Marine Turtle Surveys on
Diego Garcia

Prepared by
Ms. Vanessa Pepi
NAVFAC Pacific

March 2005

Appendix K

INTRODUCTION

This report describes the methods and discusses the results of marine turtle surveys conducted 16 – 24 July 2003, 7 – 18 March 2004 and 28 January – 2 February 2005. Surveys were conducted to support the update of the Diego Garcia Natural Resource Management Plan.

Diego Garcia is an atoll within the Chagos Archipelago in the center of the Indian Ocean. There are two species of marine turtles that are common in the Western Indian Ocean: hawksbill turtles (*Eretmochelys imbricata*) and green turtles (*Chelonia mydas*) (Frazier 1975). Other species that may be encountered are loggerheads (*Carreta carreta*), olive ridleys (*Lepidochelys olivacea*) and leatherbacks (*Dermochelys coriacea*). Diego Garcia was surveyed for the Atoll Research Bulletin (1967) and it was noted that although turtles were not very common at Diego Garcia, hawksbills were observed within the lagoon. While surveying Diego Garcia in 1970 Frazier (1975) also observed that there was little sign of nesting turtles around Diego Garcia. However, more recent surveys of the atoll have indicated that there appears to be an increase in populations of turtles nesting there (Mortimer & Day 1999).

Marine Turtle Natural History

Sea turtles are long-living animals whose history extends back approximately 90 million years (Bustard 1972). These reptiles are iteroperous (show repeated cycles of reproduction), with very predictable nesting behaviors. They lay a relatively large number of eggs several times during the nesting season, and show high nest site fidelity (Miller, 1997). The estimated age at first breeding for sea turtles is about 30 – 50 years and they do not breed at a uniform or minimum size; size is not a reliable indicator of maturity or breeding status (Miller, 1997). All species of turtles migrate some distance from the foraging area to the nesting area and spend up to several months at the nesting grounds (Miller, 1997). The interval between reproductive periods, or remigration interval, is a few to several years (Miller, 1997). Sea turtles like to use beaches with deep loose sand and typically nest during the warmer months (Miller, 1997).

Hawksbill turtles (*Eretmochelys imbricata*)

Hawksbill turtles are highly coveted for their shells for making jewelry. They are listed as 'endangered' under the Endangered Species Act and are listed as 'critically endangered' on the IUCN Red List. While these turtles may be a commonly observed species in certain tropical reef habitats, these are typically subadult turtles and very few nesting colonies are known (Pritchard, 1997). This species is one of the smaller marine turtles with a narrow head and a hawk-like beak (NMFS and USFWS, 1988a). The carapace has thick, overlapping scutes with a very serrated posterior

margin (NMFS and USFWS, 1998a). Hawksbills can be differentiated from green turtles by a pair of prefrontal scales (located at the front of the head, above the eyes) instead of one prefrontal scale (NMFS and USFWS, 1998a).

Young hawksbills are believed to be pelagic until they reach a carapace length around 20 – 35 cm. They forage most commonly on various invertebrates (i.e., sponges, demosponges, soft corals, tunicates and mollusks) (Bjorndal, 1997). Moreover, hawksbills have been observed to forage in shallow habitats that are < 3m (9.8 feet) deep (Houghton, *et. al.* 2003). Research in the Pacific and Indian oceans has shown that younger turtles have a more omnivorous diet, including eat aquatic vegetation and algae (Bjorndal 1997). During the 1996 study, Mortimer and Day (1999) observed immature hawksbills within the barrachois at the southern end of the island foraging on algae.

Hawksbills will nest during the night and/or the day (Miller, 1997). In the Western Indian Ocean, they are characterized as diurnal nesters. Although this behavior is considered common throughout the Chagos Archipelago, it has not been quantified (Mortimer and Day 1999). Peak nesting at Diego Garcia has been reported to be from November to February by Frazier (1977) and December to March by Stoddart (1971). During their surveys, Mortimer and Day (1999) observed significant nesting in February and March of 1996.

The average carapace length for a nesting female is 78.6 cm (30.9 in) (Miller 1997). On average, hawksbill turtles nest up to three times during the nesting season with an average clutch size of 130 eggs (Miller 1997). Frazier (1975) estimated that there were about 300 hawksbills nesting at Diego Garcia and Mortimer and Day (1999) estimated that there are approximately 300 – 700 hawksbills that nest within the Chagos Archipelago.

Juvenile hawksbills forage at Diego Garcia, however, since most turtles do not nest at their foraging area even if nesting by adult turtles occurs there – they most likely migrate somewhere else (Houghton, *et. al.* 2003; Miller 1997)). Hawksbill turtles may migrate to the Seychelles to nest. This is supported by data showing that populations of juvenile hawksbills from the Chagos Archipelago and the Seychelles could not be genetically differentiated from each other (Mortimer and Broderick 1999).

Green turtles (*Chelonia mydas*)

Historically, green turtles have been coveted primarily for their flesh (NMFS & USFWS 1998b). Currently, they are listed as 'threatened' under the Endangered Species Act and are listed as 'endangered' on the IUCN Red List. They are one of the larger marine turtles of the five species and have a smooth carapace with four pairs of lateral scutes and a lower jaw-edge that is coarsely serrated (NMFS and USFWS, 1998b).

Young green turtles are believed to reside throughout pelagic habitats and are assumed to have an omnivorous diet during that time (Bjorndal, 1997). When they reach a size between 20 – 35 cm in carapace length they enter benthic foraging areas and feed primarily on seagrasses and algae and may opportunistically feed on marine invertebrates (Bjorndal, 1997).

Green turtle nesting can occur during any month at Diego Garcia, but is believed to peak between June and September (Frazier 1977). The average carapace length of a nesting female is 99.1 cm (39.0 in) (Miller 1997). They typically nest at night, lay approximately 3 clutches per nesting season and have an average clutch size of 113 eggs (Miller, 1997). Frazier (1975) estimated that there were 300 green turtles nesting at Diego Garcia. In 1996 Mortimer and Day (1999) estimated that approximately 400 – 800 green turtles nest within the Chagos Archipelago with Diego Garcia being the second most important nesting area within the archipelago.

METHODS

Survey Coverage Descriptions

- 16 – 24 July 2003: Nesting activity information was observed and noted while walking around the outer perimeter of Diego Garcia and a section of the inside (Barton Point to Cust Point).

- 7 – 18 March 2004: Nesting activity was observed and noted while walking around outer perimeter of Diego Garcia, a section inside (Barton Point to Cust Point) and the 3 islands at the mouth of the atoll.

- 28 January – 2 February 2005: Surveys focused on areas of known nesting activity. Four surveys were conducted at night [1) T-site to Horsburgh Point, 2) T-site to the south end, 3) GEODDS to Horsburgh Point and 4) T-site to rifle range.]. One survey was conducted during the day from Cannon Point recreation area to the south end of the fuel tank farm.

