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# Rapid Assessment Report

Dugong distribution and Fishing pressure in the  
Bazaruto Archipelago  
June – July 2013



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## Table of Contents

INTRODUCTION	P3
EXECUTIVE SUMMARY	P5
1. Study Area	P5
2. Methodology	P5
3. Observations	
3.1 Dugong distribution	P8
3.2 Fishing pressure	P16
3.3 Threat identification	P17
4. Recommendations	P18
ACKNOWLEDGEMENTS	P20
REFERENCES	P21

## List of Figures

Figure 1. Rapid Assessment Study Site showing search effort.	P6
Figure 2. Frequency of Dugong group/herd sizes.	P7
Figure 3. Combined Dugong sightings from 23, 24, 29, & 30 June, and 15 & 16 July.	P8
Figure 4. Dugong sightings per day of Assessment.	P9
Figure 5. Northern cluster in the Nova Mabone region.	P10
Figure 6. Central Clusters to the north and south of Isla Santa Carolina.	P11
Figure 7. Southern Cluster to the west of Isla de Benguerra.	P12
Figure 8. Mother-calf pairs in the Nova Mabone region.	P13
Figure 9. Mother-calf pairs to the north and south of Isla de Santa Carolina.	P14
Figure 10. Distribution of Fisheries.	P15
Figure 11. Fishing pressure and threat identification.	P16
Figure 12. Gill net distribution and threat identification.	P17
Figure 13. Proposed Gill net free Zone	P19

## List of Tables

Table 1. Search effort.	P7
Table 2. Search effort and observations.	P7
Table 3. Proportion of calves to adults.	P12

## INTRODUCTION

Throughout most of their global range, Dugong populations have diminished by at least 20% in the last century (Marsh *et al.* 2002), and recent evidence put forward by the Convention on Migratory Species (October 2010) suggests that Dugongs face the risk of extinction within the next 40 years. The IUCN Red List Conservation Status of Dugongs is uneven across the species' range, with the East African population categorized as Endangered (Second Signatory State Meeting of the *MoU on the Conservation and Management of Dugongs and their Habitats throughout their Range, 2013*). A Situational Analysis prepared by the Endangered Wildlife Trust (Allen 2011), supported by several aerial survey findings (Provancha & Stolen 2008, Cockcroft *et al.* 2008, Findlay *et al.* 2011), population assessments (WWF 2004, Marsh *et al.* 2002), and expert input (Attwell 2009.a) indicates that the east African coastline supports a regionally significant Dugong population in Mozambique, located within and bordering the Bazaruto Archipelago National Park.

Based on the available data and deficiency of mortality reports, population estimates for Dugongs in the Bazaruto Archipelago are difficult to reach (Attwell 2009.a). Evaluating abundance without information on the population's dynamics is unfeasible, and no trend in abundance can be deduced from available data (Cockcroft *et al.* 2008). However, based on a number of aerial survey findings (Cockcroft *et al.* 2008, Provancha and Stolen 2008), delegates of the International Dugong Workshop held in Maputo (2009) considered various approaches to the release of an "official" estimate for the Bazaruto population, including "between 200 and 250 individuals", or "between two and three hundred", or "in the low hundreds". The most recent aerial surveys performed in 2008 suggest an abundance estimate of 247 (Standard Error of 34,09) Dugongs in the Bazaruto region (Findlay *et al.* 2011). Survey data and symposia have conceded that this population represents the last viable Dugong population within the entire Western Indian Ocean region (Cockcroft *et al.* 2008, Second Signatory State Meeting of the *MoU on the Conservation and Management of Dugongs and their Habitats throughout their Range, 2013*).

Dugong life history parameters, habitat requirements, and complete dependence on seagrasses, makes the species particularly vulnerable to anthropogenic disturbances that influence their population growth and forage availability. Populations worldwide have suffered overexploitation primarily due to direct and also incidental capture, and habitat loss (Marsh *et al.* 2002). Population simulations indicate that, even under conditions of low natural mortality, and no human-induced mortality; a Dugong population is unlikely to increase more than 5% per year (Marsh 1995.a, 1999). A sustainable level of human-induced mortality has been estimated at only 1-2% of females of a population (Preen 1998).

A Population Viability Analysis performed on the Bazaruto Dugongs by Cockcroft *et al.* (2008) concludes that regular deaths caused by anthropogenic sources, are the major cause of population decline. Furthermore, findings by Muaves (2009) indicate that gill nets used by commercial fishing operators from Vilanculos and Inhassoro are predominantly responsible for Dugong entanglement, and mortality. In order of priority, threats to Dugongs have been identified as bycatch and habitat loss, and are both attributed to the absence of effective law enforcement (Attwell 2009.a, Allen 2011) and minimal integration of environmental management, co-ordination, and co-operation at National Level (Attwell 2009.a).

Findings of the *Situational Analysis for Dugong Conservation in the Bazaruto Archipelago* (Allen, 2011) and recommendations from the International Dugong Workshop led The Endangered Wildlife Trust to develop a conservation strategy that prioritised mitigating threats to Bazaruto's Dugong Population. The strategy is applied through the Dugong Emergency Protection Project, and aligns with the *Conservation and Management Plan for the Memorandum of Understanding on the Conservation and Management of Dugongs and their habitats throughout their range*. The Dugong Emergency Protection Project (DEPP) is formally associated with the Parque Nacional do Archipélago do Bazaruto through a Support Partnership Agreement that facilitates the application of enhanced law enforcement to strengthen Dugong conservation in the Bazaruto Archipelago.

The objectives of the Dugong EPP are:

- i. To facilitate enhanced law enforcement within the Bazaruto Archipelago National Park by identifying resource, training, and capacity requirements, and providing these where necessary and to the best of EWT's ability.
- ii. To develop a marine-themed local environmental education curriculum, and host teacher-training workshops to facilitate the effective delivery of lesson plans.
- iii. To identify and implement where feasible, a range of sustainable alternative livelihood opportunities for resident fishing communities in order to reduce dependence on marine resources, maintain the BANP as a prime tourism resource for Mozambique, and stimulate the local economy.
- iv. To raise the public profile of Dugongs so these become Bazaruto's flagship species.

In association with (i) above, the application of a revised law enforcement strategy and the provision of two new and fuelled marine patrol boats complete with VHF radio communication system (linked to 5 base stations at each of the Park's outposts) has allowed the PNAP to enhance their law enforcement effectiveness, and achieve the following results from April to July 2013:

- A total of 78 marine patrols, recording and reacting to 183 infringements.
- Confiscation of 1,557 items of illegal fishing equipment.
- Seizure of 442kg of illegally harvested marine resources.
- Location and removal of 5 gill nets.

Throughout 2013 and until June 2014, The EWT will continue mapping gill net occurrence and Dugong distribution by way of aerial surveillance and monitoring at an average of 15 – 20 hours of flying per month in order to develop a seasonal spatial representation of Dugong distribution and threats to Dugongs. Simultaneously and in partnership with the PNAB, The EWT will sustain the facilitation of enhanced marine Law Enforcement activities in order to remove gill nets from the Park and its surrounds. The aerial surveillance and monitoring flights serve not only to record Dugong distribution and the occurrence of fishing pressure, but also direct the marine patrol teams to the location of illegal fishing activities within the Park through radio communication and GPS support.

## EXECUTIVE SUMMARY

The *Rapid Assessment of Dugong distribution and fishing pressure in the Bazaruto Archipelago* was administered by the EWT's Dugong Emergency Protection Project (Dugong EPP) during June and July of 2013 on behalf of WWF, Mozambique. Through funding dispensed by WWF, a total of 16 hours of aerial surveillance and monitoring were performed, and co-funding provided by Save our Species (SOS) supplemented another 9 hours of aerial surveillance and monitoring.

The objectives of the Rapid Assessment were to generate a technical report presenting the spatial distribution of Dugongs and turtles within and outside the Parque Nacional do Archipelago do Bazaruto (PNAB), and document the distribution of fishing pressure in these locations. The spatial layers of gill net fishing pressure and Dugong distribution were integrated to present the location of potential threats posed to Dugongs. No population estimates, analyses or modelling of population numbers are put forward in this Assessment. Only numbers of recorded Dugongs are presented based on observations.

