juvenile individuals, with only one juvenile green turtle moving to a different feeding area during the study period (Mancini *et al*., In Prep.). Further data are needed in order to cover migratory patterns of all species and size classes and identify important turtle areas.

CHALLENGES OF SATELLITE TELEMETRY STUDIES IN EGYPT

The use of satellite tracking equipment is not easy in Egypt and no clear procedure currently exists to apply for permits. Tracking and GPS devices are generally considered military equipment and would require the approval of the Ministry of Defence. However, when a program is run in collaboration with the Ministry of Environment (i.e. EEAA) no permit is required (M. Hanafy, pers. comm.).

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THE *MASIRAH TURTLE CONSERVATION PROJECT*: THE FIRST TURTLE TRACKING ON MASIRAH ISLAND, OMAN

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INTRODUCTION

Oman hosts important nesting colonies for four species of sea turtle; loggerhead turtles (*Caretta caretta*), green turtles (*Chelonia mydas*), olive ridley turtles *(Lepidochelys olivacea*) and hawksbill turtles *(Eretmochelys imbricata*), with all four species nesting on Masirah Island (Ross & Barwani, 1982). The Masirah Turtle Conservation Project (MTCP) aimed to establish a population assessment of the four species of turtle that nest on Masirah Island as well as produce environmental education packages and a General

Management Plan for the Island, based on sustainable development. The 5-year project (2004-2008), the first of its kind in the region, worked closely with local authorities, fisher's associations and schools as well as the people of Masirah. An integral part of the project involved the use of satellite telemetry to track loggerhead, olive and green turtles that nested on the Island.

This project summary reviews published findings and recommends areas for further work.

METHODS

We used standard attachment methods (Godley *et al.*, 2002), using two-part epoxy to attach either Kiwisat 101 satellite transmitters (Sirtrack Ltd, Havelock North, New Zealand) or SPLASH 5 satellite transmitters (Wildlife Computers, Redmond, Washington, USA) to the carapace of randomly selected individual nesting turtles. Using Kiwisat 101s, we tracked 10 nesting loggerhead turtles from north eastern Masirah in May 2006 and two green turtles from eastern Masirah (one in August 2008 and one in September 2008). Using seven Kiwisat 101s and two SPLASH 5s we tracked nine nesting olive ridley turtles in March/April 2008.

The transmitters were programmed to be continuously on for the duration of the battery life, with transmissions suppressed when the turtles were submerged through use of an on-board saltwater switch. Tracking data were collected and managed through the Satellite Tracking and Analysis Tool (STAT; Coyne & Godley, 2005).

RESULTS

As indicated above, analysis and reporting of tracks from these three species have been previously published (Rees *et al.*, 2010; Rees *et al.*, 2012a, 2012b). The dispersed end-points of the tracks for the different species and individuals ranged from the southern Red Sea to the vicinity of the Strait of Hormuz (entrance to the Arabian Gulf). No turtles migrated eastwards to the Indian sub-continent (Figure 1). For loggerhead turtles the main findings were that they largely remained in oceanic habitats with a focal area between Socotra Island and mainland Arabia (see also Tiwari *et al.*, 2018). For olive ridley turtles, the main findings were that they mainly migrated to neritic habitats often within 120km of the nesting site, and that there was a suggestion that foraging site selection had carry-over effects on adult body size. For green turtles the main findings were that both individuals migrated over 2,400km into the Red Sea, but selected different foraging grounds separated by several hundred kilometres.

DISCUSSION

Since the initial MTCP tracking study, extensive tracking of nesting loggerhead turtles has been undertaken by the Masirah Conservation Project and continues to date (Tiwari *et al.*, 2018). The tracking results, when analysed and published, should benefit practical conservation and management of this threatened population significantly.