Locations and characteristics of all turtle tracks and body pits were recorded and mapped using a Trimble GeoExplorer CE global positioning unit (GPS). Nesting activity by either species was identified as a crawl, a body pit, an egg chamber, or a potential nest (or backfill). A crawl is signified by tracks made by a turtle as it makes progress on the beach, for example, as it emerges from the water and crawls up the beach. A body pit is the first of any type of defined digging behavior that occurs while in the process of nesting. The turtle uses both front and rear flippers to dig a pit until the turtle's head is below the level of the sand surface (approximately 15 inches (38.1cm)). After the body pit is dug, the turtle uses only the hind flippers to dig a small, cup-like hole that is a little longer than the length of her flippers (approximately 16 inches (40.64 cm). This cavity, called the egg chamber, holds the eggs during incubation. After the turtle finishes laying her eggs, the female covers the eggs with sand using mainly the hind flippers in the beginning, but switching primarily to the front flippers to throw sand behind her to cover the area while slowly moving forward. This last action assists in hiding the exact location of the egg chamber. Species were identified using the following defined parameters: hawksbill tracks are approximately 70-85 cm (27.6 – 33.5 in) wide, have a wavy tail–drag mark and an alternating gait while green turtle tracks widths are approximately 95 – 144 cm (37.4 – 56.7 in) and have a synchronous gait (Lutz and Musick, 1997). The approximate age of the tracks or digging activity was recorded along with any evidence that the nest successfully hatched by looking for hatch pits. During the July 2003 survey, information on whether or not beach stretches were considered good nesting habitat were recorded in a field notebook.

RESULTS

July 2003

During the July survey I recorded activity that had occurred during the past two months in order to focus on nesting activity occurring during the June – July time period. There were 65-recorded sightings during this survey (Figs. 1-6). I observed 16 potential nests, 21 body pit areas (some locations had multiple body pits in the area), 3 excavated egg chambers and 25 crawls (some locations had multiple crawls in the same area and it became difficult to distinguish if the tracks were made by one or several turtles).

Along Simpson Point no signs of turtle activity were observed. This particular stretch of beach appeared as if it would be a very difficult location for successful hatching, largely because the high tide line extended into the dense vegetation. The area along the runway (Fig. 2) had stretches of beach that appeared to be capable of supporting successful nesting attempts. Nests or digging activity were observed in that area, however, I observed that at least one of the recorded potential nests had been washed over. The greatest amount of turtle activity was observed from the

south tip up to Horsburgh Point (Fig. 4). No nesting activity was observed on beaches along the inside of the atoll from Barton Point south to Cust Point. I was not able to visit the 3 islands at the mouth of the atoll during this survey and am, therefore, unable to state whether or not nesting activity occurred on those islands during June and July.

Thirty-three turtle tracks were measured in July. The mean track width was 113.4 cm (44.6 in) with a minimum width of 89 cm (35 in) and a maximum width of 167 cm (65.7 in). The two smallest track widths [89 cm (35 in) & 93 cm (36.6 in)] are below the 95 cm (37.4 in) cut-off for green turtle tracks. However, they are greater than the maximum track width for hawksbills [85 cm (33.5 in)]. All tracks observed were indicative of a green turtle crawl due to the track widths and the synchronous gait pattern of the tracks.

March 2004

There were 27 recorded sightings of nesting activity during the March survey (Figs. 7-10). During this survey I recorded evidence of nesting within the last 2-3 months in order to avoid recording activity that had been previously observed during the July survey. I observed 8 potential nests, 16 body pits, 2 excavated egg chambers and 1 crawl. Almost all activity observed was at least one month old. I observed two nests with hatch pits (the eggs had hatched and the hatchlings had emerged) and one of the nests was excavated. The size of the clutch was approximately 95 eggs with 6 rotten eggs. There were no partially or fully developed hatchlings still in the egg and no hatched dead hatchlings within the nest cavity for this nest. It is highly probable that a green turtle laid this nest (determined off of clutch and egg size).

Nesting activity was recorded in the area along Simpson Point (Fig. 7) and again, the majority of nesting activity occurred from the southern tip north up to Horsburgh Point (Fig. 8). There was some sporadic nesting activity observed between Horsburgh Point and Cust Point on the ocean side (Fig. 9). The 3 islands (East, Middle and West Islands) were visited during this survey. No turtle nesting activity was observed on these 3 islands. The only island that would be able to support nesting is East Island.

Only 3 tracks were observed and measured during the March survey. The measurements were: 98 cm (38.6 in), 68 cm (26.8 in), and 76 cm (29.9 in). The two smaller widths were within the range of defined hawksbill track widths while the largest was in the range of the green track widths. Additionally, the two smaller measurements were indicative of hawksbill crawls due to the asynchronous gait pattern of the tracks versus the larger tracks mostly likely made by a green turtle (a pull-push pattern of the gait showing all four flippers moving in a synchronous fashion).

January/February 2005

This survey occurred after the December 26, 2004 earthquake/tsunami event. The original intention was to conduct night surveys and find nests laid that night; identify which species laid the nest, mark the nest in order to monitor the incubation period and determine the clutch size. The survey focused on the area that been previously identified as having the majority of nesting activity (southern tip north to Horsburgh Point). Four night surveys were conducted during this visit; the locations are described in the methods.

The majority of activities observed occurred prior to the tsunami. The diggings were typically up into the vegetation line and were partial. No older nests and no signs of hatching were observed. From the southern tip to the T-site area, the erosion looked like it had increased (corroborated by N. Guzman who frequents the area and is familiar with turtles there). The area from the T-site to Horsburgh Point had areas that were still suitable for nesting. One likely nest was observed and marked along with one crawl. In general, the beaches along Diego Garcia appeared to have been affected by the tsunami. The one survey conducted during the day was from Cannon Point down to the southern end of the fuel tank farm. The beach along that area was more eroded with very steep banks (Fig. 11). The beach looks similar to what I had observed during the July surveys. I observed no signs of older nesting activity or any signs of recent activity.

Figure 11. Erosion observed along Cannon Point.

DISCUSSION

Only green turtle nesting activity was observed during the June – July time frame. Most likely greens and hawksbills were nesting November through February. Although, I did not observe any recent nesting (i.e., during most of February and March), I did observe likely hawksbill tracks and the green turtle nest that hatched. My observations were different from Mortimer's (1997) observations, where she reported significant nesting during March.

The tsunami appeared to have had an adverse affect on marine turtle nesting. Any nests would have been destroyed due to the unusually high tide that occurred after the earthquake and as the result of the subsequent erosion of the beaches. This may be a temporary effect, as it appeared that sand was already being re-deposited in the area from the southern tip to Horsburgh Point. It appears that there are regular shifts in sand deposition along the beach from Cannon Point to the southern end of the fuel farm, so it seems probably that the area will be suitable for nesting during the next November through February time period.

