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Patterns of dispersal of hawksbill turtles from the Cuban shelf inform scale of conservation and management

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A B S T R A C T

Conserving and managing populations of marine vertebrates can be complex when they occupy the waters of multiple nations, crossing heterogeneous legal and management landscapes. Hawksbill turtles (*Eretmochelys imbricata*) are subject to varying levels of use in Caribbean countries and their conservation and management is complicated by the extent to which they are a 'shared' resource. In 1997 and 2000, Cuba attempted to 'downlist' hawksbills from Cuban waters to CITES Appendix II to allow limited international trade. The research on movement and dispersal of hawksbills reported here was undertaken to better inform discussion about the impacts of their harvest. Flipper tagging and satellite tracking demonstrate that the majority of study turtles remained in Cuban territorial waters. Of 1170 hawksbills tagged (525 adults and 606 juveniles), 12% ($n = 143$) were recaptured. All recaptured adults ($n = 16$ males, 38 nesting females and 30 adult females in-water) were in Cuban waters. Of the 59 juveniles recaptured, only four recaptures were outside Cuban waters (Nicaragua = 2, Colombia = 1, USA = 1). Fourteen hawksbills tagged in the waters of other nations were recaptured in Cuban waters. We also satellite tracked 21 turtles (one adult male, ten nesting females and ten non-nesting adult females), of which five tags failed, 11 stayed in Cuban waters for the duration of transmissions (1–809 days) and five foraged in the waters of other nations (Mexico $n = 1$ an adult female; Honduras $n = 2$, both post-nesting turtles; Colombia $n = 1$ an adult female; and the eastern Lesser Antilles $n = 1$, an adult male), with differences for nesting and non-nesting turtles. Our results, demonstrating extended site fidelity within Cuban waters, suggest that strengthening national management within national jurisdictions that host hawksbill turtles is fundamental to improving regional conservation as a whole.

1. Introduction

1.1. Managing regional stocks of endangered species

The conservation and management of marine vertebrates that cross international borders, and are thus shared resources, is complex. Each nation state typically has its own legislation governing marine resource ownership, and the cultural, traditional and economic values attributed to the same species are often diverse. A species may be subject to harvest at varying levels, legal and illegal, reported or unreported, by some or all nation states, with or without management programmes aimed at achieving sustainability (Rodrigues and Gaston, 2002; Brosius and Russell, 2003; Kark et al., 2009). The most effective way to conserve such species, and thus retain both intrinsic and utility values (Brockington et al., 2006; Campbell and Godfrey, 2010), can become a contentious issue (Thorbjarnarson, 1999; Hutton and Leader-Williams, 2003; Morishita, 2006). A collaborative approach among nation states might seem desirable or necessary, but individual nation states may be reticent to commit to such instruments if doing so undermines basic rights of use in their national

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waters or on the high seas. For example, Member States agreed that the International Convention for the Regulation of Whaling (ICRW) could set annual quotas for whaling in their areas of operation, through independent scientific assessment. This major breakthrough in the international use of shared resources (Morishita, 2006; Goodman, 2011) became highly controversial, however, when the scientific data indicated that commercial whaling could resume (IWC, 2011), but Member States retained a moratorium on whaling. The cooperative use of marine resources (e.g. tuna, sharks, marine turtles) through international agreements may thus seem desirable from a conservation viewpoint, but some nation states might be unwilling to risk following the IWC model and the hostile political exchanges associated with it (Morishita, 2006).

1.2. Hawksbill turtle exploitation and legislation

Hawksbill sea turtles (*Eretmochelys imbricata*) have been exploited for their meat and shell plates ("tortoiseshell") for centuries. Through the 1970s and 1980s, many countries enacted legislation to either stop or control the harvesting of hawksbills (Groombridge and Luxmoore, 1989), and in 1993, large-scale commercial international trade in their shell plates, once considered the primary threat to the species, essentially ceased. This international protection from trade reduced total demand for harvest across the Caribbean and was undoubtedly a conservation success for Caribbean hawksbill turtles (despite varying levels of local demand and use being retained). Eleven Caribbean nations or territories still have legal fisheries for hawksbills, but they cannot legally trade their products internationally, and many more illegal or unregulated fisheries exist across the region (Richardson et al., 2006). Legal and illegal harvest may constrain the ability of some local populations to recover from depletion (Bell et al., 2006; Allendorf et al., 2008; Conover et al., 2009). However, when harvest levels are reduced and strictly controlled, rapid rates of population increase have been reported. Some depleted hawksbill populations are now considered stable and recovered (CITES, 2002; Richardson et al., 2006; Beggs et al., 2007; Kamel and Delcroix, 2009; Mortimer and Donnelly, 2008; Allen et al., 2010).