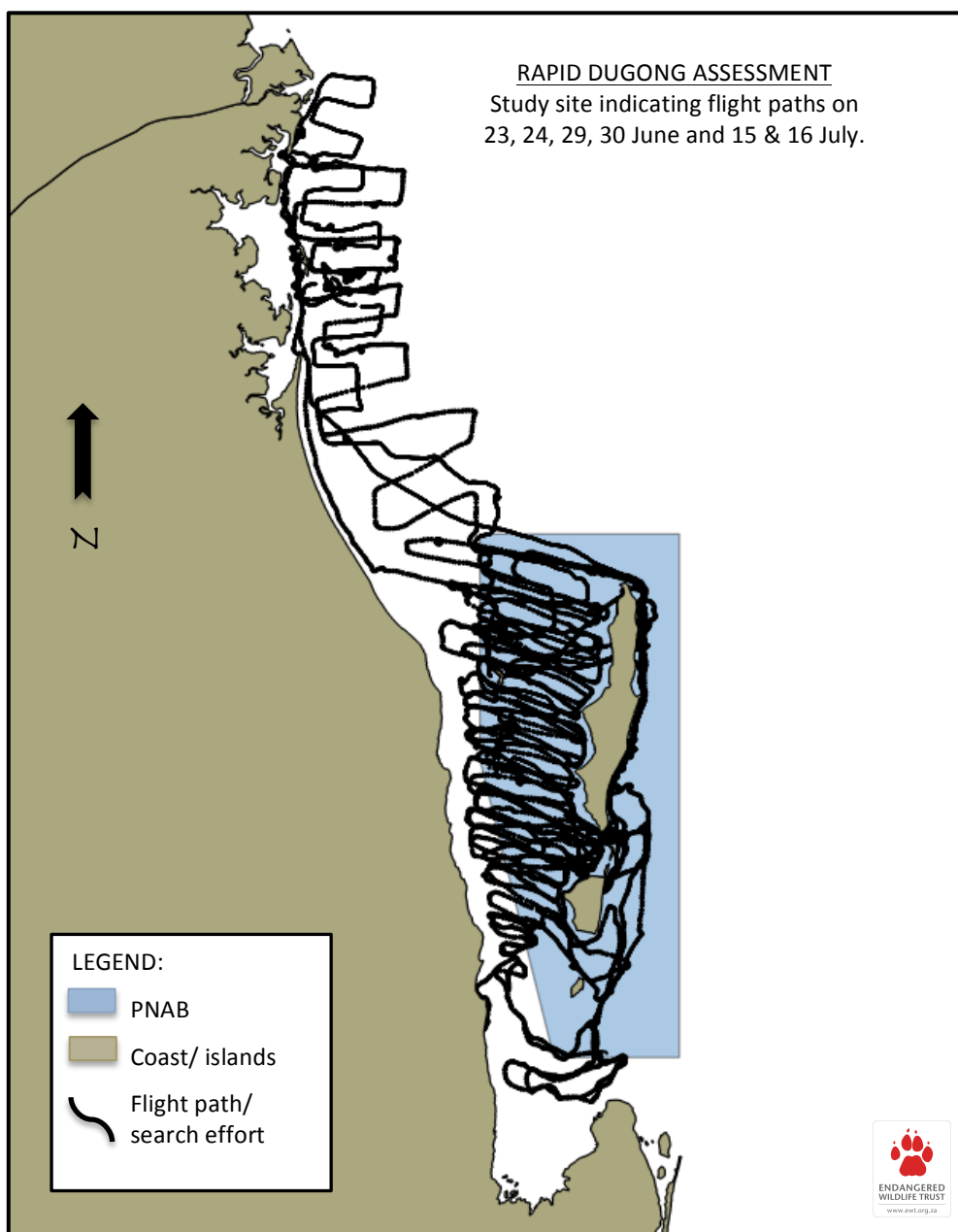
### 1. Study Area

The area of coverage included in the Rapid Assessment incorporated the Marine Protected Area of the Parque Nacional do Archipelago do Bazaruto, and the marine zone bordering the north of the Park to Bartolomeu Dias, the Nova Mabone - Nyamabwe, and Rio Save regions (Figure 1). The Assessment's southernmost search effort extended to Bangué Island within the PNAB boundary.

The Assessment concentrated on regions of known Dugong occurrence based on previous surveys, observations during random flights performed in 2012, primary channels at low tide, and regions of high seagrass cover. The search effort was minimal on the eastern shores of the islands, in areas of high wave action and low bathymetry, and extended no further than 20 nautical miles from the coast.

### 2. Methodology

Dugong distribution in the Greater Bazaruto Archipelago was investigated using aerial surveillance. The Assessment observation flights were performed in a Bat Hawk Ultra-light aircraft. The aircraft was outfitted with customary communication headsets and a standard navigational GPS system. Owing to the Bat Hawk's configuration, the number of observers is limited to one person only, and the endurance is limited to 4 hours. The Assessment was flown at an average speed of 104 Km per hour, while altitude varied between 300 and 700ft depending on visibility conditions. Three observers were used for the duration of the full Assessment, and their observations were recorded on a 10-inch tablet using The WildlifeSurvey Application (Potgieter, 2012). The pilot, as well as each member of the survey team were practiced in distinguishing Dugongs from similarly-sized marine mammals, and observer training was performed prior to the Assessment to increase familiarity with The WildlifeSurvey Application and aircraft elements and safety. Data from the training flights were not included in the Assessment. Observation flights were deemed ineffectual and thus cancelled when winds greater than 15 knots prevailed.



**Figure 1.** Rapid Assessment Study Site showing search effort.

A total of 2,484km of unsystematic line transects were flown in a predominantly east-west formation, and unlike systematic transects, at varied grid spacing. Grid spacing within the boundary of the PNAB ranged between 0,67km and 2km, with an average of 2,17km, while grid spacing to the north of the park ranged from 1,41km to 7,02km, with an average of 3,37km. The objectives of using varied grid spacing were to promote observation flexibility, allow the pilot to divert to any fishing activities and Dugong sightings within his field of detection in order to verify Dugong numbers and to count calves as accurately as possible, and to navigate around sandbanks. A sum of 25 hours and 40 minutes were flown over six days (Table 1).

Data from the WildlifeSurvey Application were downloaded on completion of the flights as Microsoft Excel spreadsheets. These were converted into CSV text files and imported into Quantum GIS software. Flight paths and observations were developed into separate shapefiles and used to spatially present

the Assessment’s findings. While the Assessment focussed on the enumeration of Dugongs and gill nets, turtles and other fishing activities were also recorded.

Date	Distance (Km)	Time (Hours)
23/06/2013	480	5
24/06/2013	472	5
29/06/2013	336	3,30
30/06/2013	256	2,30
15/07/2013	576	5,30
16/07/2013	364	4,10
<b>Total</b>	<b>2,484 Km</b>	<b>25hours, 40mins</b>

**Table 1.** Search effort.

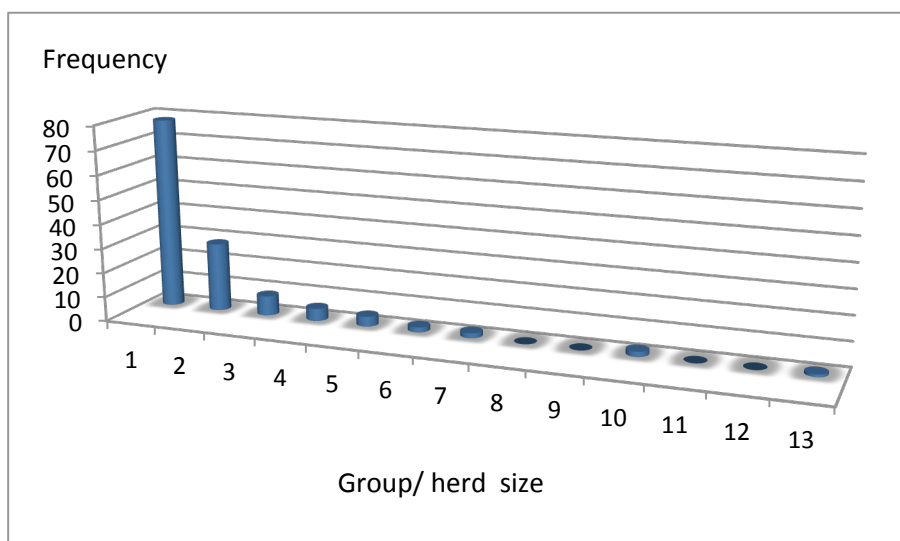
### 3. Observations

A total of 253 Dugongs, 570 turtles, and 10 gill nets were observed during the Assessment as follows (Table 2):

Date	Flight time (Hours)	Transect length (Km)	Dugong observations	Turtle observations	Gill net observations
23/06/2013	5	480	19	114	0
24/06/2013	5	472	49	136	0
29/06/2013	3,5	336	53	266	0
30/06/2013	2,5	256	3	54	0
15/07/2013	5,5	576	34	0	0
16/07/2013	4,1	363	95	0	10
		<b>2,483</b>	<b>253</b>	<b>570</b>	<b>10</b>

**Table 2:** Search effort and observations.

The largest Dugong herd observed numbered 13 animals, while 60% of sightings were of individuals and 21,5% were observed as paired Dugongs.