LITERATURE CITED

Bjorndal KA, 1997. Foraging ecology and nutrition of sea turtles. In: The Biology of Sea Turtles (Lutz PL, Musick JA, eds). Boca Raton: CRC Press, Inc.; 199-231.

Bustard, R. 1972. Sea Turtles – Natural History and Conservation. New York: Taplinger Publishing Company.

Frazier J. 1977. Marine turtles in the western Indian Ocean: British Indian Ocean Territory, Comores. Typescript. ii + 33, vi + 114 pp.

Miller JD, 1997. Reproduction in sea turtles. In: The Biology of Sea Turtles (Lutz PL, Musick JA, eds). Boca Raton: CRC Press, Inc.; 51-82.

Mortimer, J. A. and M. Day. 1999. Sea turtle populations and habitats in the Chagos Archipelago. In: Ecology of the Chagos Archipelago (Sheppard, C.R.C., Seaward, M.R.D., eds). West Yorkshire England: Westbury Academic and Scientific Publishing: 159-176.

National Marine Fisheries Service and U.S. Fish and Wildlife Service. 1998a. Recovery plan for U.S. Pacific populations of the hawksbill turtle (*Eretmochelys imbricata*). National Marine Fisheries Service, Silver Spring, MD.

National Marine Fisheries Service and U.S. Fish and Wildlife Service. 1998b. Recovery plan for U.S. Pacific populations of the green turtle(*Chelonia mydas*). National Marine Fisheries Service, Silver Spring, MD.

Pritchard PCH, 1997. Reproduction in sea turtles. *In*: The Biology of Sea Turtles (Lutz PL, Musick JA, eds). Boca Raton: CRC Press, Inc.; 1-28.

Key Map: Sea Turtle Activity Observed on Diego Garcia (July 2003)

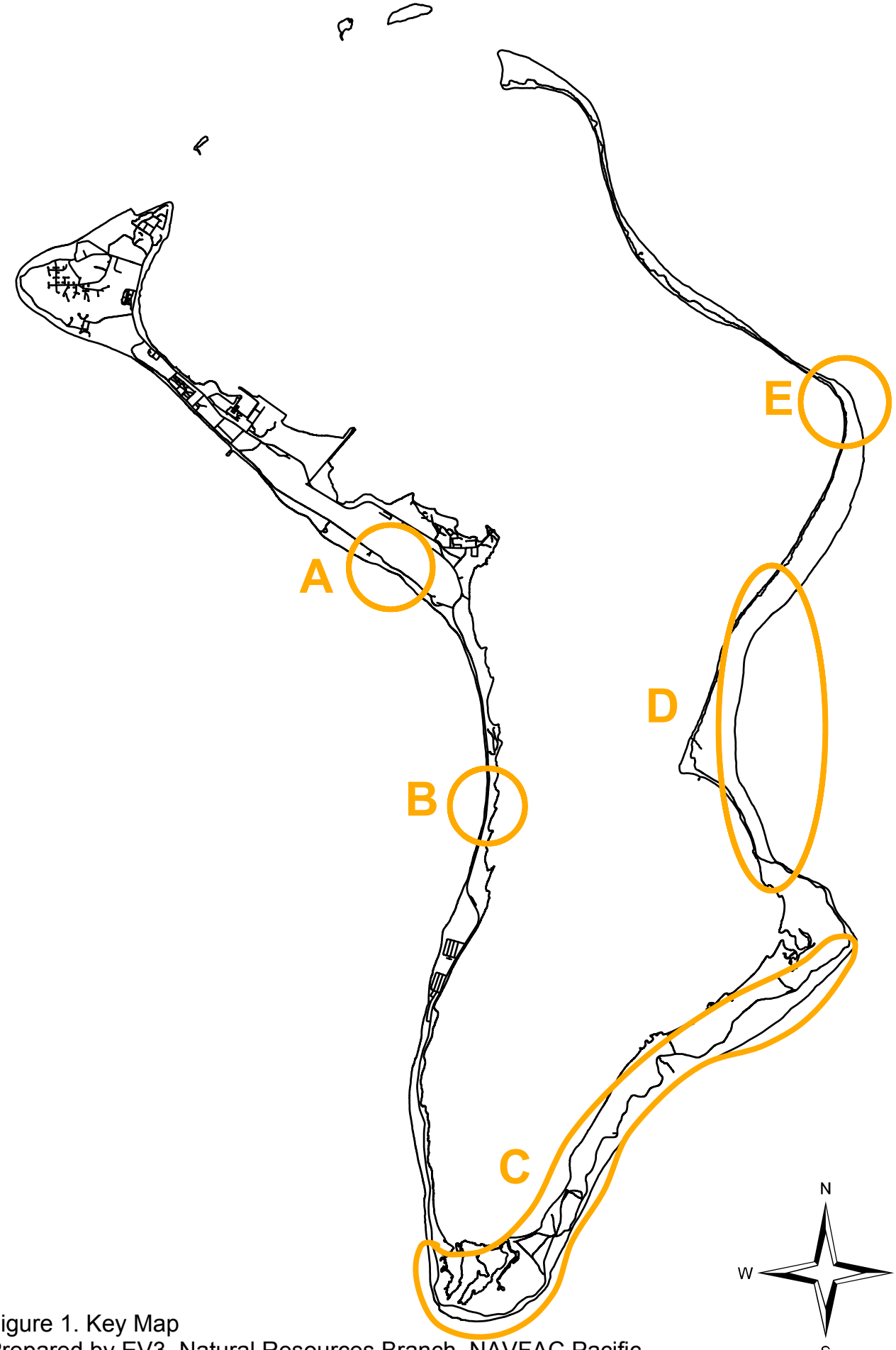
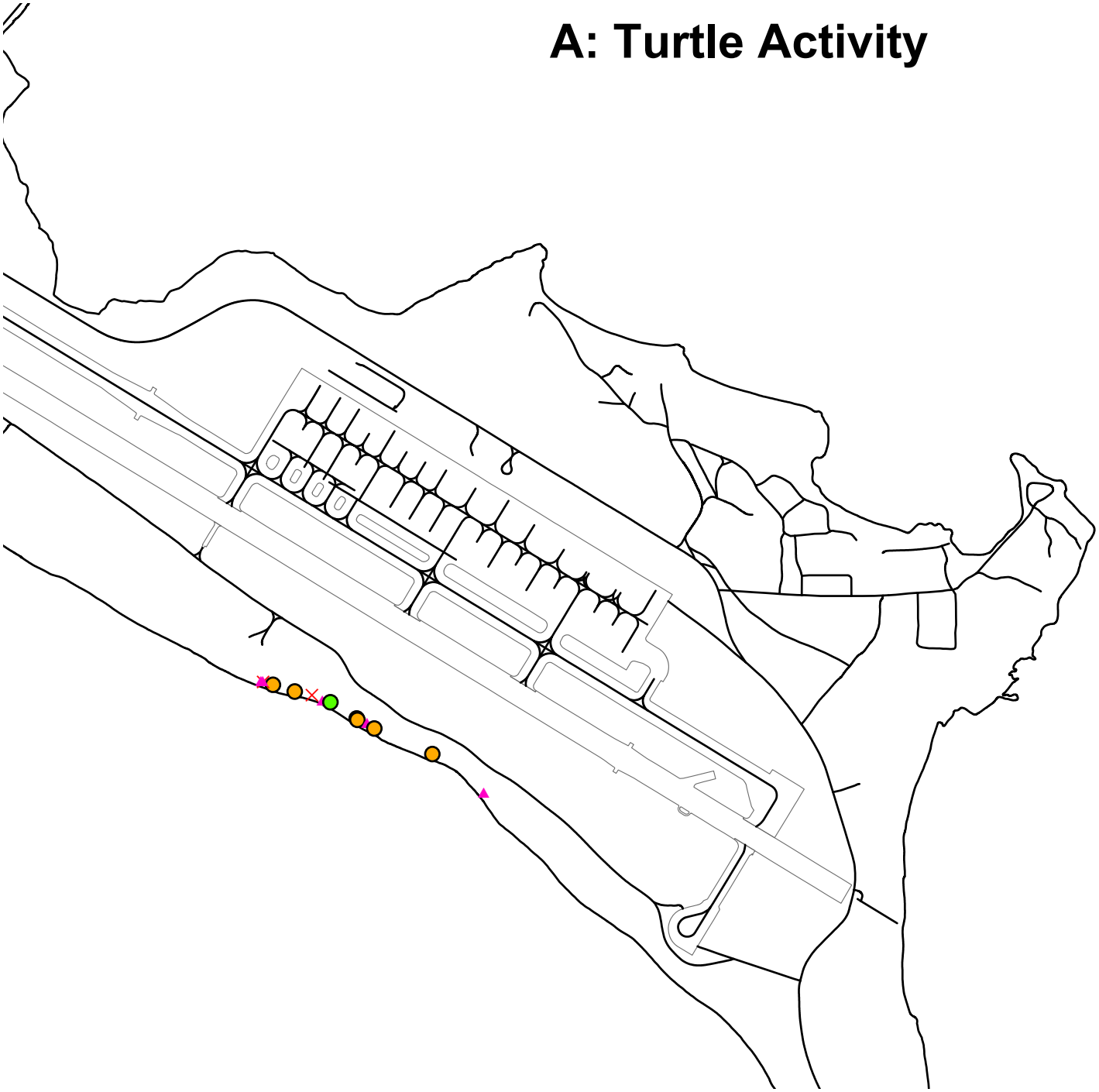