1.3. Cuba and hawksbill turtles

As in other Caribbean countries, the conservation and management of hawksbill sea turtles in Cuban waters has evolved over time. Hawksbills were harvested in Cuba with little or no management from at least the 1500s. From the 1960s onward, the harvest was managed as a commercial fishery taking about 5000 individuals per year (Carrillo et al., 1999). The harvest was dramatically reduced in 1990, when Cuba joined CITES and retained a small-scale traditional harvest of less than 500 turtles annually, at two sites. At that time Cuba claimed the reduced harvest was both conservative and sustainable, based on apparent stability in the body size and abundance of turtles caught, and on increasing nest abundance (ROC, 1998, 2000). Cuba used the meat domestically and wanted to trade the shell plates with Japan. This period involved a very strong commitment to research and monitoring of both the harvest and the wild population, in an effort to quantify the impact of harvesting on both the national and regional population. It is during this period that most of the results reported in this study were collected. Although listed on Appendix I of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), which prohibits international trade, nations such as Cuba that lodged "reservations" with CITES could still trade legally with other nations with a reservation (such as Japan). In 1993, Japan withdrew its reservation and trade between the two countries ceased, despite Cuba hosting one of the largest hawksbill populations in the Caribbean (McClenachan et al., 2006; Mortimer and Donnelly, 2008). In 1997 (and again in 2000) Cuba therefore proposed that the hawksbill turtle population in Cuban waters be 'downlisted' to CITES Appendix II (ROC, 1998, 2000), permitting highly regulated and limited trade between Cuba and Japan. Its proposals were based on benefits to local people, a commitment to transparent annual monitoring and research, sustainable use being achieved, and a commitment to safeguards should a population decline occur (ROC, 1998, 2000; summarised in Campbell and Godfrey, 2010). Arguments debating the sustainability (Mrosovsky, 2000, 2003; Campbell, 2002; Godfrey et al., 2007; Webb, 2008) or potential lack thereof (Mortimer et al., 2007), prevented a consensus on reinstating legal trade of tortoiseshell being reached. Regardless, Cuba closed their hawksbill turtle harvest in 2008 and the national programme now supports only non-consumptive uses.

1.4. Hawksbill turtle ecology

Hawksbill turtles are globally distributed in the tropical and subtropical waters of over 100 countries (Márquez, 1990; McClenachan et al., 2006). They are thought to show a high degree of site fidelity (e.g. León and Diez, 1999; Van Dam and Diez, 1999; Witt et al., 2010; Blumenthal et al., 2009a) to coral reefs (León and Bjorndal, 2002; Meylan, 1988; Hill, 1998) and unlike other cheloniid species, juveniles occupy benthic developmental habitats that may overlap with adult foraging ranges (Meylan et al., 2011). Foraging areas occupied between nesting events are poorly known for most hawksbill populations (Godley et al., 2008).

1.5. Genetics of Caribbean hawksbill turtles

Hawksbill turtles from single Caribbean foraging populations are usually comprised of individuals from multiple genetic origins (Moncada et al., 1998; Bass, 1999; Diaz-Fernandez et al., 1999; ROC, 2000; Bowen et al., 2007; Mortimer et al., 2007; Blumenthal et al., 2009b; Browne et al., 2010), but Cuban haplotypes contribute most heavily to all Caribbean foraging populations (0–44.7%) as well as its own (43.4–72.0%; Bowen et al., 2007). It is estimated that Cuba hosts up to 55% of foraging turtles originating from other Caribbean countries (Bahamas, Dominican Republic, Puerto Rico and the US Virgin Islands; Bowen et al., 2007).

1.6. Aims and objectives

This study uses flipper tag returns and satellite tracking to gain insights into the scales of movement of Cuban hawksbill turtles in order to assess: (i) the likely impact of their traditional harvest on neighbouring populations; and (ii) the effectiveness of improving national conservation and management programmes as fundamental building blocks for improved regional management.

2. Methods

2.1. Study area and background

The Republic of Cuba occupies an elevated shelf (110,992 km^2, 1200 km long) hosting the second largest area of shallow fringing reef in the Caribbean (<30 m deep; 3290 km^2; Burke and Maidens, 2004; Carillo and Contreras, 1998; Moncada et al., 1999).

2.2. Flipper tagging

The Fisheries Research Centre of Cuba operates the Cuban National Tagging Programme (CNTP). During the study period (1989–2009), flipper tags (Inoxidizable steel Monel and Titanium tags) were applied to the trailing edge of the front flipper of juvenile ($n = 606$) and adult hawksbill turtles ($n = 525$; 122 males and 403 females) from the northeast (Nuevitas, Las Tunas) and southern parts of Cuba (Doce Leguas, Isla de la Juventud, Moncada et al., 2010; Fig. 1) and to a further 39 hawksbills of unknown sex. All turtles were measured (following Bolten, 1999) and sex determined where possible. Turtles smaller than 65 cm length were considered juveniles. Nesting females ($n = 74$) were tagged after they nested in the Doce Leguas Keys (December 1994–November 2006). Juvenile hawksbill turtles were also released from a captive "head-starting" programme ($n = 54$) between November 1993 and October 2007 at Isla de la Juventud and Doce Leguas Key.

