Aerial Census Survey of Marine Mammals and Sea Turtles within the Rovuma Concession Block and Parque Nacional Quirimbas, Mozambique

June 2007

Prepared for:

Anadarko Moçambique Area 1, LDA
Avenue de Zimbabwe - 1214
CP 2830, Mozambique

Prepared by:

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ACKNOWLEDGMENTS

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1.0 INTRODUCTION

CSA International, Inc. (CSA) was contracted by Anadarko Moçambique Área 1, Lda (AMA1) to conduct an aerial census survey of marine mammals and sea turtles within nearshore areas of the Rovuma Concession Block (RCB) and the adjacent Parque Nacional Quirimbas (PNQ), offshore northern Mozambique (**Figure 1**). The primary objective of the survey was to collect baseline information on the distributions and densities of marine mammal species, particularly the dugong (*Dugong dugon*), and sea turtle species within the two survey areas. The dugong is threatened worldwide and listed globally by the World Conservation Union (IUCN) as vulnerable to extinction (IUCN, 2006). Little information is available on the status of dugongs in the western Indian Ocean, particularly in nearshore waters off northern Mozambique (WWF Eastern African Marine Ecoregion, 2004). Data collected from this survey will be used to support the development of an Environmental Impact Assessment document for AMA1's proposed seismic survey of the RCB.

This report provides a description of field survey methods and a presentation of the results, including a chronology of events. Distributions and densities of marine mammals and turtles sighted during the survey also are presented and discussed.