Figure 1. Key Map
Prepared by EV3, Natural Resources Branch, NAVFAC Pacific
September 2005
UTM, Zone: 43S, Datum WGS84

Sea Turtle Activity Observed On Diego Garcia (July 2003)



Turtle Activity

- **Potential Nest**
- **Body Pit**
- **Crawl**
- **Egg Chamber**

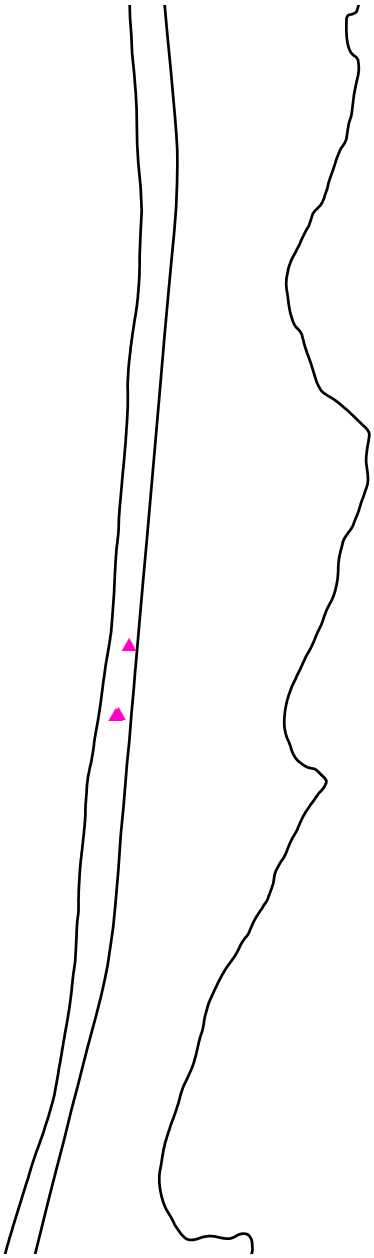
0 180 360 720 Meters

N
W E
S

Figure 2. Turtle Activity, A
Prepared by EV3, Natural Resources Branch, NAVFAC Pacific
September 2005
UTM, Zone: 43S, Datum WGS84

Sea Turtle Activity Observed On Diego Garcia (July 2003)

B: Turtle Activity



Turtle Activity

- **Potential Nest**
- **Body Pit**
- **Crawl**
- **Egg Chamber**

0 95 190 380 Meters

N W E S

Figure 3. Turtle Activity, B
Prepared by EV3, Natural Resources Branch, NAVFAC Pacific
September 2005
UTM, Zone: 43S, Datum WGS84

Sea Turtle Activity Observed On Diego Garcia (July 2003)

