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Leatherback turtle conservation in the Caribbean UK overseas territories: Act local, think global?

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ABSTRACT

Leatherback turtles migrate across the jurisdictions of multiple sovereign states and present complex challenges to those responsible for their conservation. Concern for marine turtles has led to their protection under range state legislation and protective listing under a suite of multilateral environmental agreements. Evidence suggests that a distinct, reproductive sub-population of leatherback turtles is shared amongst a number of northern Caribbean range states, including the UK overseas territories (UKOTs) of Anguilla and the British Virgin Islands (BVI). The post-nesting movements of three female leatherbacks were tracked after they nested in Anguilla ($n=1$, tracked for 228 days) and the BVI ($n=2$, tracked for 12 and 13 days, respectively). These turtles used territories of multiple range states, with the leatherback tracked from Anguilla also migrating through high seas to foraging grounds in Canadian waters. In addition, a review of regional leatherback flipper tag return records helps define the range of this northern Caribbean nesting population (NCNP), which appears to be in recovery in some range states. While national legislation and conservation efforts appear to have contributed to these population recoveries, most relevant MEAs appear to have played little or no role. However, opportunities for constructive dialogue between NCNP range states exist under the Cartagena Convention the United Nations Convention on the Law of the Sea and the International Commission for the Conservation of Atlantic Tuna (ICCAT). UKOT conservation managers would, therefore, be justified in prioritising unilateral leatherback conservation action, and multilateral efforts through the Cartagena convention and regional fishery management mechanisms, over potentially costly accessions to additional MEAs.

1. Introduction

The conservation of migratory marine vertebrate species is complex and challenging. Basic understanding of their expansive ranges has traditionally been limited by the logistical difficulties in accurately documenting their migratory behaviour at sea [1]. However, contemporary research has made significant contributions to understanding of the ranges of migratory marine vertebrates and has elucidated the political challenges of managing them [2]. Where animals migrate across geo-political borders, they are subject to differing national natural resource-use policy, management capacity and conservation priorities [3].

Marine turtle mark-recapture studies, which usually involve the application of flipper tags on females at nesting beaches, have revealed migrations across the territories of multiple sovereign states [4,5]. The recognition of migratory marine turtle species as 'shared resources' has led to several authors calling for cooperative international management efforts (for examples see [3,6,7]). To address this perceived need, several multi-lateral environmental agreements (MEAs) encourage or oblige signatory states to protect marine turtles and their habitat (see [8,9]). In addition, some multi-lateral Regional Fisheries Management Organisations (RFMOs) have adopted fishery-specific management measures to mitigate harmful marine turtle interactions [10].

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Leatherback turtles (*Dermochelys coriacea*) are migratory, and are highly adapted to utilise habitats across ocean basins, including tropical nesting beaches and temperate marine foraging grounds [11,12]. The species is listed globally as 'critically endangered' by the International Union for the Conservation of Nature [13], and some authors have forecast imminent extinction for nesting populations in the Indo-Pacific [14]. In contrast, some leatherback nesting populations in the Atlantic basin appear to be increasing in size [15,16].

Mark-recapture and genetic studies of leatherbacks nesting in Puerto Rico and the US Virgin Islands (USVI) suggest that the Northern Caribbean nesting population (NCNP) is a distinct stock [15,17,18], which also uses beaches in the neighbouring UK overseas territories of Anguilla and the British Virgin Islands (BVI), as well as other Antillean states [18,19]. The most southerly of these is Dominica, which also lies within the Southern Caribbean/Guianas leatherback stock range [15]. In order to address leatherback conservation concerns, national protective legislation and conservation efforts at nesting beaches have been established in Puerto Rico, the USVI and the BVI for a number of decades, which have contributed to apparent nesting population recoveries in those range states [18,20,21].

Although little is known about the post-nesting migrations of turtles from the NCNP, two tag recoveries from non-nesting turtles suggest that their foraging range extends as far north as the eastern seaboard of the USA and Canada [22,23]. Knowledge of leatherback behaviour at sea has, however, been revolutionised in recent decades by the application of satellite telemetry using the Argos System [24]. Satellite tracking studies have increased understanding of leatherback migration and habitat use, and facilitated the identification of threats and management priorities [25–28]. To date, there has been limited published research from satellite telemetry studies on nesting leatherbacks from the NCNP [15]. The earliest study recorded internesting movements of a single turtle between USVI and Puerto Rico [29], another study recorded a limited post-nesting movement of a single leatherback tracked from Puerto Rico [30], and a more recent study recording local internesting movements of two turtles fitted with satellite transmitters after nesting in Dominica [31]. Unpublished post-nesting tracking data from a leatherback fitted with a satellite transmitter in Puerto Rico suggest that the NCNP range may also extend into the North East Atlantic [15].

