numbers of tags and over short periods that are unlikely to lead to management and conservation results. Satellite tracking efforts often work best as large collaborations where tracks are coalesced into larger data sets, and that results of satellite tracking need widespread dissemination (Jeffers & Godley, 2016). Satellite tracking can be a useful tool in determining Important Turtle Areas (ITAs; Pilcher *et al.*, 2014) to assist in streamlining conservation efforts for marine turtles (Gredzens *et al.*, 2014; Pilcher *et al.*, 2014; Boudouin *et al.*, 2015).

Malaysia also has a substantial history of working with satellite transmitters starting in 1991, although earlier efforts (which were far more expensive relative to today's costs) largely precluded significant sample sizes - in many cases only one to four turtles were tracked at a time. In recent years there has been a substantially greater investment to use satellite tracking to determine linkages between nesting and foraging grounds in an attempt to better inform management and conservation agencies.

Herein we present a summary of the initial findings of 15 satellite tracking projects by various government agencies and Non Profit Organisations (NGOs) in Malaysia, most of which were carried out as collaborative efforts amongst Malaysian institutions and in some cases with external agencies and Universities (Table I). We do not have access to data for one olive ridley and one leatherback tracked by the department of Fisheries Malaysia. The 15 deployments we summarise here spanned 23 years from 1993 to 2016 and collectively they provide indications of the types of migrations and in many cases the locations of foraging grounds for the two most abundant marine turtle species in Malaysia (greens and hawksbills), and inform management agencies of the need for several close bilateral conservation approaches, and additional protection of habitats in Malaysian waters.

METHODS

Deployment of tags generally occurred with small numbers of turtles (one to five) at Chagar Hutang (Pulau Redang) and Ma' Daerah, Terengganu, Kerachut Beach on Penang Island, TIHPA (Sabah / Philippines), on Tioman Island in Pahang and on Segari Beach, Perak. Somewhat larger samples (10-15) were deployed subsequently from the Talang-Satang National Park in Sarawak and from Upeh Island in Malacca, and the largest samples (24-27) were deployed more recently from Terengganu and the Turtle Islands Park in Sabah (Table 1; see Figure 1 for locations).

Data analysis methods varied across projects, but all satellite signals were sourced from Argos, and data from tags deployed after 2008 were processed by ARGOS using Kalman filtering (www.argos-system.com). WWF-Malaysia and MRF data were automatically downloaded by the Satellite Tracking and Analysis Tool (Coyne & Godley, 2005), filtered to exclude locations over land and selected for location fix qualities 3, 2, 1, A, and B. No additional post-processing or filtering of the data has been performed on these data sets as yet, and they are provided herein to complete the summary of all Malaysian tracking efforts. For turtles deployed by DOFM, SEATRU and Sarawak Forestry Corporation, data were sourced and filtered in a similar manner directly from the Argos service, and mapped independently. We recognise that the lack of filtering and modeling of data could represent errors up to ~1,000m, but for the purposes of tracking general migration routes we suggest that these potential errors are tolerable and that the findings provide a general orientation of tracks and final destinations for many of the turtles.

To develop graphics of all tracks deployed in Malaysia, particularly as some of the older data sets were not available, data were traced in Google Earth™ and plotted using ArcGIS 10.2 (www.esri.com). Where actual data were available, tracks were visually analysed and all points prior to the departure point from the nesting site were categorised as internesting (the period post-deployment until departure from the nesting site). Following an

Table 1. Meta-data for 102 transmitter deployments in Malaysia. Note: There is no data available for the single olive ridley and the single leatherback tracking efforts.