**Figure 2.** Frequency of Dugong group/herd sizes.

### 3.1 Dugong distribution

Dugong occurrence was recorded both within the PNAB and to the north of Inhassoro (Figure 3). The Assessment distinguished two recognisable Dugong assemblages; one within the PNAB boundaries, and another in the Nova Mabone - Nyamabwe region south of the Rio Save.

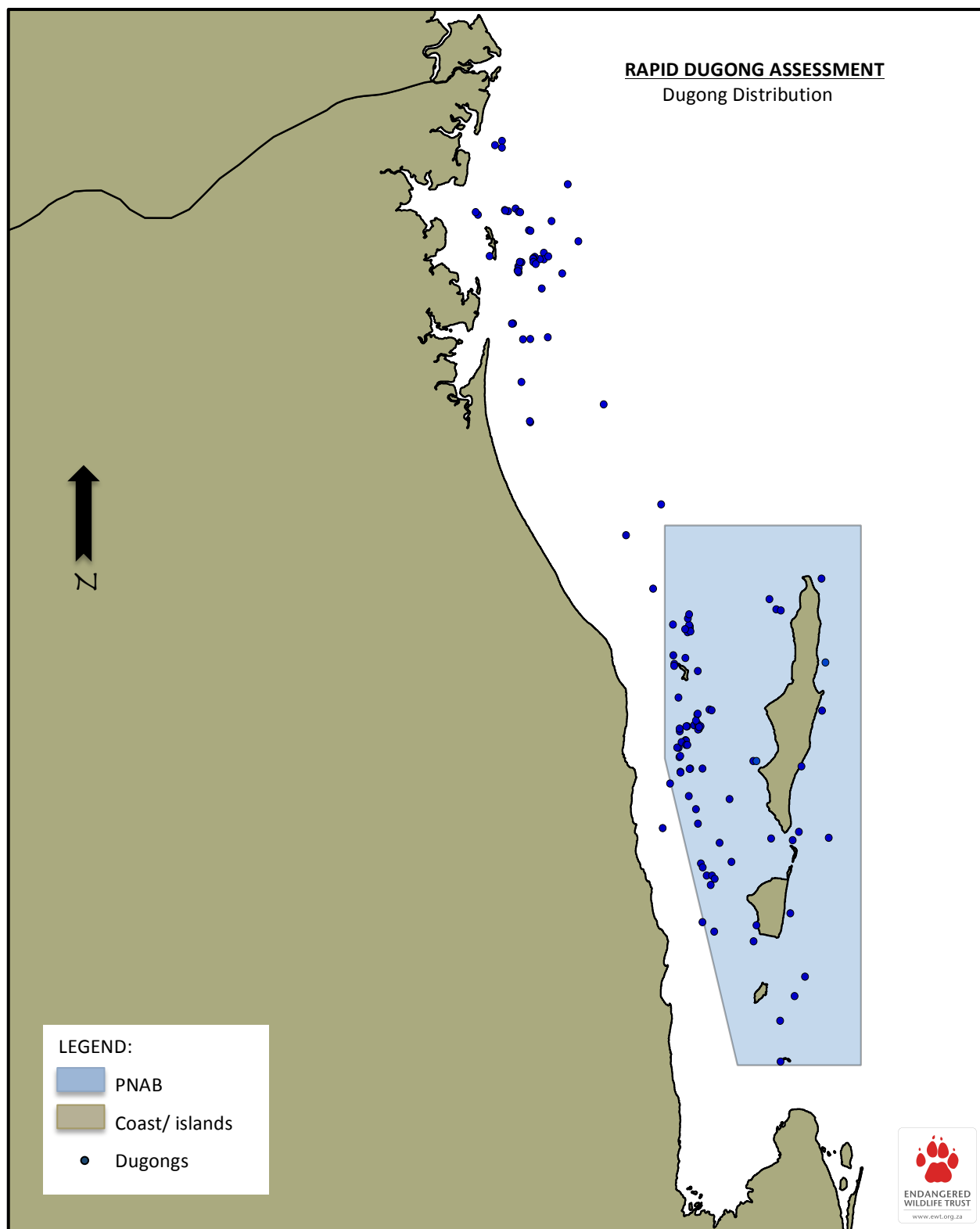
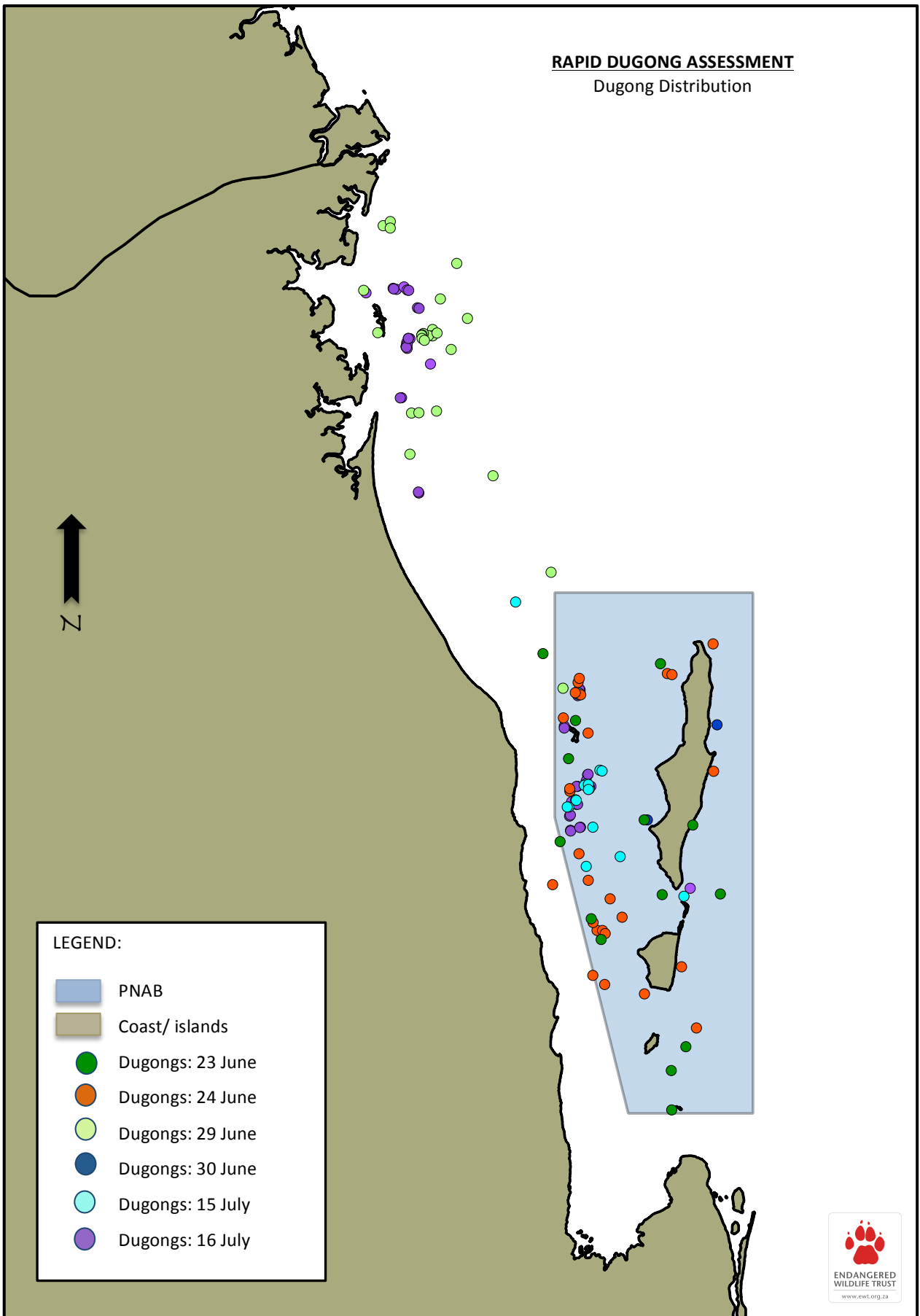


Figure 3. Combined Dugong sightings from 23, 24, 29, & 30 June, and 15 & 16 July.