No further tracking of green turtles from Masirah Island has taken place since the MTCP work in 2008, so interpretation of overwintering and foraging hotspots of that population remains hampered by small sample size. There is a pressing need for additional turtles to be tracked from the island to verify the single migratory route exhibited by both turtles from this area and to confirm the importance of the coastal waters of Oman and Yemen as a critical migratory corridor for this population. However, additional green turtles have been tracked from Ras Al Hadd, the species' main nesting area in Oman (Ross & Barwani, 1982). Some information on those tracking efforts is outlined in Antonopoulou & Pilcher (2018) and combining these data with the published data from the Masirah population will benefit understanding of regional, metapopulation behaviour of this species.

No further tracking of olive ridley turtles nesting on Masirah Island has been undertaken. Consequently, no progress has been made on confirming the influence on foraging area on body size, suggested in results of the MTCP project, and the relative importance of Oman both for nesting and foraging locations of this species lacks verification. Further tracking of nesting females in combination with extensive tissue sampling for stable isotope analysis (e.g. Zbinden *et al.*, 2011) would facilitate broad-scale interpretation of the behaviour and distribution of this unique Arabian population.

It should be noted that the hawksbill turtle, which also nests on Masirah Island, was not tracked as part of the MTCP but has subsequently received some attention with a total of 10 individuals tracked from the Island in 2011 & 2012. Data on these turtles have been published in Pilcher *et al.* (2014) and Antonopoulou & Pilcher (2018).

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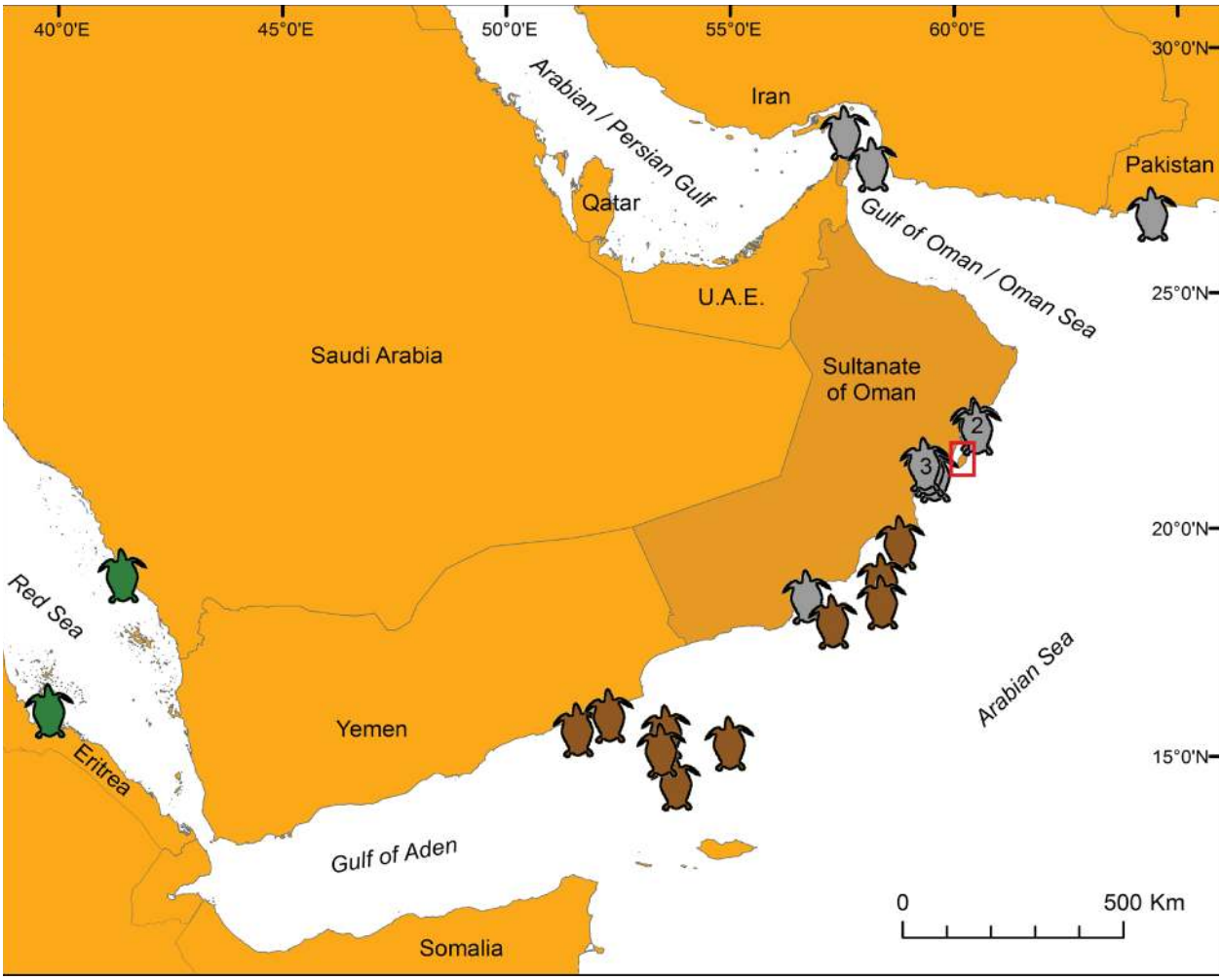