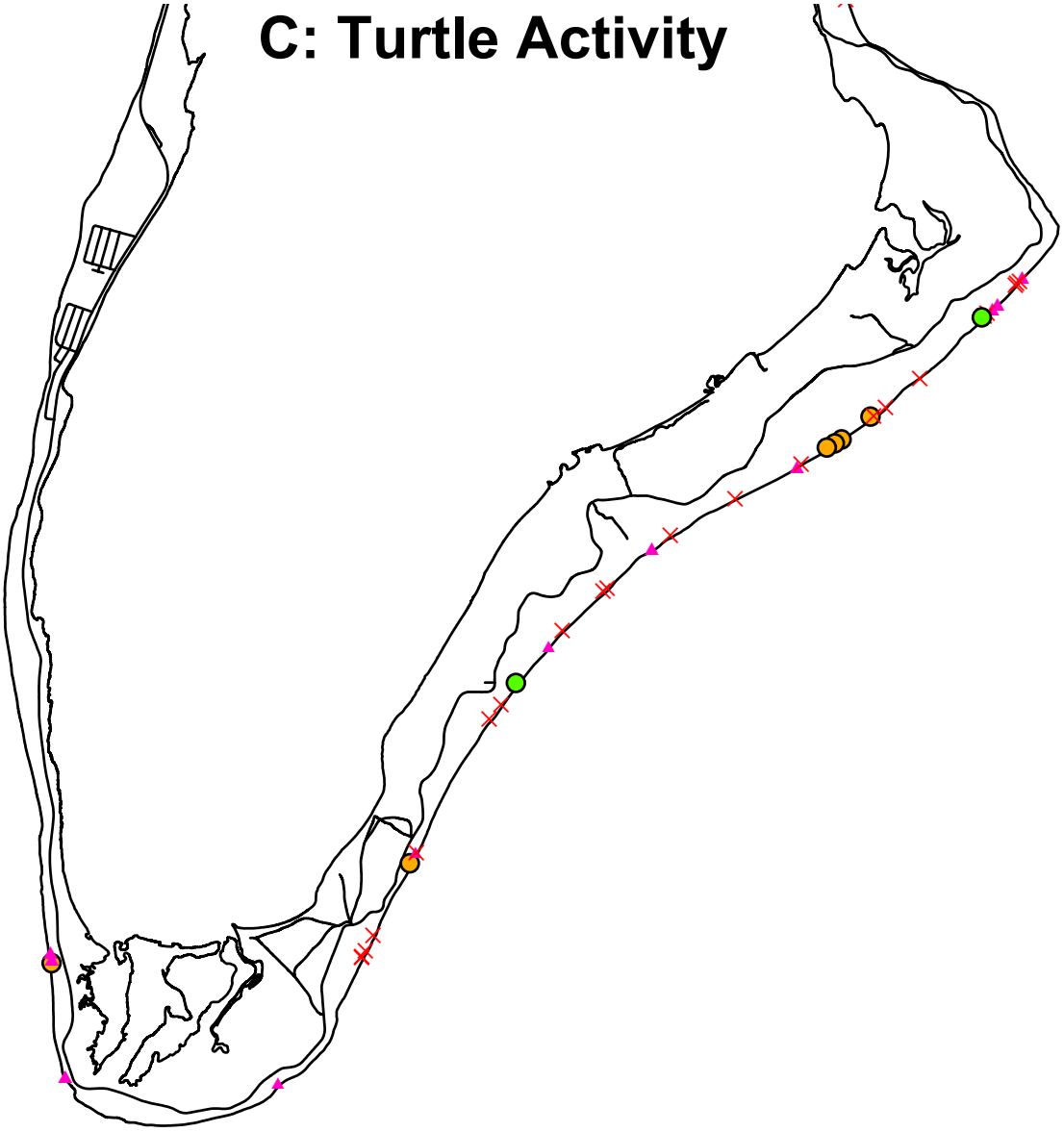


Figure 4. Turtle Activity, C
Prepared by EV3, Natural Resources Branch, NAVFAC Pacific
September 2005
UTM, Zone: 43S, Datum WGS84

Turtle Activity

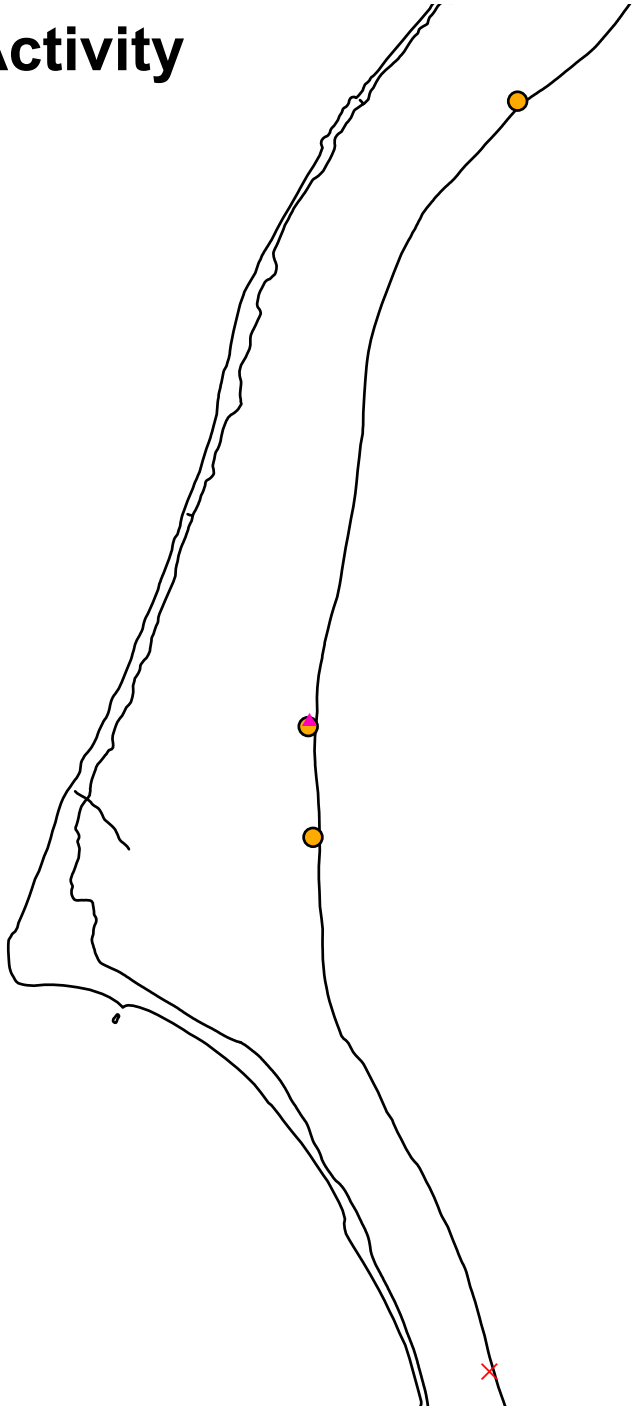
- **Potential Nest**
- **Body Pit**
- **Crawl**
- **Egg Chamber**

0 700 1,400 2,800 Meters

N
W E
S

Sea Turtle Activity Observed On Diego Garcia (July 2003)