**Figure 4.** Dugong sightings per day of Assessment.

Four distinguishable Dugong clusters were observed (Figures 5, 6, and 7), and it is assumed that three of these assemblages represent a high density of mother-calf pairs as indicated in Figures 8 and 9.

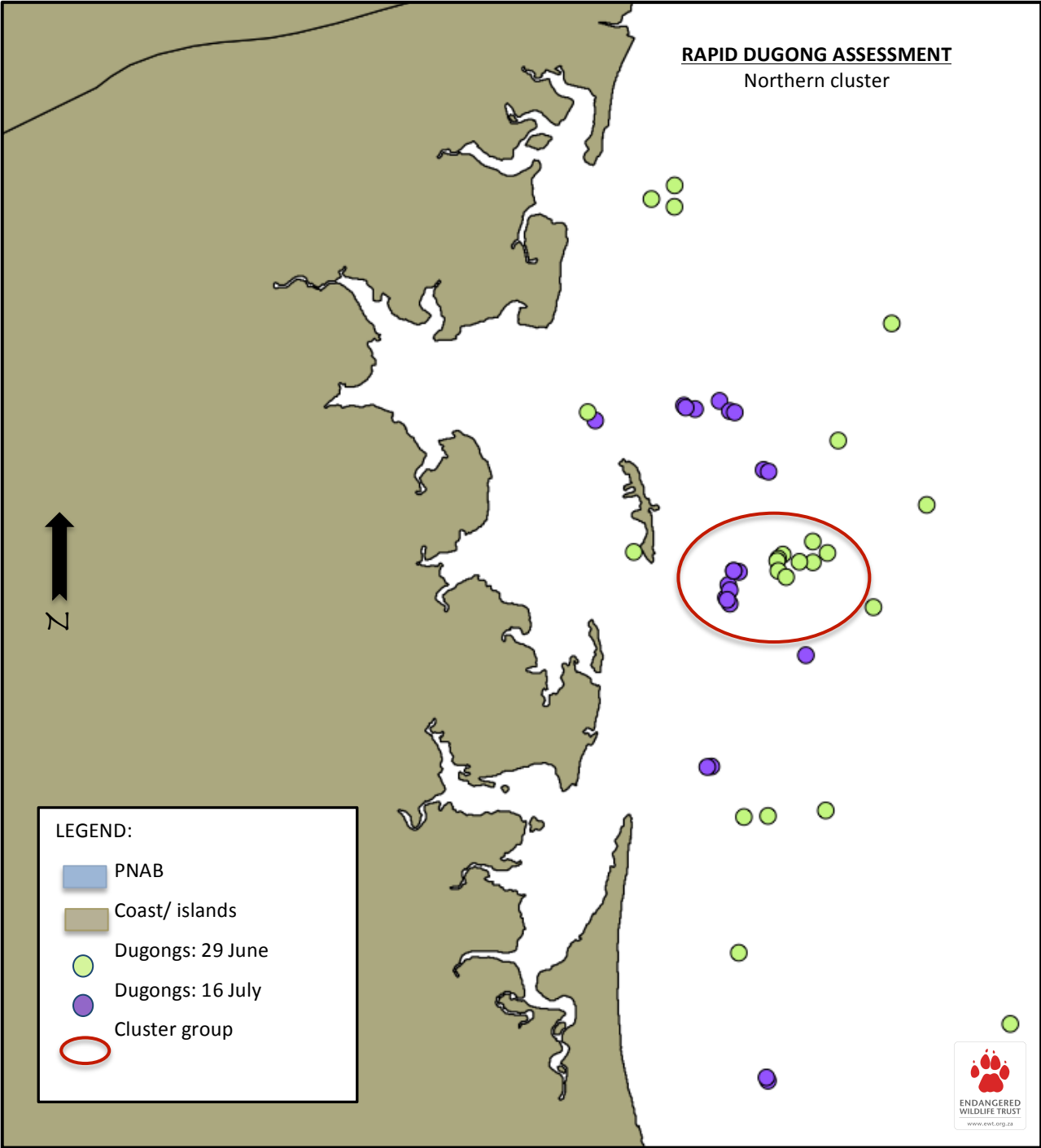
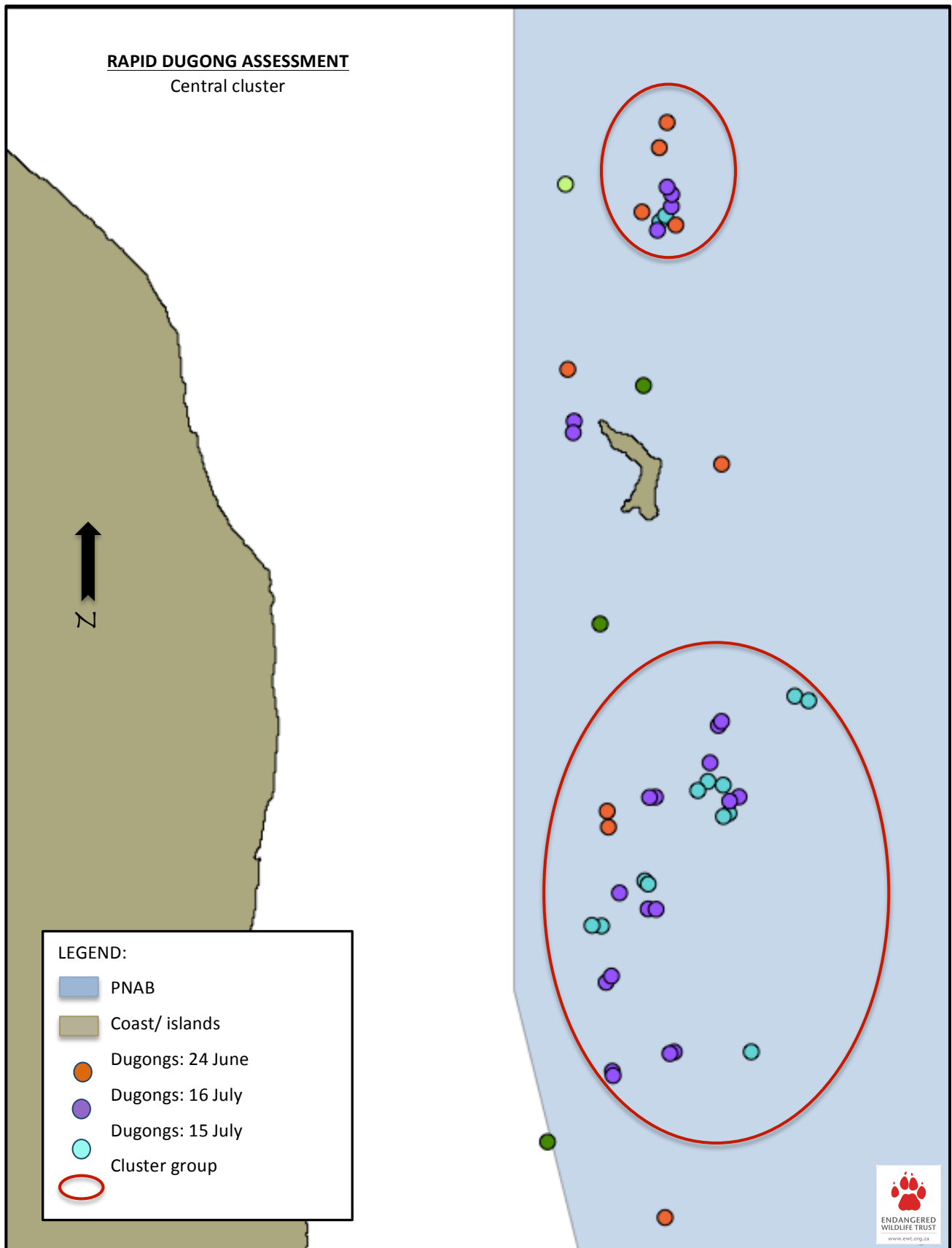
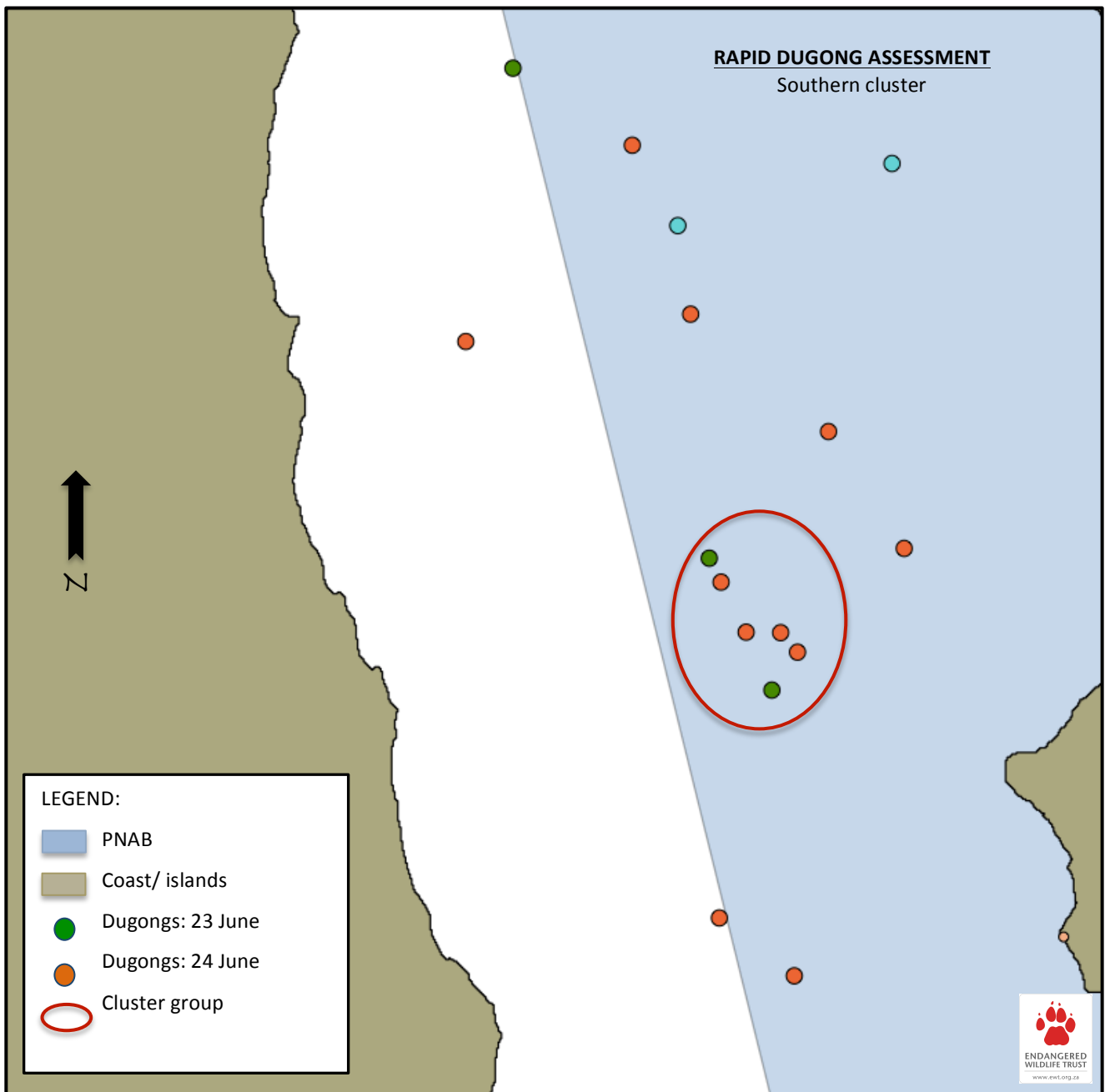