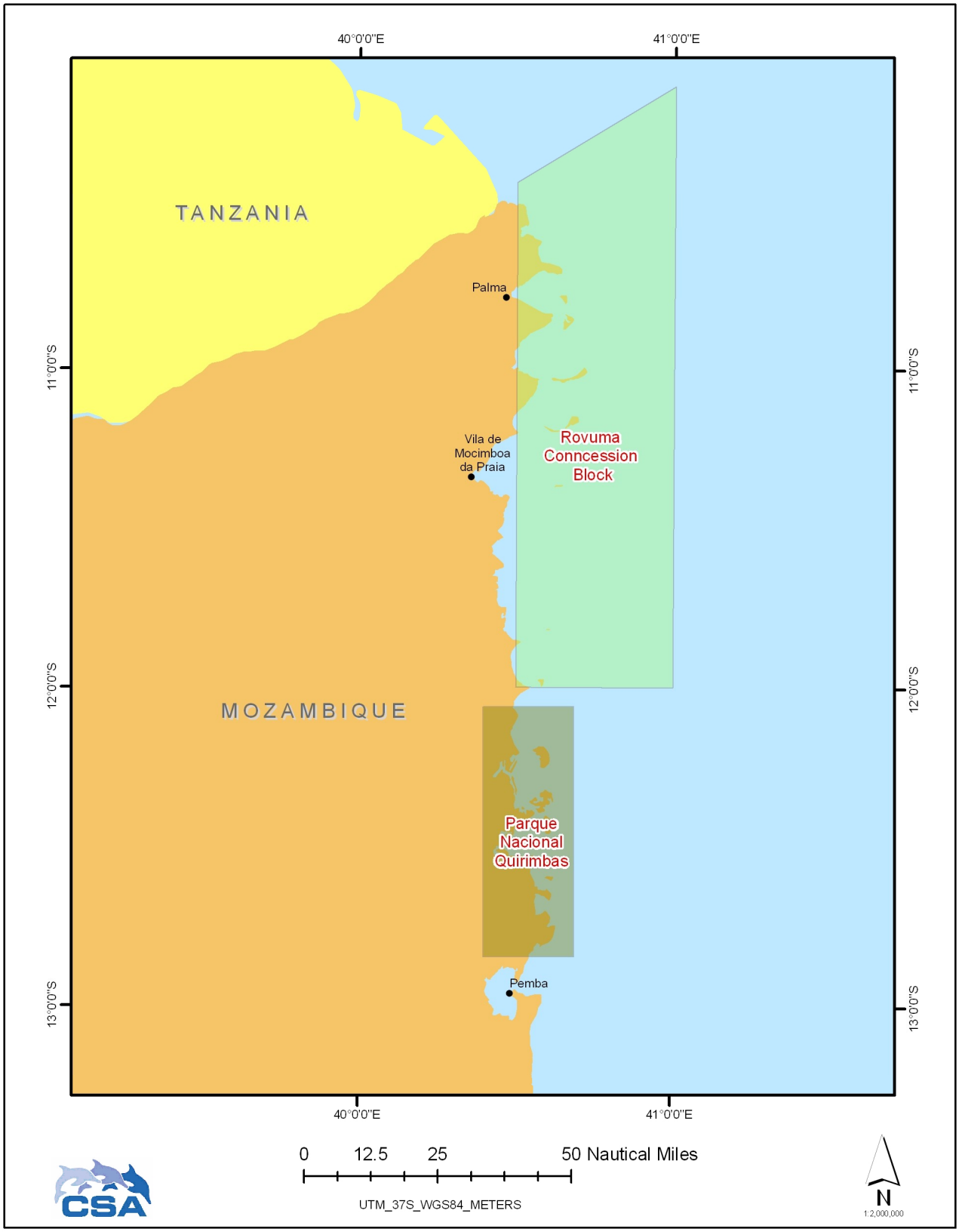

Figure 1. Northern Mozambique showing the relative positions of the Rovuma Concession Block and the Parque Nacional Quirimbas.

2.0 METHODS

2.1 SURVEY AREAS AND TRANSECT DESIGN

Two adjacent areas were surveyed: the inshore (western) component of the RCB and, at the request of PNQ management, nearshore waters of the PNQ. Survey transects were set up with 2-nmi line spacing in an east-west direction from 1) the southern boundary of the RCB survey area north to Transect 1**,** near the town of Palma (**Figure 2**), and 2) within the PNQ survey area (**Figure 3**). Transects within these two areas extended from the shoreline (defined as the high tide mark in areas of sandy or rocky shore, or the inshore [western] margin of mangrove habitat, when present) to the approximate position of the 200-m bathymetric contour. Because the northern Mozambique continental shelf from the town of Palma to the Rovuma River is relatively narrow, ranging from approximately 2 to 5 nmi in width from shore, two transects were set up (Transects 81 and 83) in parallel with the coastline from Transect 1 to the Rovuma River to avoid surveying a number of extremely short transects in an east-west direction through this area. Navigational coordinates for transect start and end points in the RCB and PNQ survey areas are presented in **Tables 1** and **2**, respectively.

After completion of the primary survey of the RCB and PNQ survey areas, a second, duplicative survey was conducted of two areas within the RCB survey area where historic anecdotal sightings of dugongs had been reported by local fishers (WWF Eastern African Marine Ecoregion, 2004). This secondary survey was conducted using 1-nmi transect spacing in an effort to maximize the chances of sighting dugongs within the RCB. The survey areas included a swath within the southern area of the RCB, a swath offshore the town of Moçimboa da Praia, and a southward transit over nearcoastal seagrass habitats. Coordinates for transect start and end points for the secondary RCB survey areas are presented in **Table 3** and shown in **Figure 4**.

2.2 FIELD METHODS

Standard line transect aerial survey methods for marine mammals and sea turtles, as developed by the U.S. Department of the Interior, National Oceanic and Atmospheric Administration (Blaylock, 1994), were used. These methods employ dedicated observers on both sides of a suitable survey aircraft who, along predetermined transects, scan a swath of sea surface that is limited only by the effective angle of view from the aircraft's window and by environmental factors such as sunlight glare, sea state conditions, and water visibility.

A single-engine Cessna 210 aircraft, provided by the Mission Aviation Fellowship (MAF), was used as the survey platform (**Photo 1**). This aircraft features a high wing (i.e., the wing is positioned above, or over the fuselage), the absence of wing struts, and retractable landing gear. These features provided excellent visibility from the aircraft for the survey observers.