D: Turtle Activity



Turtle Activity

- **Potential Nest**
- **Body Pit**
- **Crawl**
- **Egg Chamber**

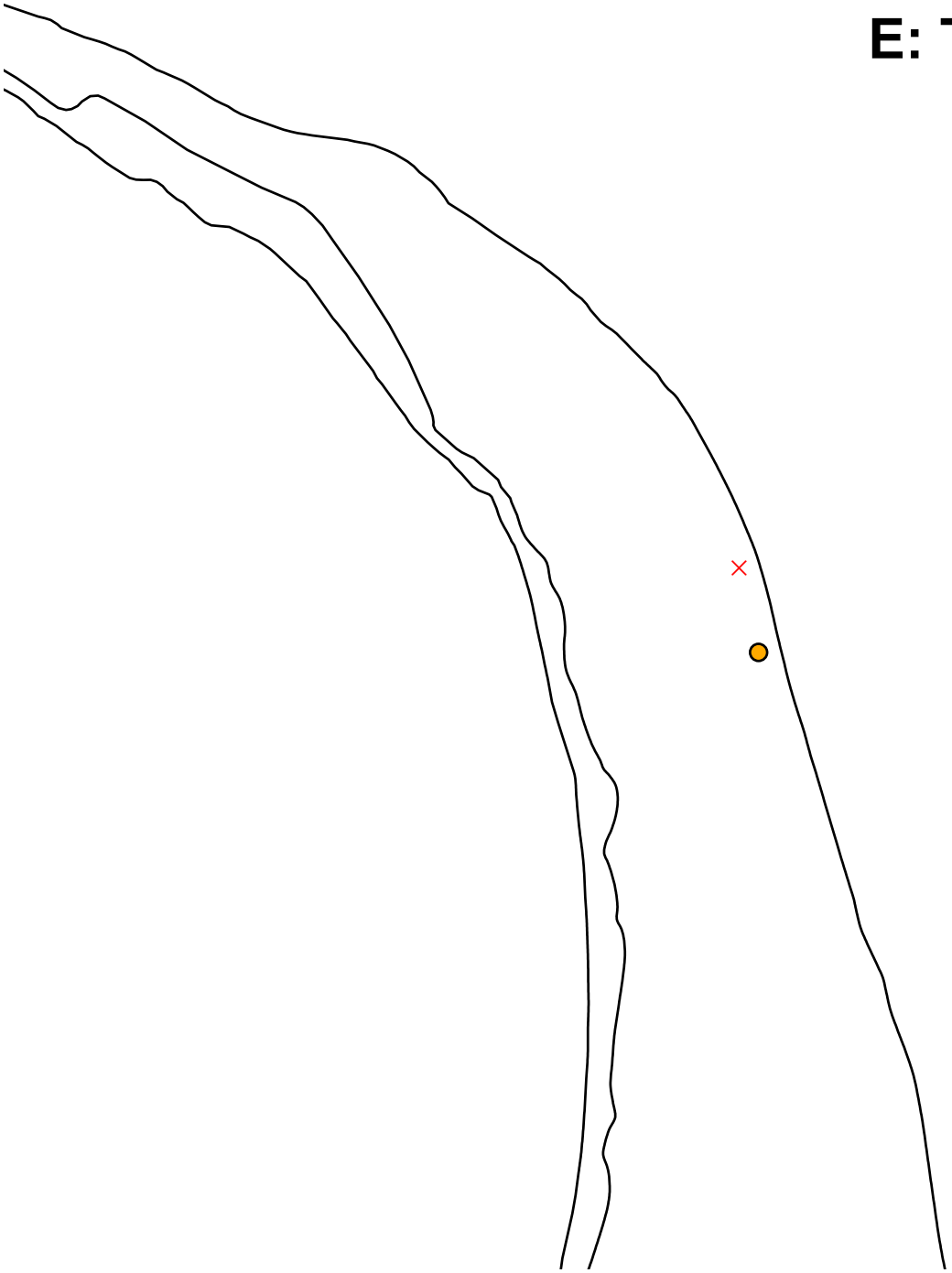
0 212.5 425 850 Meters

N
W E
S

Figure 5. Turtle Activity, D
Prepared by EV3, Natural Resources Branch, NAVFAC Pacific
September 2005
UTM, Zone: 43S, Datum WGS84

Sea Turtle Activity Observed On Diego Garcia (July 2003)

E: Turtle Activity



Turtle Activity

- Potential Nest
- Body Pit
- Crawl
- Egg Chamber

0 70 140 280 Meters

N
W E
S

Figure 6. Turtle Activity, E
Prepared by EV3, Natural Resources Branch, NAVFAC Pacific
September 2005
UTM, Zone: 43S, Datum WGS84

Key Map: Sea Turtle Activity Observed on Diego Garcia (March 2004)