Figure 5. Northern cluster in the Nova Mabone - Nyamabwe region.



**Figure 6.** Central Clusters to the north and south of Isla Santa Carolina.



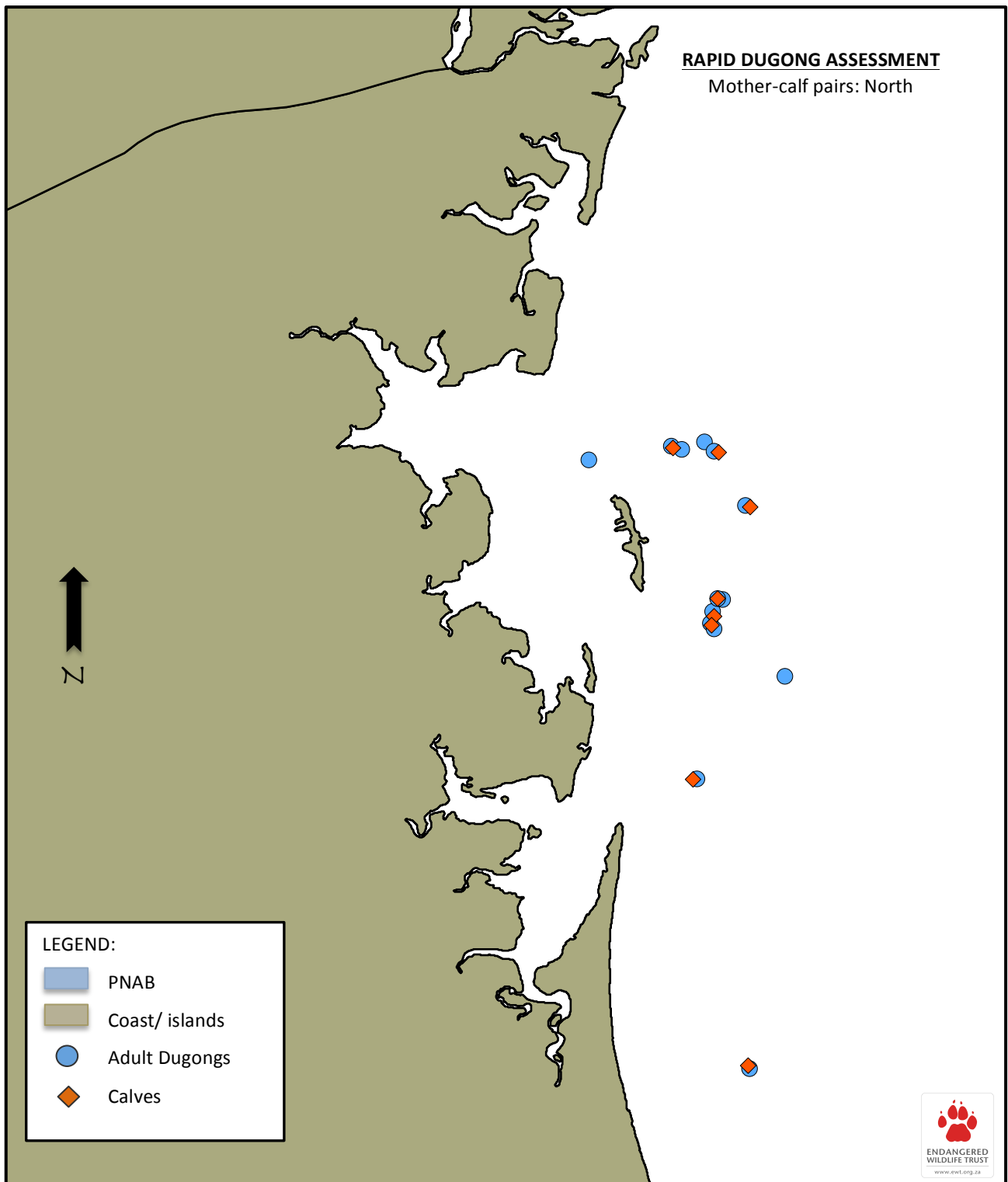
**Figure 7.** Southern Cluster to the west of Isla de Benguerra.