While marine turtle researchers have recently included the NCNP in a broader regional management unit that spans the North Atlantic [32], they also emphasise that definition of regional management units should not detract from the treatment of nesting populations as conservation and management units. To this end, there has been a call for further research to refine understanding of the status and range of the NCNP and identify states that share responsibility for the conservation of this stock [18]. However, conservation managers in the region have varied capacity and limited resources [33]. For example, conservation management authorities in the Caribbean UK overseas territories are characteristically responsible for a suite of marine resource use issues, but are often under-resourced, with insufficient capacity and financial support available for marine biodiversity conservation [34]. Authorities in the region tasked with leatherback turtle conservation must therefore decide how best to contribute to the management of this species.

This study uses a combination of satellite tracking data from leatherbacks and regional flipper tag recapture data to further elucidate the range of the NCNP. The study describes causes of leatherback mortality within the range; NCNP range states' national legislation pertinent to leatherback protection; and assesses the impact of several relevant MEAs on leatherback nesting trends. Based on this analysis, priority management measures are suggested for UKOT authorities tasked with leatherback turtle conservation.

2. Material and methods

Adult female leatherback turtles were opportunistically fitted with Satellite Relay Data Loggers (SRDL—Sea Mammal Research Unit) after they nested on beaches in Anguilla and the BVI. A single SRDL attached to a modified and bespoke harness (see [35]) was deployed consecutively on two turtles in Tortola, BVI in May 2003. The first female leatherback, Turtle 1 (Curved Carapace Length, CCL=156.2 cm), was fitted with the SRDL and harness on the night of the 1st May 2003 after it nested on Josiah's Bay (64.591°W 18.446°N). On the night of the 14th May 2003 the turtle returned to emerge on the same beach. Noting damage to the harness, researchers removed it and recovered the SRDL before the turtle returned to the sea. The harness was refurbished and was re-deployed with the SRDL on the night of the 16th May 2003 on another female leatherback, Turtle 2 (CCL=144.8 cm), after it nested at Josiah's Bay. Turtle 3 (CCL=149.5 cm) was fitted with a SRDL and harness after it nested at Captain's Bay, Anguilla (62.980°W 18.264°N) on the 13th May 2005.

Satellite Tracking and Analysis Tool [STAT, see [36]] was used to manage the data. Movements were mapped using Argos location classes (LC) 3, 2, 1, A and B. These location classes can be reliable when subject to adequate filtering [37], and therefore a speed filter was used to remove locations suggestive of travel speeds greater than 10 km h^{-1} and azimuth filtering (minimum threshold 25°). Best daily locations were then interpolated to create a smoothed track. Haul out data were examined to determine subsequent emergences.

In addition, flipper tag return data were collected through personal communication with researchers in the region and through flipper tag recovery records reported to the authors through the Wider Caribbean Sea Turtle Conservation Network (WIDECAST) Marine Turtle Tagging Centre. Information regarding national legislation and accession to multi-lateral environmental agreements was also reviewed [38–45].

3. Results

3.1. Satellite tracked movements

After being fitted with the SRDL and harness, Turtle 1 travelled due north for two days into open ocean, approximately 85 km from Tortola, where it remained for a further two days (Fig. 1). The turtle then travelled southwest to waters 16 km off the north-eastern tip of Puerto Rico where it stayed for a further two days, before heading east through the US Virgin Islands and returning to Tortola to nest 13 days after it was tagged.

After SRDL deployment, Turtle 2 also travelled due north for two days into open ocean but then travelled due east for a further three days before heading south (Fig. 1). This turtle arrived in Puerto Rico's inshore waters on the 24th May, eight days after it was tagged in Tortola. The turtle then travelled east along Puerto Rico's north coast to the inshore waters of the Fajardo–Luquillo region on the northeast tip of Puerto Rico where it emerged on Paulinas Beach (65.689°W 18.366°N), on the night of the 26th May. Transmissions ceased from this tag on the afternoon of the 28th May when the turtle was apparently heading due north away from Puerto Rico.

Turtle 3 spent 14 days within Anguilla's northern inshore waters after SRDL deployment, with haul-out data suggesting a subsequent emergence on the northeast shore of Anguilla on the