Year Started	Location	State	Species	Number	Life Stage	Capture Method	PTT Type	Partners	Citation
1993	Chagar Hutang	Terengganu	Green	4	Adult	Post-nesting	Telonics ST-3	SEATRU; DOFM	Liew *et al.*, 1995; Papi *et al*., 1995
1998	Turtle Islands Park	Sabah	Green	4	Adult	Post-nesting	Telonics ST-14	Sabah Parks; OneOcean	Sabah Parks, unpubl. data
1999	Talang-Satang NP	Sarawak	Green	9	Adult	Post-nesting	Telonics ST-14	Sarawak Forestry Corporation; SEATRU	Bali *et al.*, 2002
1999	Talang-Satang NP	Sarawak	Hawksbill	1	Adult	Post-nesting	Telonics ST-14	Sarawak Forestry Corporation; SEATRU	Bali *et al.*, 2002
2000	Turtle Islands Park	Sabah	Hawksbill	3	Adult	Post-nesting	Telonics ST-14	Sabah Parks; US National Marine Fisheries Service	NMFS & Sabah Parks, unpubl. data
2001	Chagar Hutang	Terengganu	Hawksbill	1	Adult	Post-nesting	KiwiSat 101	SEATRU; DOFM	SEATRU, unpubl. data
2005	Ma'Daerah	Terengganu	Green	4	Adult	Post-nesting	KiwiSat 101	Griffith University; DOFM	van de Merwe *et al.*, 2009
2007	Mantanani	Sabah	Green	5	Juvenile	Rodeo	Kiwisat 101	MRF	MRF, unpubl. data
2008	Upeh Island; Terendak Camp	Malacca	Green	15	Adult	Post-nesting	KiwiSat 101	WWF Malaysia; DOFM	Lau *et al.*, 2009
2008	Tioman	Pahang	Green	1	Adult	Post-nesting	Kiwisat 101	DOFM; Japanese Trust Fund IV Program	DOFM, unpubl. data
2008	Ma'Daerah; Setiu; Chagar Hutang	Terengganu	Green	24	Adult	Post-nesting	KiwiSat 101	WWF Malaysia; DOFM; Terengganu State Department of Fisheries	Lau *et al.*, 2009
2011	Chagar Hutang	Terengganu	Hawksbill	2	Juvenile	Head-started	Telonics TGM4325	SEATRU; KLCC Aquaria; Body Shop Foundation	Liew *et al.*, 2012
2013	Segari	Perak	Green	1	Adult	Post-nesting	Kiwisat 101	DOFM; Malakoff Corporation	DOFM, unpubl. data
2015	Kerenchut	Penang	Green	1	Juvenile	Head-started	Kiwisat 101	DOFM; Malakoff Corporation	DOFM, unpubl. data
2015	Turtle Islands Park	Sabah	Green	27	Adult	Post-nesting	SPOT-293A	MRF; Sabah Parks	MRF, unpubl. data

increase in travel speeds and assumption of direct purposeful travel from the nesting site with minimal deviation from a straight path, subsequent location fixes until the commencement of foraging were categorised as migration paths (see Pilcher *et al.*, 2014 for methods). For data sets which were only available as graphics, we determined if the turtle had reached a conclusive foraging ground by an accumulation of location fixes at that location. Unless this was clearly observed, this data set was not used in the determination of final foraging ground locations.

RESULTS & DISCUSSION

A total of 104 satellite transmitters have been deployed on sea turtles in Malaysia since 1993, comprising 79 green turtles (76%), 23 hawksbills (22%), one olive ridley (1%) and one leatherback (1%). Data is available for 102 of these (excluding the solitary olive ridley and leatherback tracks), and among these the track durations ranged from 10 to 625 days with a median of 77 days (Figure 3). Of the 64 post-nesting greens that were tracked, 35 (55%) reached foraging grounds, as determined by a reduction in travel rates and a shift from purposeful migration direction and unidirectional orientation to short distance movements with random heading changes (Schofield *et al.*, 2010; Foley *et al.*, 2013), or by an accumulation of location fixes at the terminal location as depicted by the original track graphic. In contrast, a total of 19 of the 22 hawksbills (86%) also reached foraging grounds. The following sections describe species- or topic-specific implications of turtle movements; a map depicting regions and locations identified in the coming sections is presented in Annex I to maintain clarity of the migration maps.

Green Turtles

Green turtle migrations took on two major forms: (i) coastal movements, whereby turtles remained in waters generally shallower than 100m; and (ii) oceanic movements, whereby turtles migrated out into deeper