2.3. Satellite tracking

Twenty-one hawksbill turtles (one adult male, 10 nesting and 10 non-nesting adult female turtles) were deployed from Cuba with Telonics ST-6 ($n = 19$) and Wildlife Computers SPOT 5 ($n = 2$) platform transmitter terminals between July 1996 and November 2009. Turtles were deployed from: (i) Nuevitas ($n = 6$); (ii) Isla de la Juventud ($n = 5$); and, (iii) Doce Leguas ($n = 10$). Turtles deployed from Nuevitas and Isla de la Juventud were captured by fishermen using nets (Carrillo et al., 1999) and at Doce Leguas, nesting individuals were captured on the beach. Data were downloaded from Argos CLS and movement metrics (e.g. distance, speed, and jurisdiction at location) calculated. Location data were filtered to retain all location classes 3, 2, 1 and A that also corresponded to transit speeds less than 5 km h^{-1} and turning angles greater than 25° (Witt et al., 2010). Bathymetry data were obtained from the General Bathymetric Chart of the Oceans, (http://www.bodc.ac.uk/projects/international/gebco/gebco_digital_atlas) and integrated with the turtle track data. All data layers were mapped and analysed using ArcGIS 9.2.

3. Results

3.1. Flipper tag recoveries

During the study period (1989–2009), 12% of flipper tags were recovered ($n = 84$ adults and $n = 59$ juveniles, including one head-started juvenile). Eleven juvenile turtles were recaptured more than once ($n = 8$ twice, $n = 2$ three times, $n = 1$ four times). No adults were recaptured multiple times. No adult turtles flipper tagged in Cuba were reported to have been caught outside Cuban waters (Fig. 2a and b), but four juveniles were later recaptured in other Caribbean nations (Nicaragua = 2, Colombia = 1, USA $n = 1$; Fig. 2c). With the exception of one adult female turtle, originally marked on the north coast and recaptured on the south coast 3.5 years later, the other 142 recaptured turtles (adults and juveniles) were caught off the same coast they were originally released on. More juveniles ($n = 59$) were recaptured at the same or nearby reefs than adult hawksbills (males $n = 16$, nesting females $n = 38$, non-nesting females $n = 30$). Adult females were rarely recaptured outside of the general area of their release (with three exceptions, which moved west along the north coast, west along the south coast and from the north to the south coast, respectively, Fig. 2a). Juveniles were recaptured after longer periods at liberty (mean 408.2 ± 591.2, range 2–3653 days, $n = 75$) than adults released in-water (females: mean 280.2 ± 463.7 days s.d., range 1–1509, $n = 30$; males: mean 199.8 ± 238.1 days, range 1–879, $n = 16$; Wilcoxon test $W = 1235$, $p < 0.05$). Like adults, juveniles were rarely captured outside the general area they were originally caught in (56 of 59 turtles).

Fourteen hawksbills tagged in foreign countries were recovered in Cuba (Mexico $n = 4$, Bahamas $n = 3$, Barbados $n = 2$, US Virgin Islands $n = 2$, Puerto Rico $n = 1$, USA $n = 1$ and Venezuela $n = 1$). Turtles tagged in Mexico (three juveniles and one adult female) were recaptured in the southwest ($n = 1$ juvenile) and southeast of Cuba (Doce Leguas: 2 juveniles and 1 adult female). Those from the Bahamas ($n = 3$ juveniles) were recaptured in the north of Cuba, and those from Barbados ($n = 2$ adult females) in the southeast and northwest, respectively. Those from the US Virgin Islands

