Discovery of New Nesting Beaches for Loggerhead Turtles (*Caretta caretta*) at Gnaraloo on the Ningaloo Coast, Western Australia

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Western Australia is believed to support the third largest population of loggerhead turtles (*Caretta caretta*) in the world (Limpus 2008). It holds all known nesting sites for loggerheads in the southeast Indian Ocean (Conant *et al.* 2009; Dodd 1988). Nesting sites span from the Shark Bay World Heritage Area northward through the Ningaloo Marine Park to the Muiron Islands (Baldwin *et al.* 2003; Conant *et al.* 2009). In Australia, nesting loggerheads are divided into two populations (or stocks) based on genetic analysis: the population of loggerheads nesting in Western Australia is the larger of the two stocks, eclipsing the other Australian loggerhead population, which nests primarily in eastern Australia and the south Pacific (Boyle *et al.* 2009; Conant *et al.* 2009). There is currently no genetic evidence to suggest that the two populations interbreed (Bowen 2003), making each more vulnerable to decline should their respective nesting habitats be disturbed. Describing and managing the full extent of loggerhead habitat in Western Australia is therefore a priority of national and international conservation significance.

The Gnaraloo coastline (Fig. 1) has been identified as one of the most important mainland nesting areas for loggerheads in Western Australia (Hattingh *et al.* 2012a,b,c). Gnaraloo Station is situated approximately 150 km north of Carnarvon within and immediately adjacent to the Ningaloo Coast World Heritage Area. Marine turtles are frequently reported in coastal waters by Gnaraloo Station staff and guests. The Gnaraloo Station Trust commenced the Gnaraloo Turtle Conservation Program (GTCP) in 2005 to identify, monitor and protect key coastal nesting rookeries of endangered marine turtles on Gnaraloo beaches, namely of loggerhead, green (*Chelonia mydas*) and hawksbill (*Eretmochelys imbricata*) turtles. (The work of the GTCP followed and formalized prior informal data collection of nesting activities over a five-year period by a community member at Gnaraloo Bay, undertaken independently of the GTCP.)

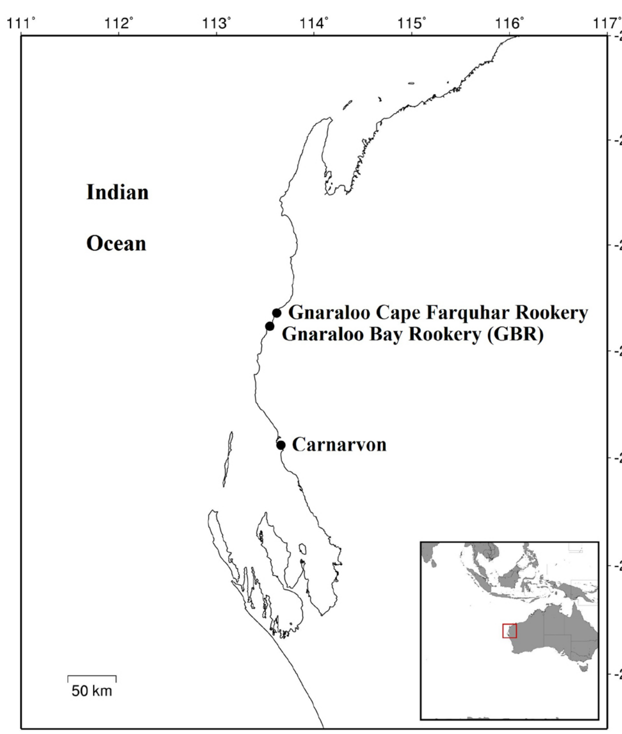

Figure 1. Map of the Gnaraloo coastline and geographical context within Western Australia.

The GTCP has been monitoring turtle nesting activities at the Gnaraloo beaches on the ground since the 2008/09 nesting season. Of the 65 km of Gnaraloo's coastline, 7 km are regularly monitored for signs of turtle nesting activity and constitute the Gnaraloo Bay Rookery (GBR) (23.76708°S/113.54584°E, 23.72195°S/113.57750°E). Daily beach patrols are conducted to identify and record all crawls and nests during the nesting season (early November-late February) and they provide the only full season coverage of nesting turtle activity for the population. There is currently no tagging program or collection of morphometric data from nesting females.

The GBR hosts between 350-500 nests (roughly 70-130 females) each season since monitoring began in 2008. The vast majority of these nests (>90%) are laid by loggerheads; the rest belong to green and occasionally hawksbill turtles (7% and ~2% of total nests, respectively, Hattingh *et al.* in review).