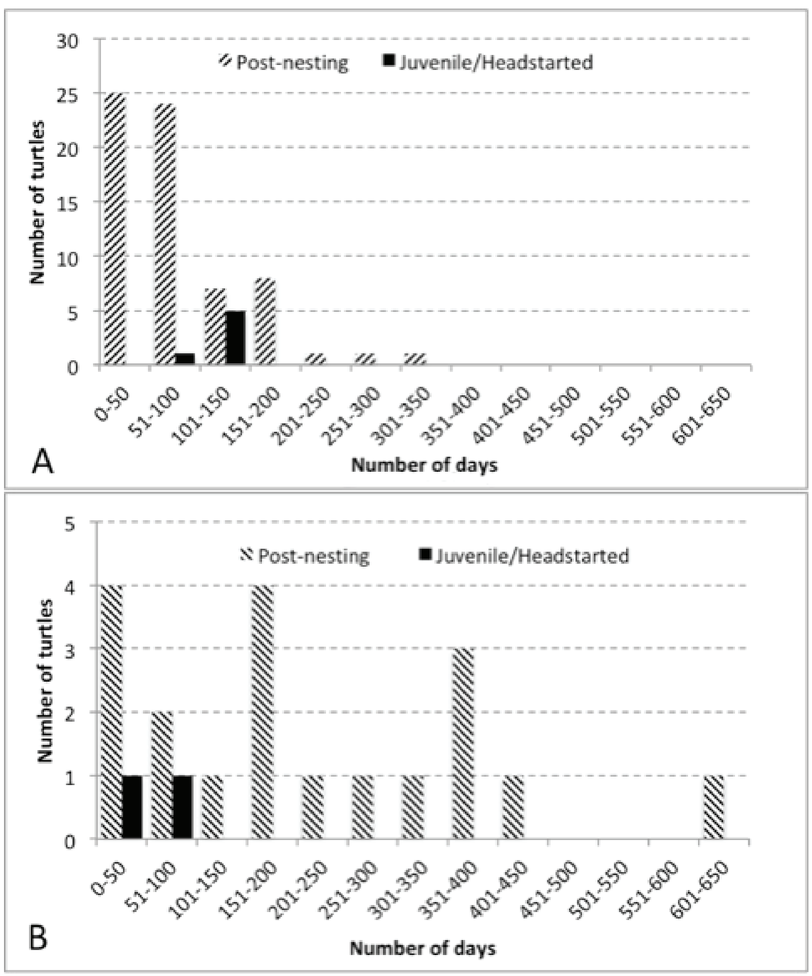

Figure 3. Transmission durations of satellite transmitters deployed on green (A) and hawksbill (B) sea turtles in Malaysia.

waters typically deeper than 3,000m and crossed either the South China Sea or the Sulu and Sulawesi Seas (Figure 4). This differentiation in behaviour patterns was also noted by Papi *et al.* (1995) for the five green turtles tracked in the 1990s. Turtles departing from Terengganu, on the east coast of peninsular Malaysia were far more likely to undertake oceanic migrations (13 out of 29 turtles; ~52%), while only two of 27 (~7%) turtles deployed in Sabah or Sarawak did likewise (one cutting diagonally in a NE direction from the Turtle Islands Park towards the middle of Palawan, and the second swimming due south from the easternmost tip of Sabah to reach Sulawesi. All of the nine turtles deployed from Sarawak remained close to shore for the majority of their migrations, and 25 of 27 turtles (~93%) from the TIP also remained close to shore during their migrations (Figure 4).

The coastal migration behaviour is of note given the prevalence of fishery-based mortality in both peninsular Malaysia (Chan *et al.*, 1988; Chan & Liew, 1996; DOFM, unpubl. data) and the Borneo states (Tisen & Bali, 2000; Jaaman *et al.*, 2009; Pilcher *et al.*, 2009). Tracking efforts by van de Merwe *et al.* (2009) also highlighted how male and female turtles remained within 30km of the nesting beach during the breeding and inter-nesting periods, which includes habitat beyond the 'no trawl zone' designed to protect turtles in this area.

Shrimp fishing in shallow nearshore waters is one of the world's leading causes of sea turtle mortality (NRC, 2010), and in Malaysia there are thousands of registered shrimp trawl vessels. In peninsular Malaysia alone there are some 200 vessels operating along the east coast where most turtles occur. In Sabah there are some 1,500 registered vessels (although not all of these are active, and not all are shrimp trawlers), and in Sarawak another 500 (DOFM, 2015). In recent years Malaysia has moved toward a legal requirement for Turtle Excluder Devices in shrimp trawl nets, with peninsular Malaysia online in October 2017, and full national implementation expected by 2022, in a joint project between the Department of Fisheries Malaysia and the Marine Research Foundation. It is expected that several thousand sea turtles will be saved each year through these efforts.