Photo 1. Cessna 210 single-engine aircraft used during the aerial survey.

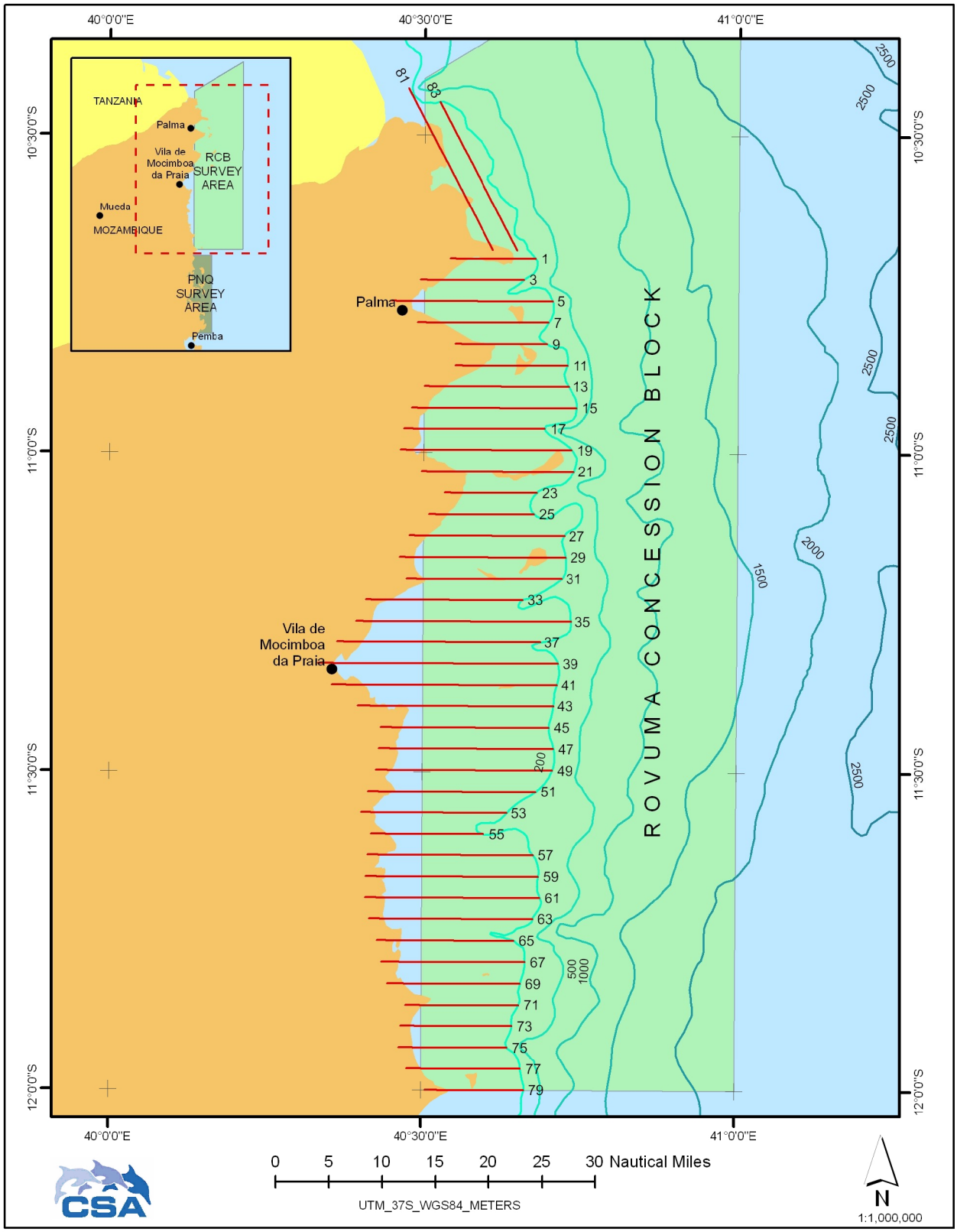

Figure 2. Rovuma Concession Block (RCB) survey area showing aerial survey transect layout.