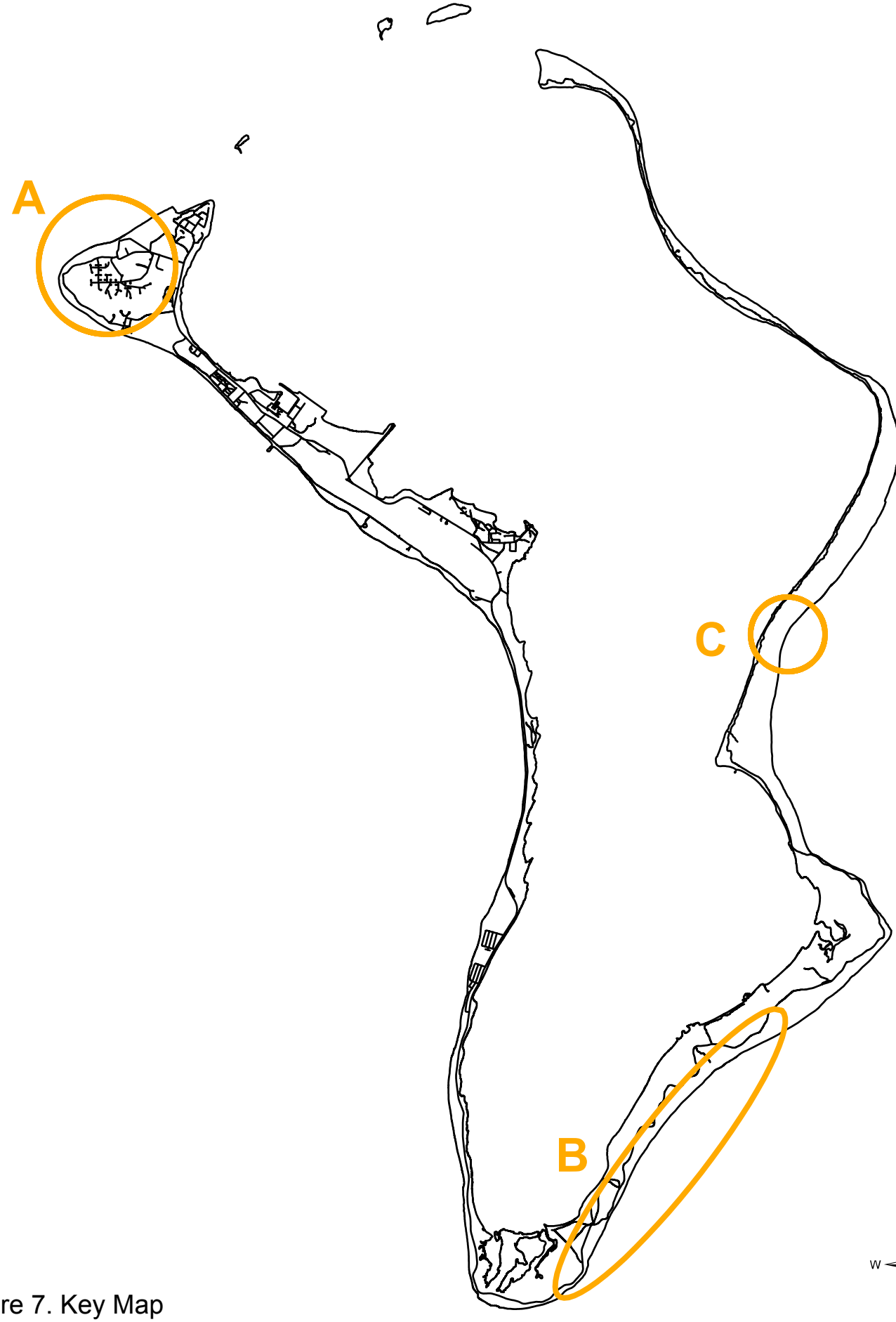
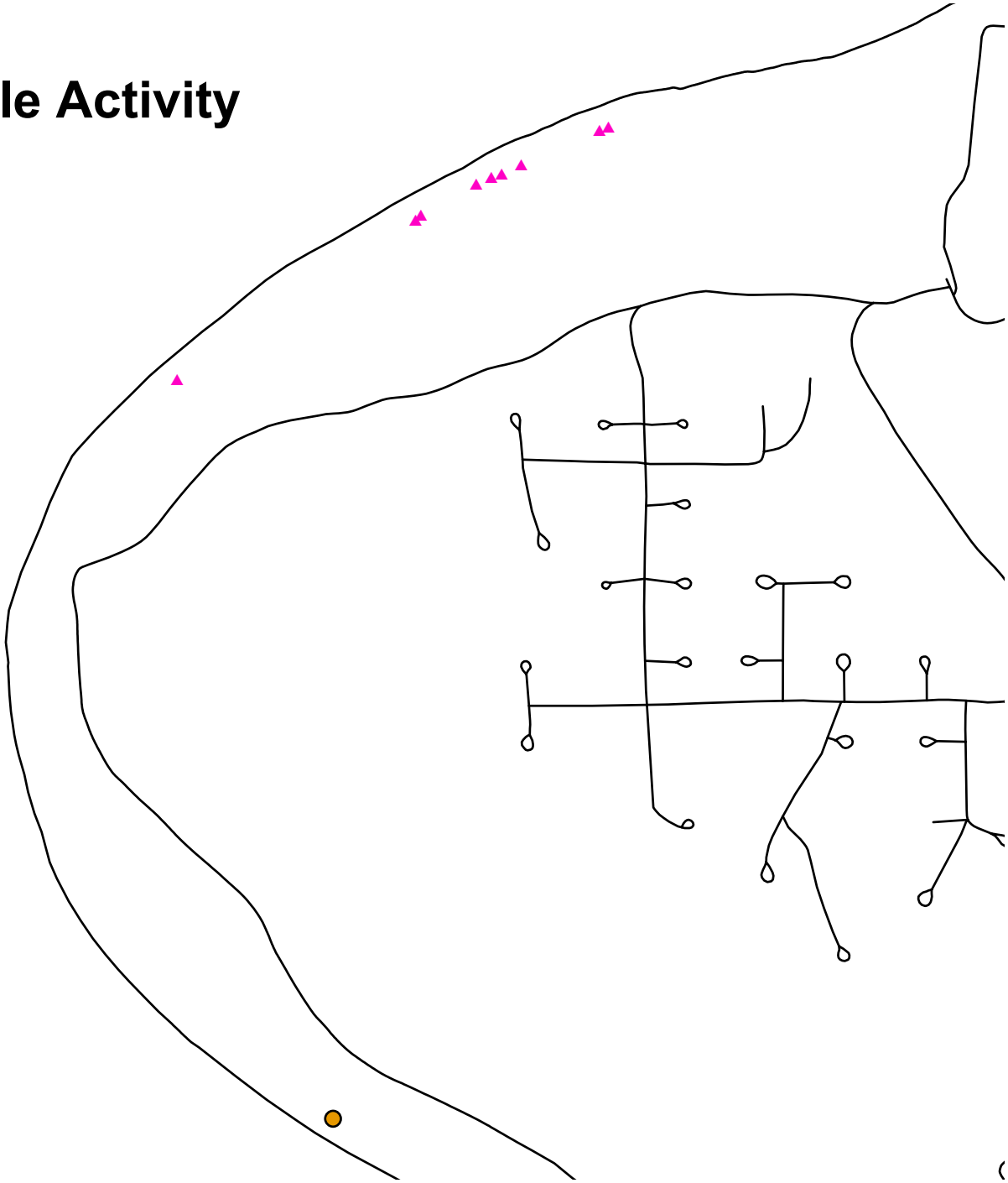


Figure 7. Key Map
Prepared by EV3, Natural Resources Branch, NAVFAC Pacific
September 2005
UTM, Zone: 43S, Datum WGS84

Sea Turtle Activity Observed On Diego Garcia (March 2004)

A: Turtle Activity



Turtle Activity

- Potential Nest
- Body Pit
- Crawl
- Egg Chamber

0 87.5 175 350 Meters

N W E S

Figure 8. Turtle Activity, A
Prepared by EV3, Natural Resources Branch, NAVFAC Pacific
September 2005
UTM, Zone: 43S, Datum WGS84

Sea Turtle Activity Observed On Diego Garcia (March 2004)