In terms of overall movements, tracking efforts to date have revealed some interesting findings: Many green turtles deployed in peninsular Malaysia remained quite close to the deployment sites, and given that many of the tag durations were not long, it is possible the turtles had not yet commenced their migration and were still in internesting areas (Figure 4). Among the longer migrations however, there are clear linkages between West and East Malaysia (~1,600km), and between Malaysia and Indonesia (700km to the Riau Islands, ~1,100km to Belitung Island and 1,300km to just north of Jakarta), the Philippines (~1,700km) and one example of a link between Malaysia and Vietnam, some 1,500km distant.

Turtles deployed from Sarawak all stayed extremely close to shore as they moved northeast towards Sabah. Several of these turtles stopped in Labuan/Lawas Bay (a known seagrass habitat) for a period before continuing on with their journeys (Bali *et al.*, 2000), and it is possible that they were feeding and replenishing energy supplies following a lengthy nesting season. Interestingly, all turtles headed northwest out through the narrow Balabac Straits to enter the Sulu Sea and then dispersed in various southwest directions, reaching foraging grounds in Tawi Tawi, southern Palawan, southeast Sabah and as far south as the Berau district in East Kalimantan, Indonesia (a minimum displacement of >2,000km). While these were all coastal movement types, the Sarawak migrations represent long migrations of ~1,200km to ~2,000km (Figure 4, northern-most reaching track).

Turtles deployed from Sabah mostly stayed coastal, with the longest track being one turtle that moved north to Palawan, continuing in a northeast direction up and around the north of Panay Island then southeast, settling eventually around Talong Island in the Visayan Sea, some 1,800km afar. Two Sabah turtles went counterclockwise out of the Sulu Sea and into the South China Sea, counter to the movements of Sarawak turtles, with turtles taking up residence close to the Klias peninsula in southwest Sabah, some 800km away. The balance of migrations headed to three main areas: southern Palawan Island and Balabac Island, at the western extent of the Philippines and just northwest of Sabah; south into Indonesia to the Berau District of East Kalimantan (Borneo) and Sulawesi; and south to other coastal sites in Sabah.

Some of the turtles from the Turtle Islands Park headed to southeast to an area just outside (in deeper waters) of the Sun Sakaran Marine Park, and one headed north to the Tun Mustafa Park, highlighting the value of Marine Protected Areas (MPAs) in safeguarding sea turtle habitat (Figure 5). These areas are all protected by Sabah Parks via State legislation. Recent work at a global level highlights how MPAs are important for safeguarding sea turtle habitat at various stages of their life cycle (Scott *et al.*, 2012), who demonstrated that turtles aggregate in designated MPAs far more than would be expected by chance when considered globally (35% of all turtles were located within MPAs) or separately by ocean basin (Atlantic 67%, Indian 34%, Mediterranean 19%, Pacific 16%). In addition, Scott *et al.* (2012) also showed that the size, level of protection and time of establishment