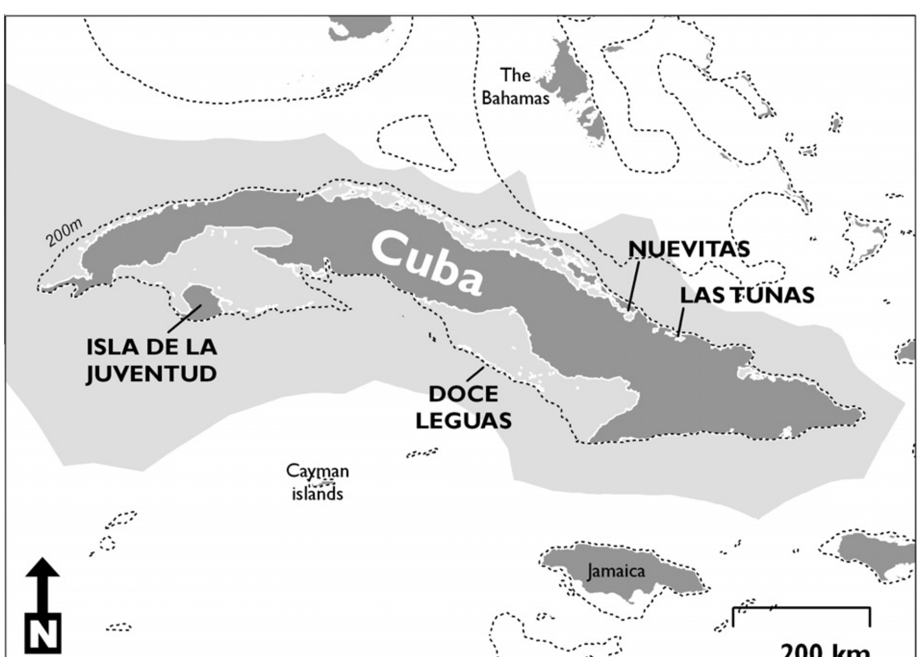

Fig. 1. Release and recapture sites for Cuban hawksbill sea turtles (200 m bathymetric contour shown in dashed black line, Cuban Exclusive Economic Zone shown as pale grey polygon, north indicated by arrow).

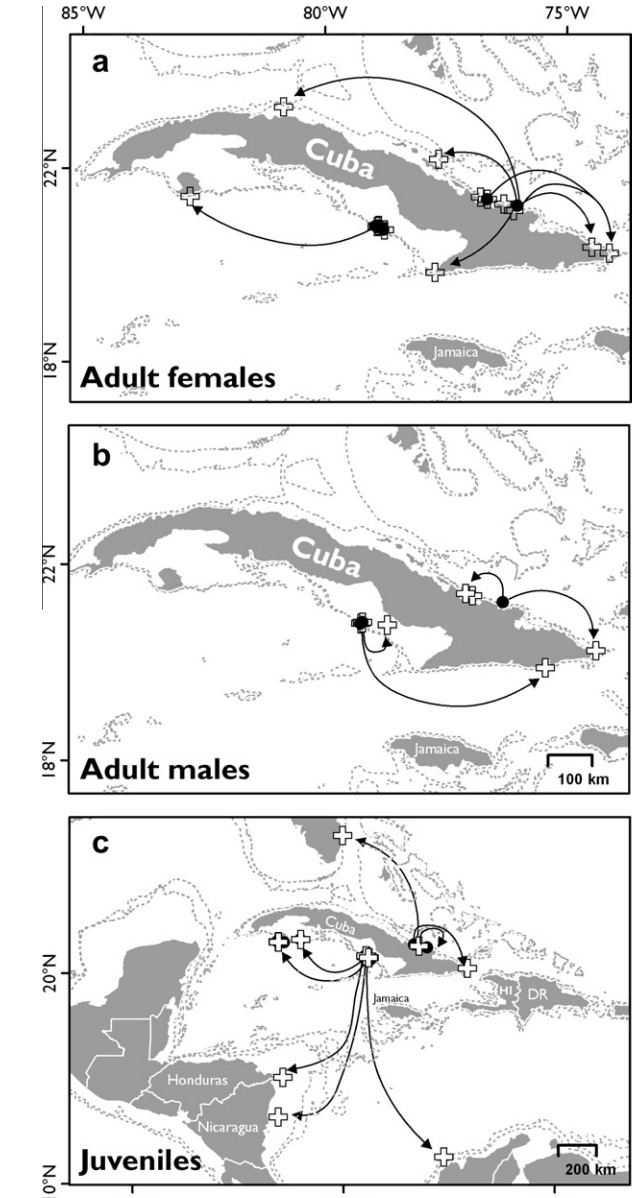

Fig. 2. Flipper tag release (filled circles) and recapture (white crosses) sites for (a) adult female, $n = 68$; (b) adult male, $n = 16$; and (c) juvenile hawksbill turtles, $n = 59$, captured in Cuban waters and tagged as part of the CNTP project. Dashed lines show bathymetric contours of 200 m and 1000 m. Curved arrows linking release and recapture sites are schematic and do not represent actual transit routes. Parts (a) and (b) are to the same, but not part (c).

($n = 2$ adult females) were recaptured in the northeast of Cuba and the one juvenile from Puerto Rico was caught in the southeast. The recapture location in Cuba and life stage for the turtles from the USA and Venezuela (both non-nesting adult turtles) were not recorded. Of the 12 recaptures with known locations, almost all corresponded to the closest Cuban location to each country (except for the turtle from Barbados).