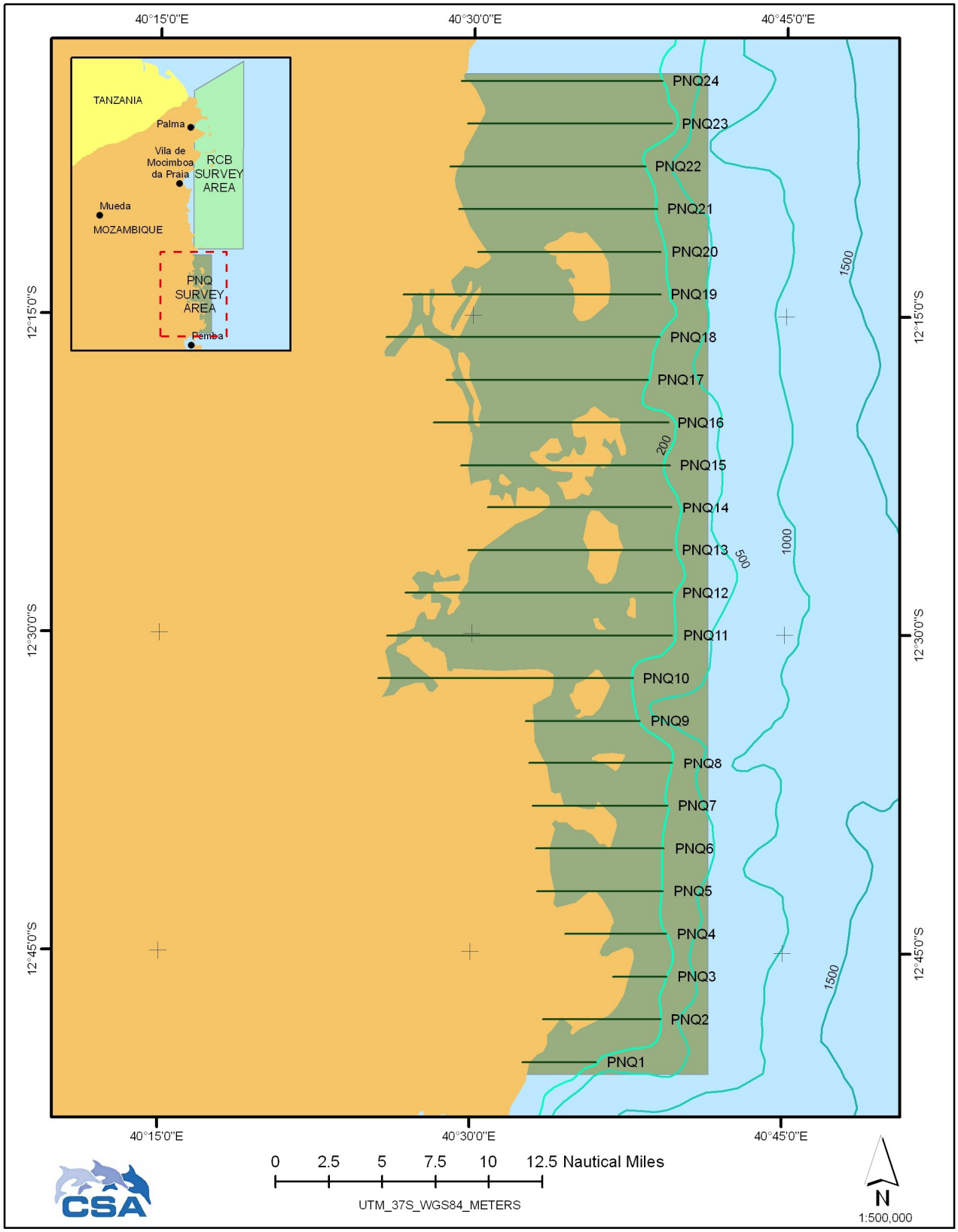

Figure 3. Parque Nacional Quirimbas (PNQ) survey area showing aerial survey transect layout.