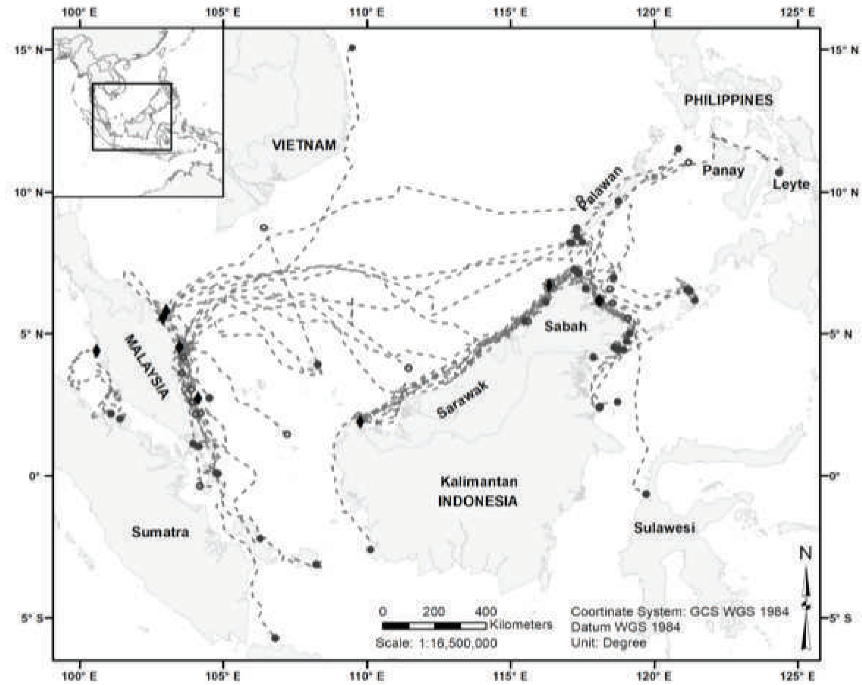

Figure 4. Post-nesting migration routes of all satellite-tracked green sea turtles deployed at key Malaysian nesting beaches (open circles represent track end points that did not reach foraging grounds; filled circles represent track end points that did reach foraging grounds; black diamonds are release points). Graphics based on the original work by Papi *et al.* (1995), Bali *et al.* (2002), DOFM (unpublished and unfiltered data), Lau *et al.* (2009), van de Merwe *et al.* (2009), MRF and Sabah Parks (unpublished and unfiltered data).

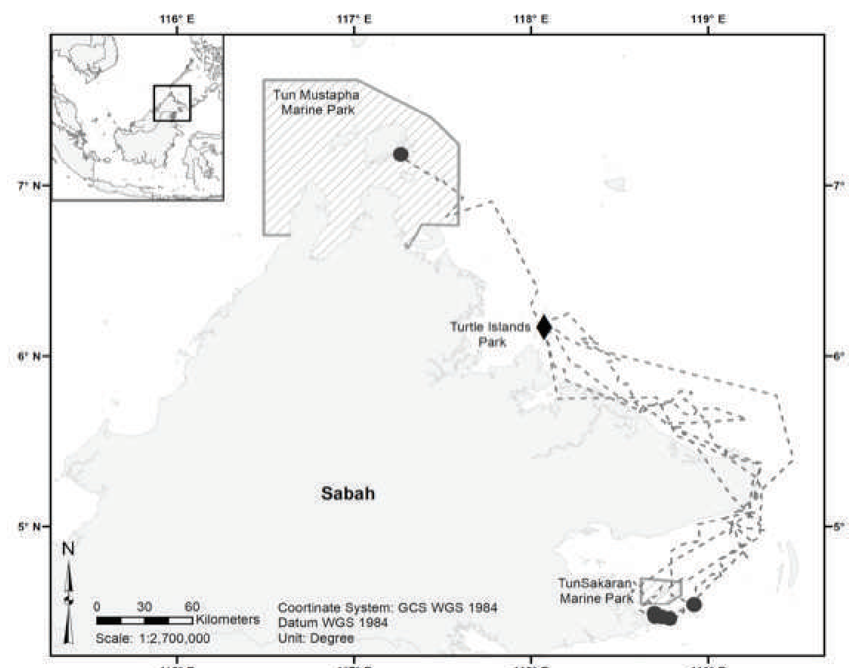

Figure 5. Movements of nesting green sea turtles in Sabah from one marine protected area (Turtle Islands Park) to the Tun Mustafa and Tun Sakaran Marine Parks (Black diamond is the release site, black filled circled final foraging ground locations). Graphics based on original work by MRF (unpublished and unfiltered data).

of MPAs affects the likelihood of MPAs containing foraging turtles, highlighting the importance of large, well-established reserves. Tracking results from Sabah reinforce these results and highlight how important these protected areas are for green turtles, but also demonstrate how (at least in the case of the Tun Sakaran Marine Park) the area is not extensive enough to protect the majority of important turtle foraging habitats, and that an eastward and southward expansion of the MPA boundaries might more effectively safeguard the species.

An additional note related to the coastal migration behaviour lies in the interpretation of conventional tag return information. Sagun (2004) reported on recoveries of tags from the Turtle Islands Heritage Protected Area, providing information on 17 turtles. Ramirez de Veyra (1994) similarly reported on recapture locations of another two turtles moving from the Turtle Islands Park in Malaysia to Puerto Princesa in Palawan and to Bacolod in Negros Occidental. But given the lack of any movement data for the intervening period between last nesting records and subsequent recapture, migration assumptions acquire a 'straight-line' form as the turtles disperse (Figure 6, left). However, satellite tracking of the same species of sea turtles, often to similar locations, paints a very different picture, with turtles studiously avoiding the deep water trenches of the Sulu Sea and preferring instead to take more circuitous and *coastal* movements (Figure 6, right).