3.2. Satellite tracking

Transmissions from five turtles (non-nesting females) were too short to identify foraging locations and were therefore omitted from analysis. Location data from the remaining 16 turtles were received for a mean of 483 ± 215 days (mean ± s.d., range 67–808 days). These exhibited two patterns of movement: (i) Departing Cuban waters for international locations in the Caribbean ($n = 5$, one male, two nesting females and two non-nesting females; mean maximum displacement 1260.5 km ± 608.8 s.d., range 773.4–2069.0), and (ii) Remaining in Cuban waters ($n = 11$, eight nesting females and three non-nesting females, mean maximum displacement 265.3 km ± 228.6 s.d., range 58.1–577.9).

3.2.1. International turtles

Of the five turtles (a–e) that left Cuban waters, two were dult females (a and b), one encountered nesting and the other captured in water at Doce Leguas. They remained there for 2 and 1 days, respectively, then travelled to Honduran waters (where transmissions stopped for turtle ‘a’). Turtle b continued to coral reef foraging areas bordering the Miskito Cayes, Nicaragua, arriving 125 days after leaving Cuba and remaining until transmissions ceased (507 days later; Fig. 3). Turtle c, an adult female captured at Isla de la Juventud headed towards Honduras the day after release, continuing towards Colombia when transmissions ceased 276 days later (Fig. 3). Turtle d, an adult female caught at Isla de la Juventud headed to the Alacranes reefs off the northern Yucatan Peninsula, Mexico (travelling for 14 days) when transmissions ceased. Turtle e, the adult male, also caught at Isla de la Juventud headed east towards the Lesser Antilles, where locations ceased (after 61 days) while the turtle was still travelling.

All five hawksbills traversed deep oceanic waters (5526 ± 1101 m mean ± s.d., range 3777–6498 m), travelling at speeds between 16.5 and 46.2 km per day (range, mean 33.5 ± 13.4 s.d.). Turtles travelled through the waters of 12 Caribbean nations, with the majority of all satellite tracked locations from Cuban waters with the next most populated waters being those of Honduras and the Cayman Islands. Although insufficient location data were received from all but one turtle to describe foraging areas with confidence, most turtles were tracked to coastal shelves (depths < 50 m) in areas where potential foraging sites might have been present.

3.2.2. National turtles

Eleven of the 16 hawksbills that were successfully satellite tracked (Turtles f–p, all females), remained in Cuban waters for the duration of transmissions (Fig. 4). Four were captured in-water (one on the north coast, the rest on the south) and seven nesting in Doce Leguas. During the tracking period (541 ± 179 days, range 224–809), none of the turtles left the shelf area, moving on average 265.3 ± 228.6 km (range 58.1–577.9) during the tracking period. Two turtles (f and g) made longitudinal movements along the southern coast of Cuba (moving 538.7 and 577.9 km, respectively), while one turtle remained in a discrete area on the north coast of Cuba and the remaining eight turtles stayed on the shallow shelf inside Doce Leguas for the entire tracking period (moving a mean maximum of 97.7 km ± 42.3 km, range 58.5–167.6 km, Fig. 4). Too few locations were received from turtles f and g from foraging areas to summarise their depth preferences for the limited periods in their possible foraging areas. Turtles h–p were located in waters 29 m deep (mean of means, range 1–132 m).

4. Discussion

4.1. The controversial management of Cuban hawksbills

Cuba’s proposal to CITES for ‘downlisting’ in 1997 became one of the most highly polarised debates in modern sea turtle conservation (Campbell and Godfrey, 2010). While genetic evidence has indicated that Caribbean foraging populations are comprised of