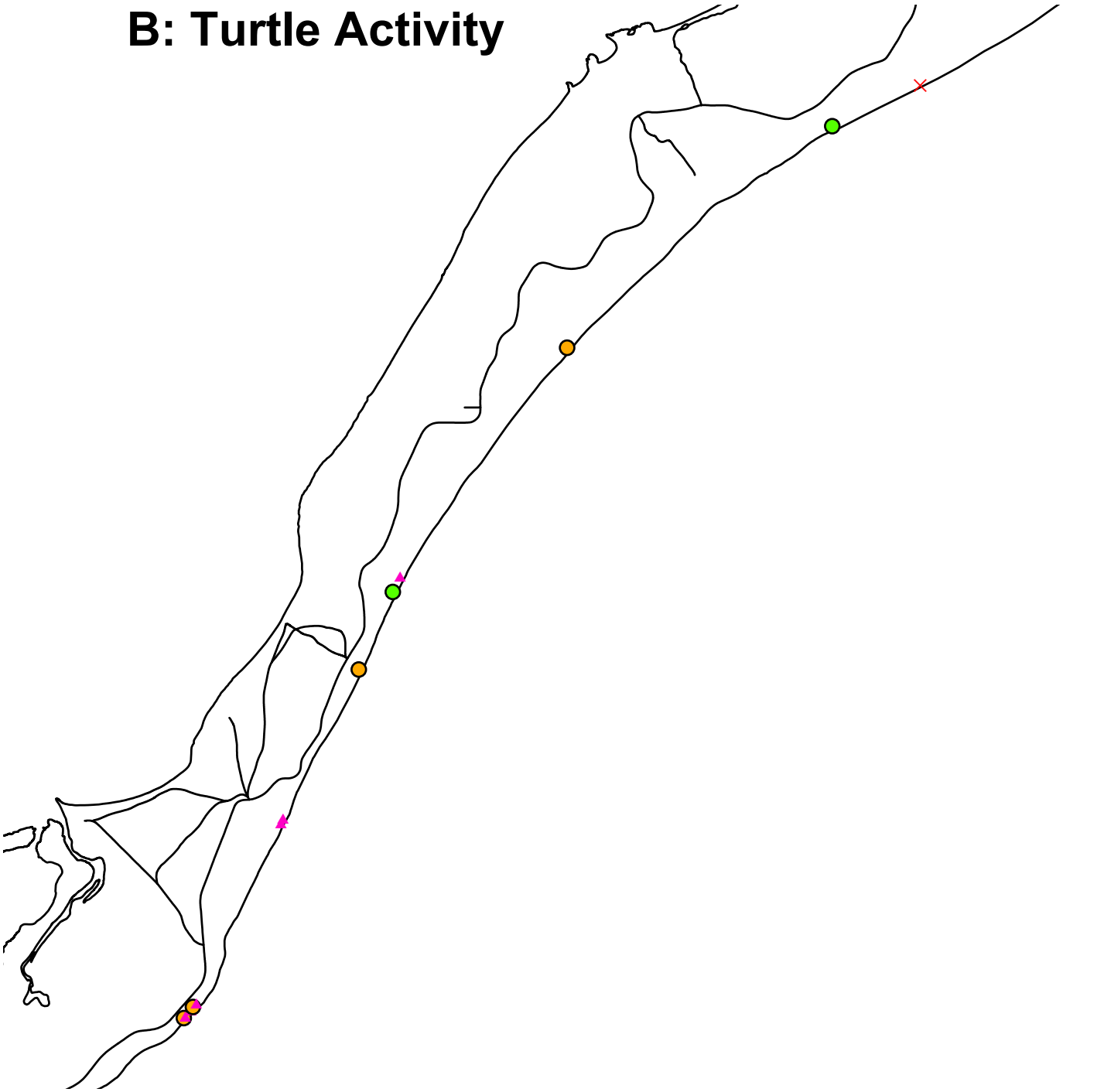


Figure 9. Turtle Activity, B
Prepared by EV3, Natural Resources Branch, NAVFAC Pacific
September 2005
UTM, Zone: 43S, Datum WGS84

Turtle Activity

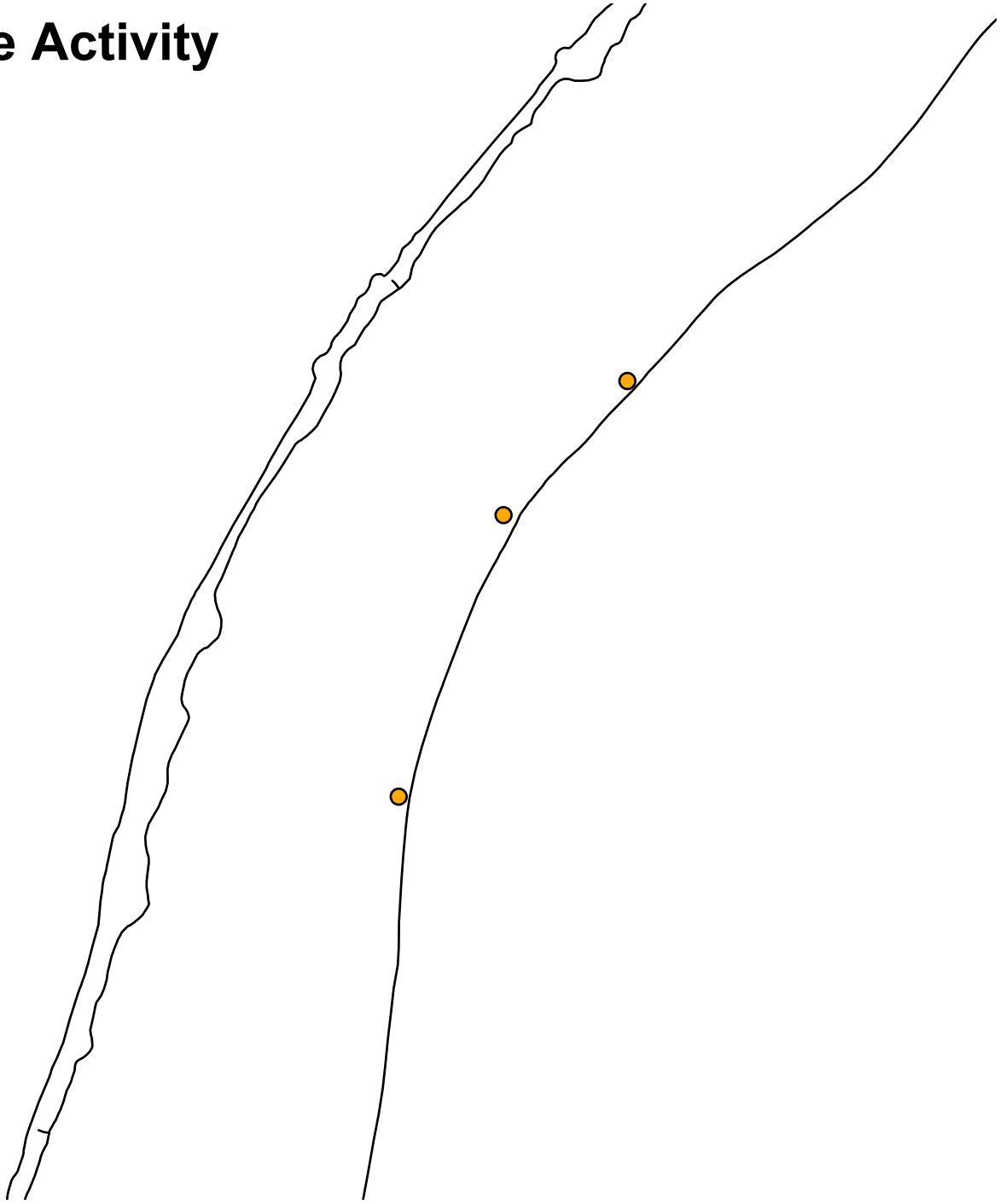
- **Potential Nest**
- **Body Pit**
- **Crawl**
- **Egg Chamber**

0 340 680 1,360 Meters

N
W E
S

Sea Turtle Activity Observed On Diego Garcia (March 2004)

C: Turtle Activity



Turtle Activity

- Potential Nest
- Body Pit
- Crawl
- Egg Chamber

0 145 290 580 Meters

N W E S

Figure 10. Turtle Activity, C
Prepared by EV3, Natural Resources Branch, NAVFAC Pacific
September 2005
UTM, Zone: 43S, Datum WGS84