One last note on the movements of green turtles relates to the one tag deployed from Terengganu which moved southeast to reach the Riau Islands in Indonesia (sitting between Terengganu and Sarawak, a site that was a known turtle destination. However, in this particular case, the next time the tag was active the turtle had moved all the way to the Con Dao Islands in Vietnam. The cessation of signals, and subsequent reception of signals for a brief period in the vicinity of Vietnam is suggestive of fisheries bycatch or purposeful capture. There is a substantial problem with sea turtle poaching in Southeast Asia (MIMA, 2009), and this particular turtle's data could indicate it was part of that trade. When the signals ended the turtle could have been kept in the hold of the vessel where signal reception was not possible, and the short subsequent reappearance of data from Con Dao might be suggestive of someone noting that the transmitter might provide location

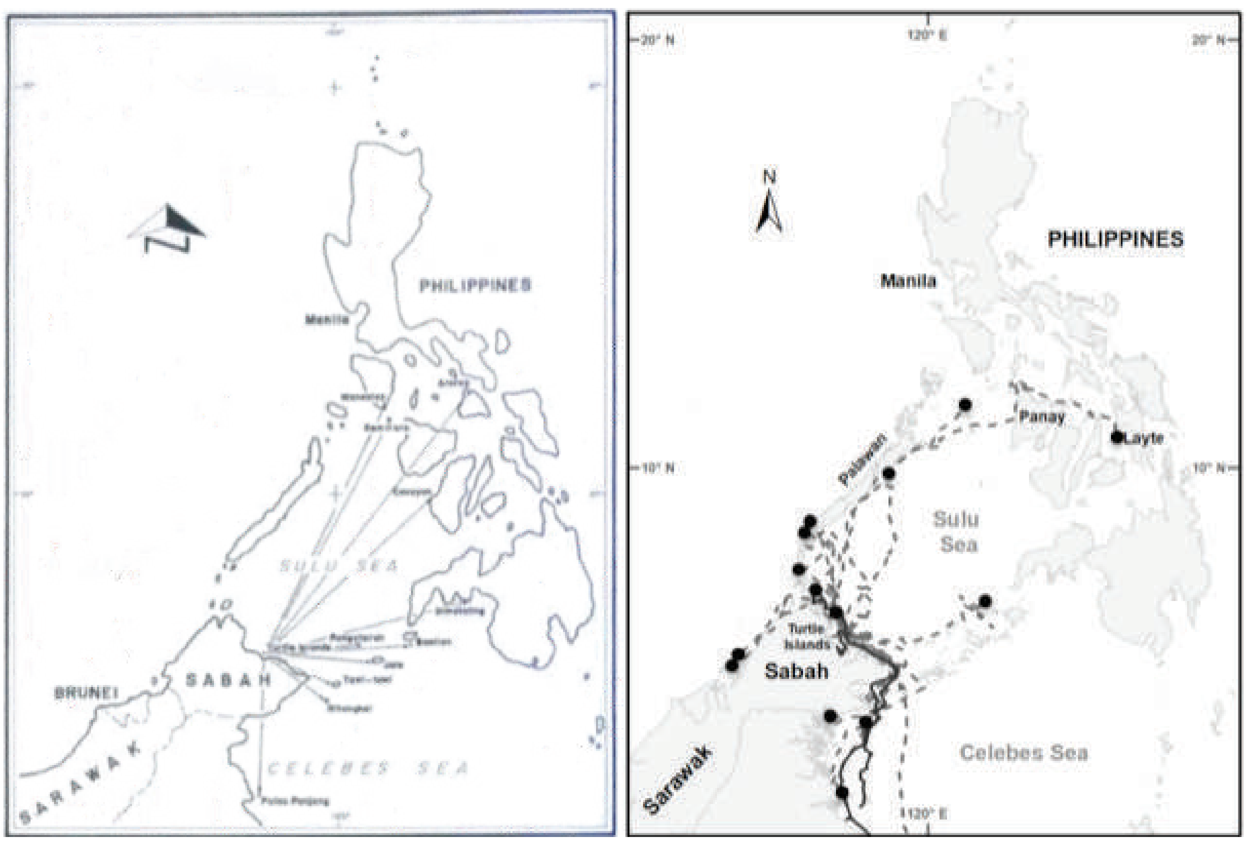

Figure 6. Inferred post-nesting migration routes green sea turtles from the Turtle Islands Heritage Protected Area from flipper tag recoveries (left; Sagun, 2004), alongside actual migration trajectories determined via satellite tracking (right; MRF, unpublished and unfiltered data). Black circles indicate end-points of the satellite tracks.

data and the transmitter being disarmed or discarded.