A total of 37 calves were observed (Table 3), and make up an overall proportion of 28% calves to the 216 recorded adults. 9 of 24 Dugongs observed on 15 July were calves, as were 28 of 67 on 16 July.

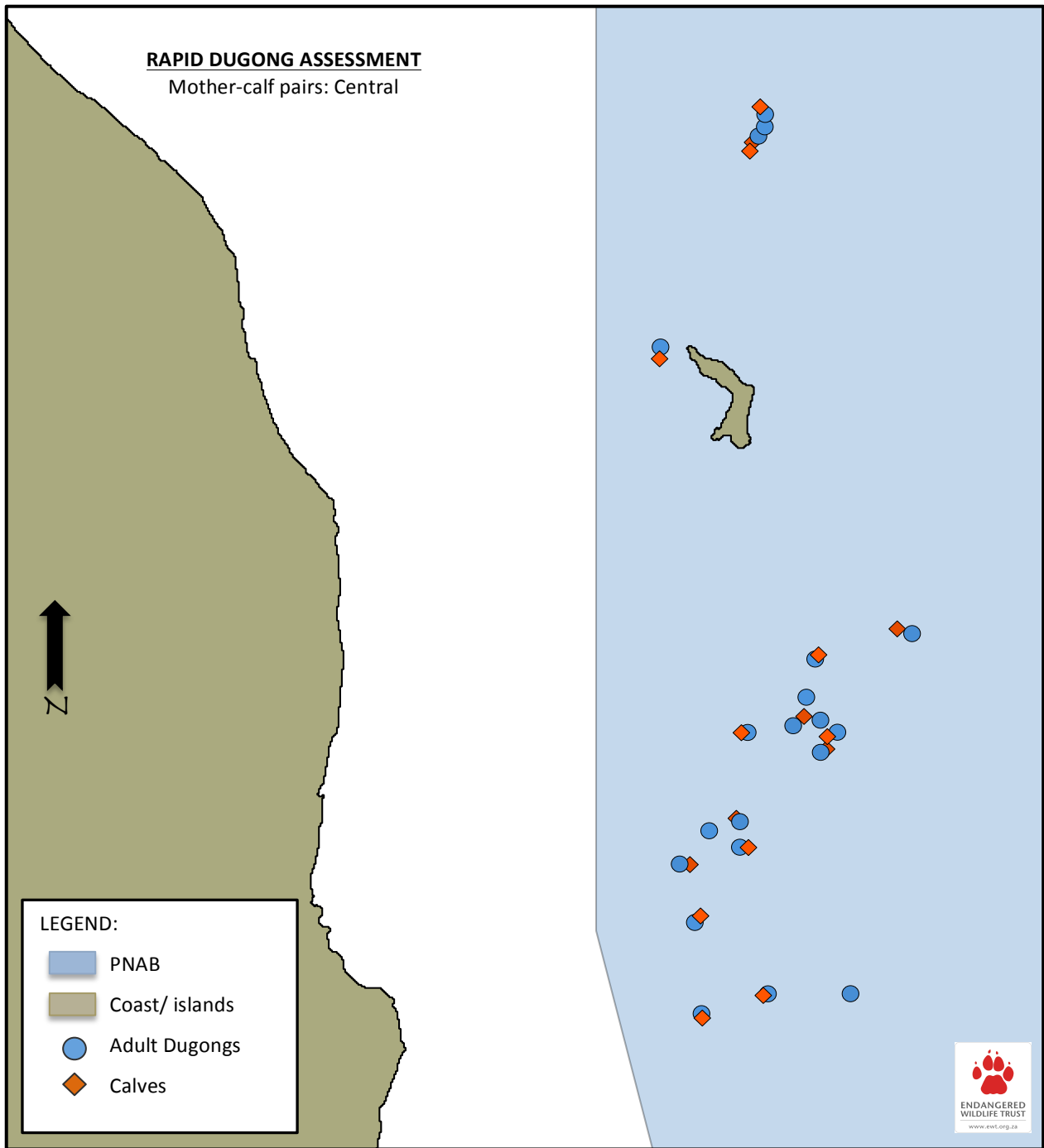
Date	Adults	Calves	Proportion of calves
15/07/2013	24	9	27%
16/07/2013	67	28	29%

**Table 3.** Proportion of calves to adults.

Mother-calf pairs were observed in the Nova Mabone - Nyamabwe region (Figure 8), and to the north and south of Isla de Santa Carolina (Figure 9).



**Figure 8.** Mother-calf pairs in the Nova Mabone region.



**Figure 9.** Mother-calf pairs to the north and south of Isla de Santa Carolina.

### 3.2 Fishing pressure

The distribution of fishing activities (Figure 10) demonstrates the use of five different harvesting methods within and to the north of the PNAB. The fisheries distribution was mapped on 15 and 16 July, and the search effort covered a flight path of 940 Km. 71% of recorded harvesting activity was hand line fishing, while both seine netting and gill netting represented 10% of recorded harvesting activity. Long line and spear fishing fisheries represented 2% and 1% of recorded harvesting activities respectively.

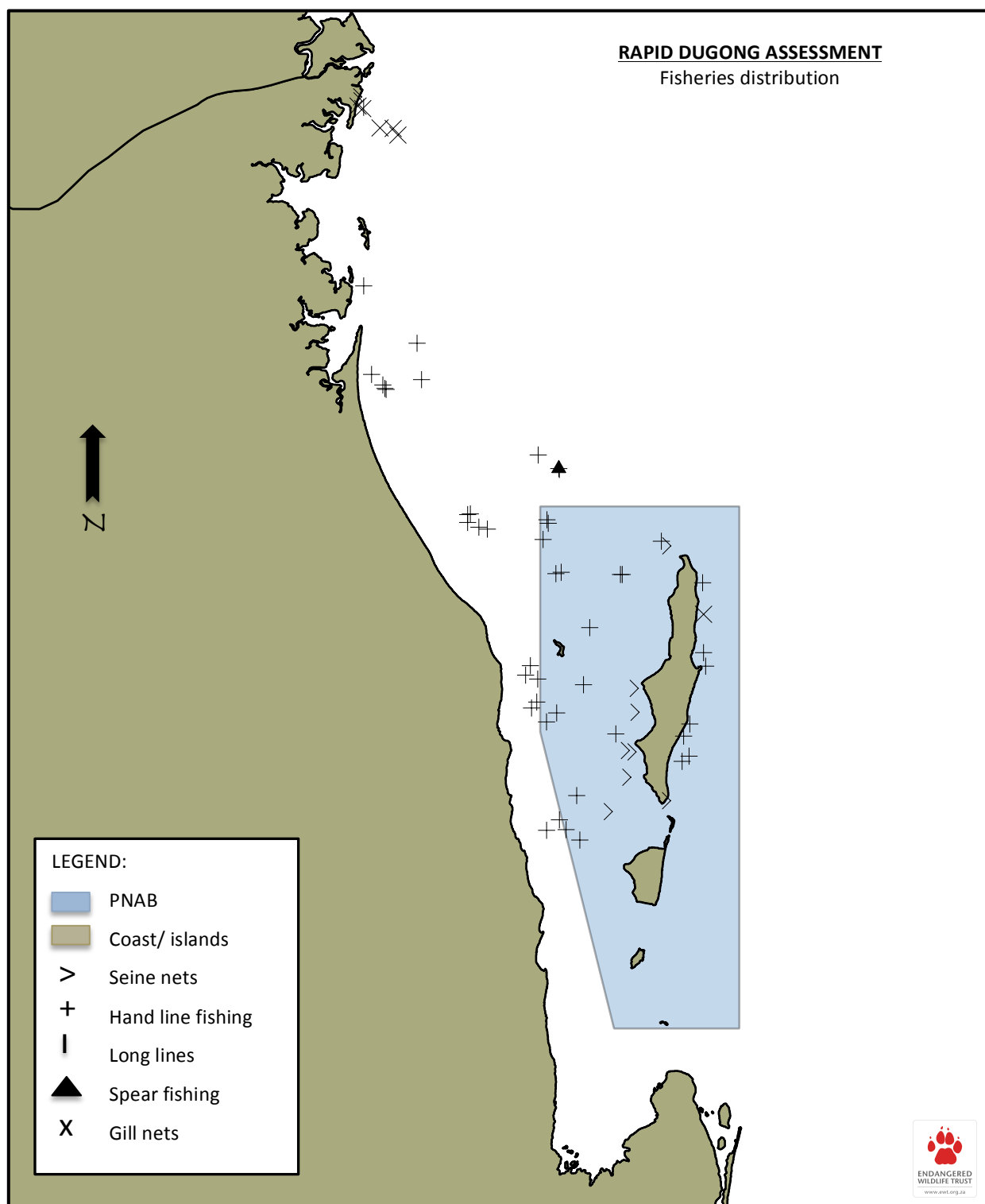


Figure 10. Distribution of fisheries.