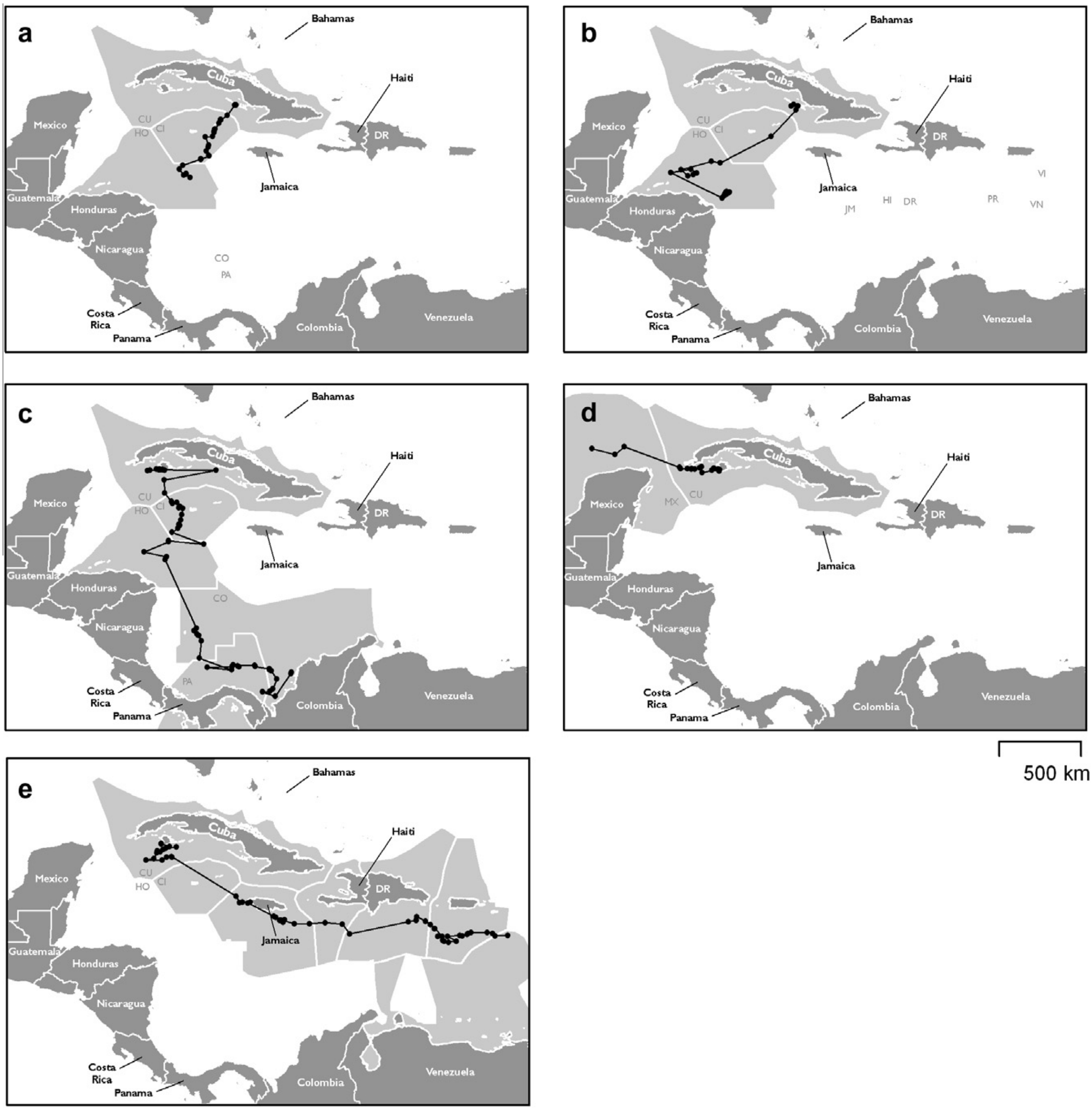

Fig. 3. Maps showing tracks of five adult hawksbill turtles deployed from Cuba that moved outside Cuban waters (nesting females: parts a and b, non-nesting females parts c and d and male turtle, part e). Light grey shading shows boundaries of the Exclusive Economic Zone for each of the countries that the turtles passed through. Mid grey shading shows locations of coral reefs (Burke and Maidens, 2004). All figure parts are shown to the same scale.

mixed stocks (with Cuban haplotypes contributing most heavily to all Caribbean foraging populations; Bowen et al., 2007), they have also shown that Cuba hosts a higher proportion of "local" haplotypes than other Caribbean nations (Bass, 1999; Diaz-Fernandez et al., 1999; Bowen et al., 2007). Foraging 'closer to home' (Bowen et al., 2007) has also been supported by recent telemetry at other sites showing that not all hawksbill turtles from nesting rookeries migrate great distances into foreign waters (Tröeng et al., 2005; van Dam et al., 2008; Horrocks et al., 2001, 2011; Meylan et al., 2011). Until this work, there had been few studies using direct (e.g. satellite tracking) or indirect methods (e.g. tagging, genetic, and forensic methods) allowing the question of sharing of hawksbill turtle stocks to be addressed objectively. The data in this study suggest that the hawksbill turtles we tracked from Cuba largely (but not exclusively) remain in Cuban waters for extended periods.

It may not be surprising that Caribbean islands for which recent nesting increases have been documented (Antigua: Richardson et al., 1999, Barbados: Beggs et al., 2007, Guadeloupe: Kamel and Delcroix, 2009, Puerto Rico: Van Dam et al., 2008) do not seem to contribute a high proportion of turtles to the Cuban foraging population (although note that these studies are separated by more than ten years), suggesting that a reduction in local pressures (such as harvest) at those rookeries may help explain the increases observed there, rather than the phase-down (1990's) and eventual closure (2008) of Cuba's traditional harvest. It would additionally