Hawksbill Turtles

Comparatively fewer hawksbills have been tracked in Malaysia (Figure 7), with the most intensive effort that of WWF Malaysia in partnership with the Department of Fisheries Malacca between 2008 and 2013 (Lau *et al.*, 2009). This project tracked 15 turtles from both the only remaining island rookery and from two sites on the mainland of Malacca state, and found that nearly without exception the sea turtles migrated southeast towards the Riau archipelago in Indonesia, south of Singapore (inset, Figure 7), where they remained for substantially longer periods than all other turtles tracked in Malaysia (an average of 227 days, range 16-625 days, SD=173.89). These turtles were confined geographically by the narrow Straits of Malacca, with the large island of Sumatra to the west. However, unlike some of the green turtles that migrated far further south (see lower left, Figure 4), none of the Malacca hawksbills moved beyond Riau. This confined migration opens up a well-defined and small-scale bilateral cooperation opportunity for hawksbill turtle conservation between Malaysia and Indonesia. Although a track is not available for the adult hawksbill studied in 1995, this turtle also swam south and settled in the Riau archipelago, further strengthening that link. Of the two head-started turtles from Chagar Hutang, one did not move from the waters close to the island, while the second headed northeast towards the southern shores of Vietnam (Liew *et al.*, 2012). Unfortunately, this turtle did not take up residence at a foraging ground, with the transmitter ceasing before the turtle reached