Figure 1. End locations of the 21 sea turtles tracked after nesting on Masirah Island, Oman, as part of the *Masirah Turtle Conservation Project*. Location of the Masirah Island (tagging site; red rectangle). Loggerhead turtles (brown), olive ridley turtles (grey) and green turtles (green). For reference to colours, see the pdf version available on-line.

leader of Masirah Island; Salman Al Farsi and the municipality wildlife rangers who assisted with locating and tagging the turtles; and Mussalam Al Madhousi who coordinated activities on the island. We would also like to thank Jean-Claude Farina of TOTAL SA, Muscat Branch; Guy Sallavyard, Gina Sardella-Sadiki, and Laure Fournier of the TOTAL Foundation; and Henri Crouhade, Hubert Faure, and Maurice Drapier of IPEDEX/ SPIE who each supported implementation and showed personal interest in the projects. Permission to work with turtles was granted by Oman's MECA.

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MARINE TURTLE CONSERVATION PROJECT: MONITORING HAWKSBILL NESTING POPULATIONS IN THE ARABIAN REGION

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INTRODUCTION

In the Arabian (Persian) Gulf, hereafter referred to as the Gulf, hawksbill turtles (*Eretmochelys imbricata*) nest at several key sites in Saudi Arabia (Miller, 1989; Pilcher, 1999), on a number of Kuwaiti islands (Meakins & Al-Mohanna, 2004), the Iranian coast and islands (Mobaraki, 2004), Qatar (SCENR, 2006; Pilcher *et al*., 2008), and the United Arab Emirates (UAE) on islands off Abu Dhabi and Sharjah (EAD, 2007; Pilcher *et al*. 2014a). In the Gulf of Oman and the Arabian Sea, nesting hawksbill populations are present in the Daymaniyat Islands and Masirah Island (Ross & Barwani 1982; Salm *et al*., 1993; Rees & Baker, 2006). The Gulf is a relatively shallow water body that undergoes extreme water temperature fluctuations with surface waters typically exceeding 30°C for sustained periods during the summer. Monitoring behavior patterns of marine turtles within these conditions can offer valuable insights on how turtles might adapt to climate change and elevated global temperatures in other parts of the world.

PROJECT PARTNERS

The Marine Turtle Conservation Project was implemented as a partnership between the Emirates Nature-WWF, formerly known as Emirates Wildlife Society-WWF (EWS-WWF), the Marine Research Foundation (MRF), as well as a number of other organisations in the region:

- UAE: Environment Agency - Abu Dhabi (EAD), Emirates Marine Environmental Group (EMEG), Environment & Protected Areas Authority, Sharjah (EPAA).
- Oman: Ministry of Environment and Climate Affairs (MECA), Environment Society of Oman (ESO), 5 Oceans Environmental Services.
- Qatar: Qatar University, Ministry of Environment Qatar, Ras Laffan Industrial City.
- Iran: Wildlife and Aquatic Affairs Bureau of the Department of Environment.

PROJECT DETAILS

The overall goal of the project was to identify post-nesting migratory routes and key foraging grounds for hawksbill