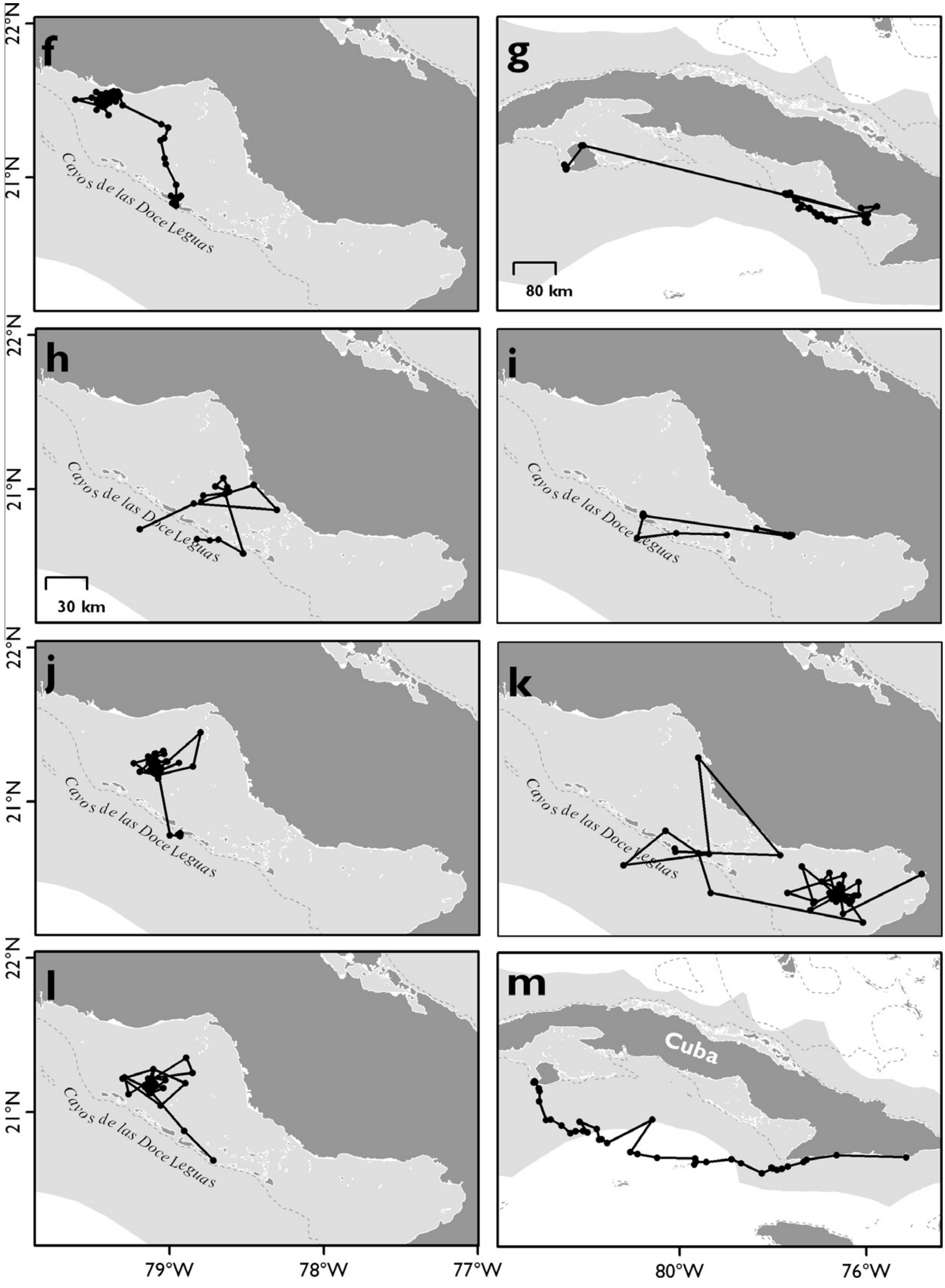

Fig. 4. Map showing tracks of eight adult female hawksbill turtles (f–m) deployed from Cuba that moved to national waters (nesting females f–l, non-nesting female m). Light grey polygon shows Cuba Exclusive Economic Zone. Dashed lines show the location of the 200 m bathymetric contour. Three turtles (n–p) are not shown for brevity.

appear that turtles from stocks foreign to Cuba occur on the coastal shelf in Cuba closest to the source rookery. Thus management could possibly be spatially structured when dealing with international movements of turtles.

4.2. Patterns of movement of Cuban turtles

Based on a growing body of satellite tracking of sea turtles (Godley et al., 2008), one might expect female turtles to migrate after nesting to foraging areas distant to the nesting beaches. Of the four female hawksbills we tracked migrating to foreign foraging grounds, only two were deployed from the nesting beach, but this does not preclude the likely scenario that the other two females could have nested in that season on Cuban beaches but were not recorded. It is possible that the male turtle, which migrated to the Lesser Antilles, was also in Cuban waters to breed. The majority of post-nesting hawksbill turtles, however, did not migrate to foreign waters with seven of the 11 turtles that remained in Cuban waters having been deployed with satellite transmitters while nesting.