To better understand the spatial extent of the nesting area, aerial surveys of Gnaraloo's coastline were completed in January 2010 and January 2011. These surveys revealed signs of turtle nesting activity on beaches located approximately 22 km north of the monitored GBR (Fig. 1). Following recommendations of the GTCP 2010/11 report (Hattingh *et al.* 2011), it was decided to begin reconnaissance monitoring of this northern area during the GTCP season 2011/12. The goal of these excursions was to investigate the significance of additional nesting beaches on the Gnaraloo coastline. Here I summarize and discuss the findings from three monitoring excursions that took place during the GTCP season 2011/12. For more detail regarding the excursions, refer to the individual Gnaraloo Cape Farquhar Rookery reports by the GTCP (Hattingh *et al.* 2012a,b,c).

We monitored the coastline adjacent to the Cape Farquhar Marine Sanctuary Zone of the Ningaloo Marine Park, located north of the GBR beach and extending from 23.64168°S/113.61544°E to 23.57697°S/113.69830°E. The coastline is approximately 14 km long, with 12.9 km of unobstructed beach and 1.2 km of rocky cliff face. Wave energy is low due to a near-shore coral reef system that extends the length of the sanctuary zone. The beach is characterized by sparse, low-lying vegetation and large dune systems.

A total of three surveys were conducted at the Gnaraloo Cape Farquhar area: from 21-23 December 2011; 21-23 January 2012; and 21-23 February 2012. Surveys were undertaken on foot at dawn each day to document turtle nesting activities from the previous

	December 21-23 2011		January 21-23 2012		February 21-23 2012	
	Nests	Total activities (including nests)	Nests	Total activities (including nests)	Nests	Total activities (including nests)
GBR	15	38	15	30	1	2
Gnaraloo Cape Farquhar area	8	17	10	19	0	0

Table 1. Comparison of turtle activities recorded concurrently at the GBR and the Gnaraloo Cape Farquhar area during Dec. 2011, Jan. 2012 and Feb. 2012 surveys by the GTCP 2011/12.

night. Details such as turtle species, type of activity (e.g., nest, unsuccessful nesting attempt, u-track and unidentified activity), beach position and GPS location were recorded for each activity. There were signs of older nesting activities that had occurred at unknown times prior to our surveys; these were classified as well as possible and recorded separately from the new activities. Regular monitoring of the GBR continued concurrently with the surveys in the Gnaraloo Cape Farquhar area.

The number of nests recorded during each survey of the Gnaraloo Cape Farquhar area was lower but comparable to the number recorded at the GBR during the same time period (Table 1). Likewise, the total number of activities recorded during each survey (including nesting) was also lower than the total number of activities recorded concurrently at the GBR. All of the nesting activities recorded during the Gnaraloo Cape Farquhar surveys were identified as loggerhead activities.

Data collected by the GTCP in the GBR since 2008 has suggested that nesting activities increase rapidly throughout December and peak during January before attenuating in early February. Similarly in the Gnaraloo Cape Farquhar area, a higher number of new activities were recorded during the December and January surveys than in the February survey. This could indicate that the breeding populations at Gnaraloo may utilize beaches at both locations. For example, loggerheads nesting at other rookeries show some movement between adjacent beaches, returning to nest on different beaches within the region where they hatched rather than one specific beach (Bowen *et al.* 2003; Pfaller *et al.* 2008). Loggerheads may also nest on different beaches in subsequent nesting events within the same season (Bjorndal *et al.* 1983). It is possible that females at Gnaraloo nest on the GBR beach as well as the beaches within the Gnaraloo Cape Farquhar area. Should this be the case, the seasonal numbers of nesting marine turtles recorded thus far on the Gnaraloo coastline may be an underestimation and the Gnaraloo rookeries may be more significant than previously known.

While preliminary results are suggestive, the timing and frequency of the Gnaraloo Cape Farquhar surveys provide a limited snapshot of turtle activity over the course of the entire nesting season. The total number of nests dug during the entire nesting season in the Gnaraloo Cape Farquhar area is not known. However, the prevalence of old activities documented during the three surveys indicates that the Gnaraloo Cape Farquhar area supports high levels of activity before and between each short-term survey. As recommended by the three Gnaraloo Cape Farquhar reports (Hattingh *et al.* 2012a,b.c), longer, more frequent monitoring should continue in order to establish and strengthen baseline trends. The addition of a tagging program would help to gain a better understanding of the temporal dynamics of nesting turtles in this area, as well as to clarify habitat use patterns of turtles nesting at each beach.

It is vitally important to document the extent of endangered turtle presence in this area of Western Australia, which is attracting increasing numbers of tourists and development. Considering the global significance of the Western Australian loggerhead population, discoveries of this kind represent important contributions to research and conservation, and emphasize the possibility of additional knowledge gaps.

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