### 3.3 Threat identification

The most significant threat to Bazaruto's Dugong population is the mainland-based gill net fishery; and the resultant mortalities caused by entanglement and drowning in the nets. Figure 11 presents a spatial representation of gill net distribution, mapped on 29 June and 16 July. Figure 12 demonstrates the proximity of gill nets to Dugongs, thus indicating a severe threat to the animals located in this region. Gill netting activity in the northern reaches of Nova Mabone and Nyamabwe, and south of the Rio Save poses extreme mortality risks for Dugongs.

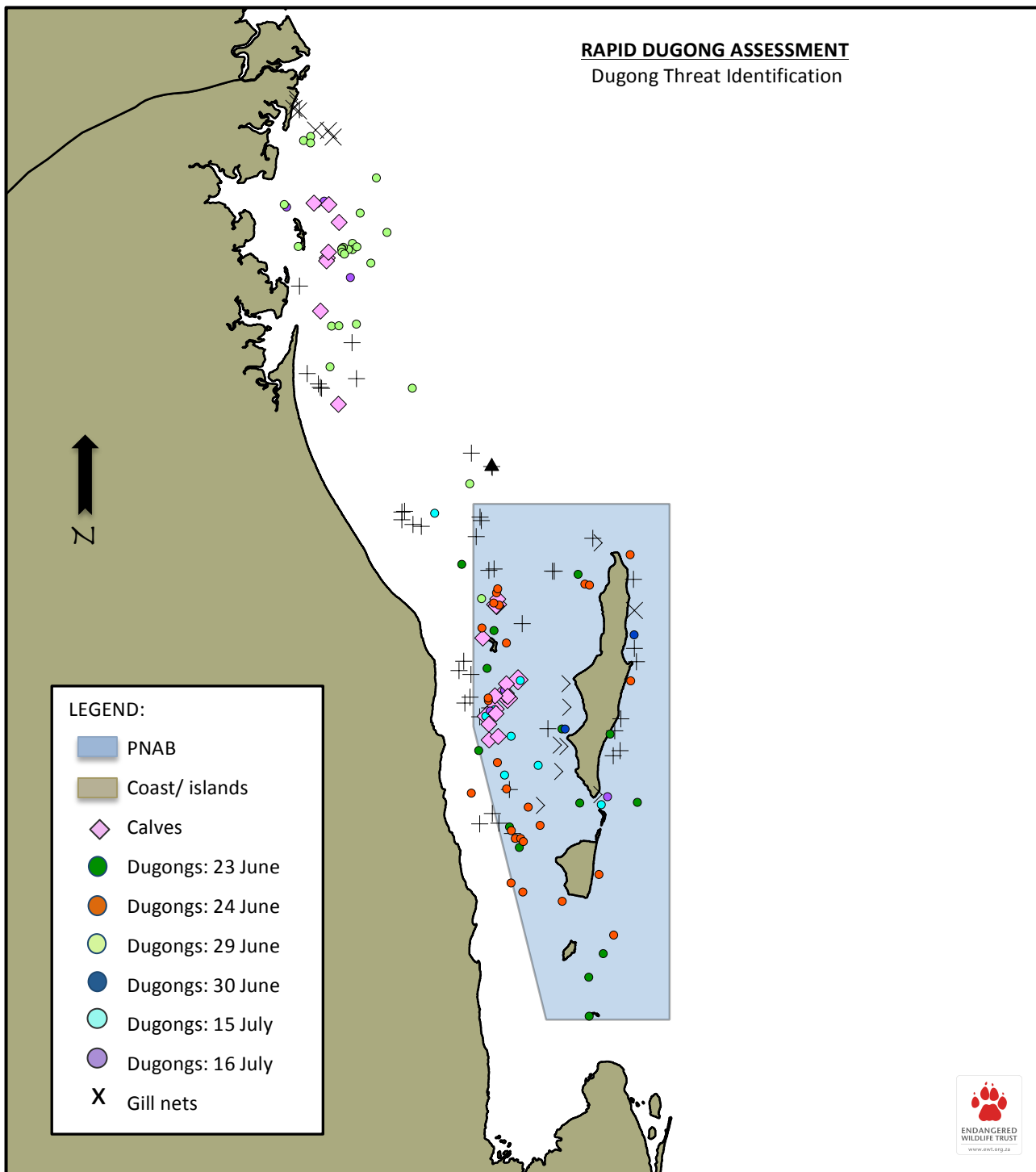
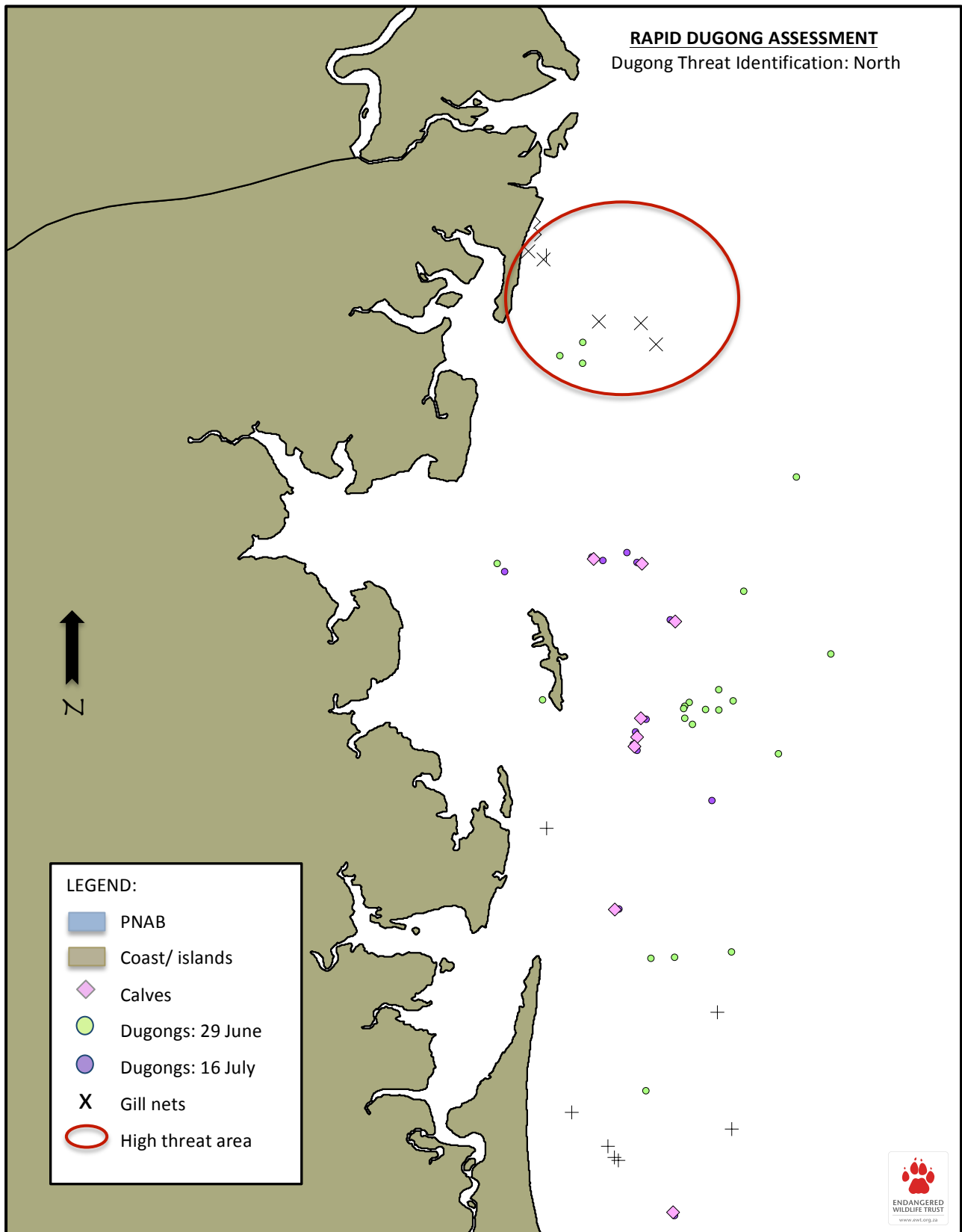


Figure 11. Fishing pressure and threat identification.