Table 1. Aerial survey transect coordinates and lengths within the Rovuma Concession Block survey area. X,Y coordinates are UTM Zone 37, WGS84 in meters; latitude/longitude coordinates are WGS84 in decimal degrees.

Transect	Start Point				End Point				Distance (nmi)
	X	Y	Latitude (°S)	Longitude (°E)	X	Y	Latitude (°S)	Longitude (°E)	
79	667281.86	8672909.87	12.00063337	40.53651669	681264.16	8673097.82	11.99819999	40.66489996	7.78
77	681589.55	8676781.51	11.96488332	40.66768332	663427.15	8676625.70	11.96723336	40.50093338	10.13
75	661808.83	8679816.48	11.93846666	40.48591666	682460.43	8680299.65	11.93303336	40.67548332	11.51
73	682363.35	8684669.92	11.89353336	40.67435003	661432.28	8684086.38	11.89988333	40.48225005	11.68
71	662997.81	8687890.52	11.86541666	40.49643329	683050.10	8687739.31	11.86574999	40.68048331	11.15
69	683553.24	8691064.24	11.83566665	40.68491663	660071.61	8691510.25	11.83283335	40.46939997	13.10
67	659083.95	8695735.31	11.79468330	40.46013332	683833.80	8695120.63	11.79898336	40.68726668	13.78
65	684161.42	8699150.93	11.76253334	40.69004997	658511.61	8698846.49	11.76658329	40.45473332	14.27
63	655123.91	8702786.82	11.73111672	40.42346669	682575.15	8702759.39	11.72999997	40.67530001	15.32
61	684501.64	8706490.66	11.69616669	40.69276667	653487.14	8706434.10	11.69821668	40.40828333	17.26
59	652901.48	8710337.82	11.66295003	40.40273334	683614.91	8710157.61	11.66306662	40.68443333	17.10
57	683742.71	8713621.20	11.63175003	40.68541668	654258.00	8713811.58	11.63148336	40.41501666	16.40
55	654339.06	8717684.34	11.59646665	40.41558338	681537.44	8717553.91	11.59631672	40.66498337	15.14
53	679608.38	8720940.90	11.56580004	40.64711671	653762.17	8721213.77	11.56458329	40.41013338	14.41
51	655428.19	8724693.37	11.53304999	40.42525004	682870.81	8725153.22	11.52755004	40.67680000	15.28
49	684007.39	8728590.60	11.49641669	40.68703331	656024.97	8728440.04	11.49915000	40.43054997	15.61
47	657438.54	8732597.41	11.46150002	40.44331664	686307.20	8732185.19	11.46379997	40.70791663	16.08
45	658930.80	8736066.74	11.43006665	40.45683338	685746.26	8736056.62	11.42883334	40.70256668	14.93
43	686799.91	8739837.40	11.39459998	40.71201665	654559.42	8739528.36	11.39896668	40.41661668	17.94
41	649539.97	8743462.39	11.36361664	40.37044996	687177.27	8743360.36	11.36273332	40.71528336	20.99
39	687921.67	8747104.24	11.32885003	40.72190002	648288.77	8747024.19	11.33146666	40.35883335	22.05
37	653721.09	8750834.61	11.29678330	40.40843334	687805.49	8750855.05	11.29494998	40.72063337	18.97
35	688411.00	8754483.60	11.26211668	40.72598331	655721.79	8754428.85	11.26420003	40.42659996	18.20
33	657604.97	8758095.50	11.23096663	40.44368329	688381.09	8758066.11	11.22973335	40.72551665	17.13
31	689098.61	8761847.04	11.19551667	40.73188329	664634.24	8761804.39	11.19711668	40.50788331	13.61
29	662333.55	8765774.04	11.16133331	40.48663338	688698.08	8765571.83	11.16186669	40.72801668	14.67
27	688176.19	8769120.31	11.12981664	40.72305004	664333.30	8769198.37	11.13028331	40.50478330	13.28
25	667335.44	8773085.73	11.09500002	40.53208336	691422.69	8772836.68	11.09604996	40.75256666	13.40
23	690942.75	8776700.23	11.06115005	40.74796664	670110.48	8776596.17	11.06313334	40.55731662	11.60