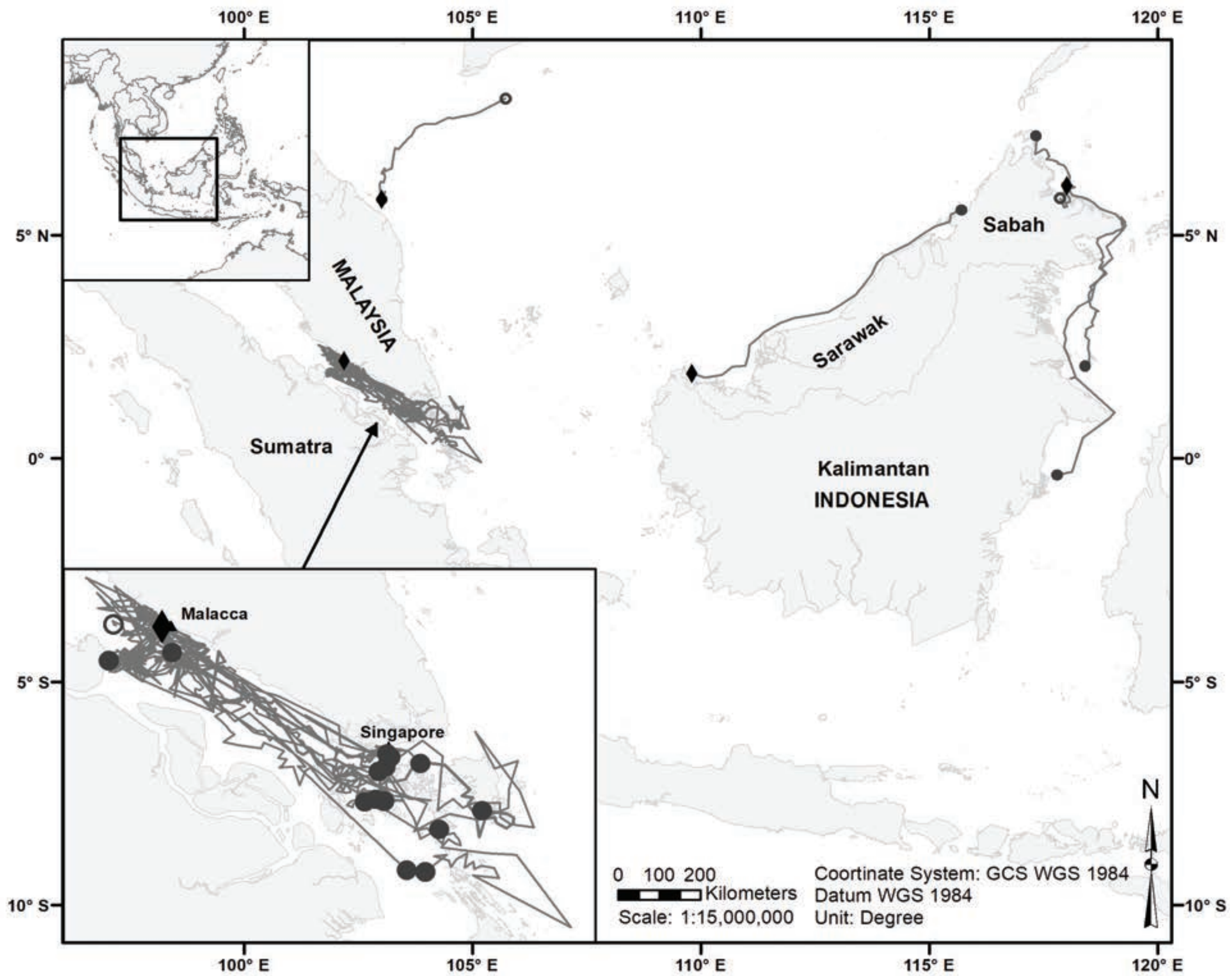

Figure 7. Routes of all satellite-tracked hawksbill sea turtles deployed at key Malaysian nesting beaches (open circles represent track end points that did not reach foraging grounds; filled circles represent track end points that did reach foraging grounds; black diamonds are release points). Northernmost track from Terengganu was a head-started turtle. All others were post-nesting migrations. Graphics based on the original work by Bali *et al.* (2002), Lau *et al.* (2009), Liew *et al.* (2012) and Sabah Parks (unpubl. data).

the Con Dao archipelago (upper track, Figure 7).

Hawksbills tracked from Sarawak and Sabah all adopted the coastal movement behaviour, rarely moving off the coastal shelf and staying within the confines of the island of Borneo (Bali *et al*., 2002, Sabah Parks, unpubl. data). Unfortunately sample sizes are low, and further work is needed to elucidate the true nature of habitat use for hawksbills leaving rookeries in Sabah and Sarawak. However, while the turtles did not move off the Borneo shelf, movements were substantial for three of the turtles: One moved some 830km from Sarawak to Membakut in Sabah, another moved 1,050km from the Turtle Islands to an area near Samarinda in Indonesia, and a final one moved 520km from the Turtle Islands Park to Kakaban Island in Indonesia. These long distance movements suggest that the notion of hawksbills being more sedentary than other species (e.g. Chung, 2009) may be less applicable to many of the Borneo hawksbills. This is also supported by recent tracking of hawksbills in the Seychelles where turtles have undertaken long migrations, with one of them moving nearly 4,000km (Hays *et al*., 2014).

Regional Significance

Notwithstanding the local extinction of the leatherback and the virtual cessation of olive ridley nesting, Malaysia remains home to some of the more robust populations of green and hawksbill sea turtles in Southeast Asia (Shanker & Pilcher, 2003). These turtles are a shared resource given the extensive movements and the genetic linkages amongst foraging and nesting stocks (see Joseph, 2006; Joseph *et al*., 2014, 2016), and understanding movements and interlinkages between nesting populations and foraging stocks is becoming increasingly more important with rising pressures on the marine environment. At the regional level the various populations combine to form Regional Management Units (RMUs; Wallace *et al*., 2010) based on shared genetic backgrounds, distribution of foraging grounds, and known migrations. The tracking efforts in Malaysia go a long way to contributing to refining the boundaries of green and hawksbill sea turtle RMUs, and provide substance to status assessments undertaken by entities such as the IUCN SSC Marine Turtle Specialist Group. The differentiation between coastal and oceanic migrations, and the selection of identifiable foraging habitats provide regional and Malaysian management agencies with a wealth of information on which to build conservation agendas for these species. Bycatch reduction on coastal waters remains a key priority, but so do bilateral agreements and on-the-ground programmes to protect turtles at the various life stages and in the varied locations identified by this work. We believe there is still a lot more to be done as relates to tracking sea turtles from Malaysian rookeries to safeguard sea turtles, but we also believe the foundations of much of this work have already been laid by the legacy of the work we summarise herein.

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