**Figure 12.** Gill net distribution and threat identification.

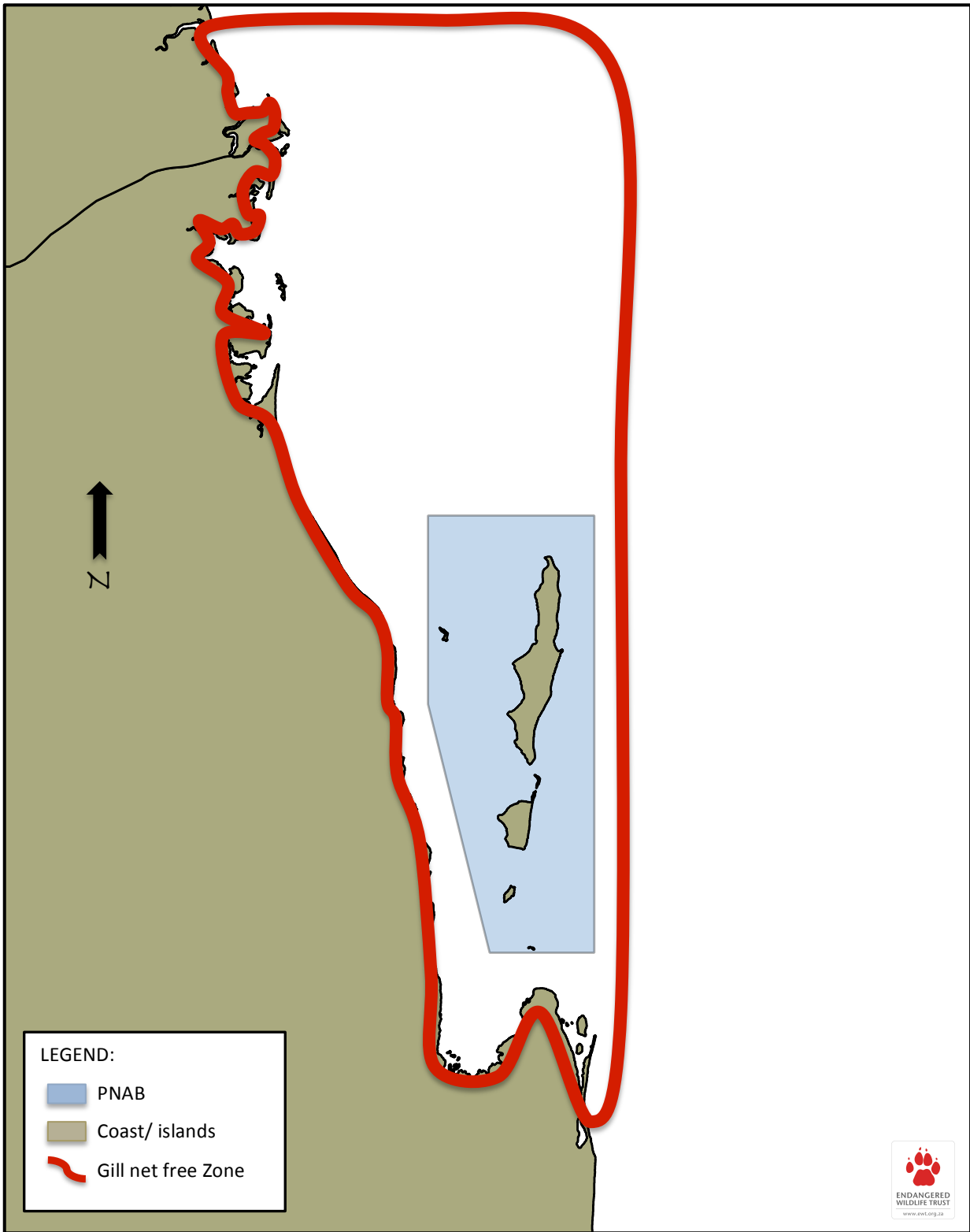
#### 4. Recommendations

Based on the Assessment's findings of Dugong distribution and gill net occurrence, and considering that the most significant threat to Bazaruto's Dugong population has been identified as bycatch-entanglement and drowning, the EWT suggests that- in line with its short term approach to enhance Dugong conservation; further threat hot-spots are identified through additional surveillance flights-most particularly in the Nova Mabone – Nyamabwe region. Following which, it is recommended that regional stakeholders including Municipal Government Administrators, the Small Scale Fisheries and Maritime representatives, and National Park's Authorities, meet to observe the issue of Gill net fishery effects on the Dugong population, and debate potential solutions and alternatives involving area closures or a transition to alternate fishing gear. The EWT recommends that consideration be given to a process of Gill net registration, followed by a fishing gear exchange, reinforced by a prohibition of gill net use from the Southern bay of Vilanculos to the Rio Save mouth (Figure 13).

Since the combined effect of applying a more effective and structured law enforcement strategy with Aerial surveillance and monitoring support have yielded positive results in terms of lowering illegal fishing activities and the use of gill nets within the PNAB, the EWT would suggest applying a similar intervention approach in the Nova Mabone – Nyamabwe region. In this regard, resources for a small, staffed outpost, including radio communication and a fuelled law enforcement vessel would be required. It is recommended that Law enforcement operations in this region are modelled on the system applied within PNAB, following a set of Standardized Operational Procedures.

Moreover, a more sustainable and long term approach to enhanced Dugong conservation, applied in unison with capacity building and enhanced law enforcement is recommended. To this effect, the EWT suggests the investigation of alternative livelihood opportunities for fishing communities. The first step in this process is to develop an understanding of the economic value of fisheries through a livelihood analysis. The results will allow practitioners to discern the economic significance of various types of fishing/ harvesting methods, and suggest alternative livelihood opportunities able to match or better these. EWT is conducting a livelihoods analysis on Benguerra and Bazaruto islands, and expects to evaluate the results by December 2013. It is recommended that the livelihoods analysis is replicated in the districts of Inhassoro and Nova Mabone – Nyamabwe, and a robust alternative livelihood investigation be conducted hereafter. Based on an extensive literature review, the EWT considers sea cucumber (*Holothuria*) culture as a feasible alternative livelihood opportunity. This has demonstrated significant success in Madagascar, confirming the potential to provide communities with a supplementary source of income and to decrease the economic incentive of fishing (Robinson and Pascal 2009). It is suggested that finance be sought to conduct a feasibility assessment of sea cucumber culture in the Nova Mabone – Nyamabwe region.

Awareness and education are also needed as drivers for long term conservation intervention, and should not be overlooked. The EWT has designed a set of interactive, marine-themed environmental education lesson plans, which are earmarked for integration into the Local schooling curriculum after applying a series of teacher-training workshops. Further finances are required to convene the training workshops and print the lesson plans.



**Figure 13.** Proposed Gill net free zone.

Additionally, further collaborative efforts between the NGO sector is advocated. It is recommended that regionally based Conservation Organisations undertake to align their programmes in order to strengthen the application of any Dugong conservation and awareness activities, and to avoid replication. The same principal is suggested for the engagement between Regional Conservation Groups and Task Force Units.

## **ACKNOWLEDGEMENTS:**

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