4.3. Insights into spatial ecology from multiple methodologies

The results of this work highlight the insights that can be gained into spatial ecology of marine species using multiple methods (Godley et al., 2010). Though it is possible that tagged turtles dispersing away from Cuba could have been disproportionately under-reported, the results of our flipper tagging were, however, supported by the observer-independent satellite tracking results. Zbinden et al. (2011) contextualised flipper tag returns from Greek loggerhead turtles (*Caretta caretta*) with satellite tracking to identify major foraging areas without the inherent observer bias from flipper tagging. Their results allowed them to confirm that flipper tagging data had correctly identified major foraging areas. Increasingly, studies are contextualising expensive satellite tracking data with other alternative approaches, permitting the study of a greater number of individuals with a deeper understanding of their ecology. For example, molecular data can, if used judiciously, connect distant foragers to their breeding grounds, allowing for estimations of stock contributions to foraging grounds containing satellite tracked turtles (Blumenthal et al., 2009b; Bowen et al., 2007). By contextualising our tracking and flipper tagging data with previously published molecular data (Bass, 1999; Diaz-Fernandez et al., 1999; Bowen et al., 2007; Blumenthal et al., 2009b) it was possible to gain a more integrative view of the scale of management needed for Caribbean hawksbills. Stable isotopes of carbon and nitrogen have been used to reveal not only where loggerhead turtles from Japan (Hatase et al., 2002), the USA (McClellan et al., 2010), Cuba (Moncada et al., 1998) and the Mediterranean (Zbinden et al., 2011) may migrate, but on what prey they may forage when there.

4.4. Cuban turtle movements in the context of the wider Caribbean

Studies describing the movements of hawksbill turtles have been published from the Caribbean (Horrocks et al., 2001; Tröeng et al., 2005; Van Dam et al., 2008), and Pacific Islands (Parker et al., 2009). These studies suggest that hawksbill turtles generally occupy small coastal home ranges when compared with other turtle species, although evidence is building that larger hawksbills may occur in deeper waters than was previously thought (Blumenthal et al., 2009a). Likewise, juvenile hawksbills appear to be rarely located in high seas unless in transit to foreign foraging grounds.

4.5. Management recommendations

The management of wild stocks of large marine vertebrates has received much attention. In general, where consumptive use is involved, it seems that the more charismatic a species, the more controversial the debate (Morishita, 2006). In the case of hawksbill turtles, there has not been a consensus on the likely effects of any current or future harvest (Campbell, 2002; Campbell and Godfrey, 2010). In contrast, a constructively debated and apparently well-managed system for sustainable consumption of crocodilians, which like sea turtles are large, long-lived reptiles that are comparatively slow to mature (Webb and Carillo, 2000), has been operating for decades (Thorbjarnarson, 1999). The approaches to legal consumptive use between the two groups are quite different. First, marine turtles are charismatic and non-threatening to humans, unlike the generally maligned crocodilians, and thus political discussions about them may include emotional arguments against their harvest. Second, fishing for hawksbill turtles in the Caribbean usually takes place at an artisanal scale (Carrillo et al., 1999). This also occurs with crocodilians, but most managed crocodilian harvests cease well before Catch Per Unit Effort (CPUE) becomes prohibitively low. In contrast most Caribbean turtle fishers can usually continue fishing for other stocks despite low turtle CPUE, thus the harvest (legal or not) effectively never ceases (a problem with some highly depleted crocodile populations). Third, although the available data indicate that the Cuban harvest was sustained for many centuries, there are insufficient data before and after it was scaled down to assess its effect (Campbell and Godfrey, 2010). Finally, other stressors, such as by-catch, habitat degradation, and climate change may obscure the effects of harvest and preclude a robust analysis ever taking place.

Planning for conservation is arguably most easily achieved at the level of individual geo-political units, obviating the need for collaborative policy making and legislation (Rodrigues and Gaston, 2002; Moilanen and Arponen, 2011; Tuvi et al., 2011). However, resources (financial, political and motivational) for such conservation may differ significantly by geopolitical unit and thus migratory animals usually cross heterogeneous conservation landscapes (Halpern et al., 2006; Vazquez et al., 2008; Kark et al., 2009). In the case of Caribbean hawksbill turtles, it would seem that a portion of each nesting population studied so far may not leave local waters (Tröeng et al., 2005; van Dam et al., 2008; Horrocks et al., 2001, 2011; Meylan et al., 2011) but that there are other key Caribbean foraging sites for hawksbill turtles, most notably Cuba and Nicaragua, and each of these nations have different approaches to the regulation of legal and illegal capture and harvest of hawksbill turtles (Bräutigam and Eckert, 2006). National management in every Caribbean country hosting hawksbills, using the existing laws for their conservation, may be the most important step to improving the conservation of the regional population of hawksbill turtles in the Caribbean. Improvement on a nation-by-nation basis represents an attainable and practical goal for regional conservation.

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