Table 1. (Continued).

Transect	Start Point				End Point				Distance (nmi)
	X	Y	Latitude (°S)	Longitude (°E)	X	Y	Latitude (°S)	Longitude (°E)	
21	669729.82	8780436.38	11.02843335	40.55365003	690500.41	8780484.26	11.02696669	40.74371663	11.57
19	689872.45	8784014.90	10.99508336	40.73778333	664120.44	8783696.63	10.99921663	40.50216664	14.33
17	690983.63	8787776.98	10.96101667	40.74774997	663162.36	8787722.01	10.96286668	40.49321667	15.49
15	664294.44	8791552.65	10.92818331	40.50340002	690733.24	8791417.89	10.92811663	40.74526662	14.71
13	691041.74	8795302.61	10.89298333	40.74788333	667926.94	8795101.54	10.89593335	40.53646667	12.86
11	673857.00	8798789.37	10.86231664	40.59053337	689342.22	8798924.12	10.86033337	40.73214999	8.63
9	686618.20	8802584.42	10.82738334	40.70705002	677023.90	8802513.23	10.82850004	40.61931667	5.33
7	667173.02	8806426.19	10.79358330	40.52905004	685863.90	8806231.66	10.79444998	40.69996667	10.39
5	685366.83	8810284.87	10.75783329	40.69521662	662362.03	8809959.79	10.76185004	40.48490003	12.83
3	666262.42	8813559.41	10.72913331	40.52040000	683774.57	8813807.54	10.72606667	40.68048334	9.74
1	684168.83	8817227.12	10.69513335	40.68391668	678307.48	8817359.99	10.69421664	40.63033330	3.27

Table 2. Aerial survey transect coordinates and lengths within the Parque Nacional Quirimbas survey area. X,Y coordinates are UTM Zone 37, WGS84 in meters; latitude/longitude coordinates are WGS84 in decimal degrees.

Transect	Start Point				End Point				Distance (nmi)
	X	Y	Latitude (°S)	Longitude (°E)	X	Y	Latitude (°S)	Longitude (°E)	
PNQ1	667112.71	8579937.14	12.84109996	40.53990002	674763.54	8580769.88	12.83314997	40.61033334	4.30
PNQ2	679886.90	8584627.95	12.79798332	40.65730002	674916.19	8584065.66	12.80334999	40.61155002	2.80
PNQ3	676497.10	8588005.22	12.76765002	40.62588333	680760.21	8588175.45	12.76586666	40.66513331	2.38
PNQ4	680526.46	8591237.74	12.73820001	40.66279998	674786.18	8591391.90	12.73713336	40.60993331	3.22
PNQ5	670444.63	8595373.34	12.70138333	40.56973332	679757.01	8595472.42	12.69996669	40.65546665	5.18
PNQ6	680429.41	8599006.47	12.66798334	40.66145005	670301.03	8598886.56	12.66963331	40.56821669	5.64
PNQ7	671298.22	8602732.16	12.63481669	40.57718336	680344.65	8602766.59	12.63399997	40.66045002	5.03
PNQ8	680923.19	8606616.53	12.59916663	40.66555005	669729.71	8606296.30	12.60268331	40.56255000	6.26
PNQ9	668111.26	8610065.23	12.56870005	40.54745002	677839.75	8610211.05	12.56685001	40.63696664	5.41
PNQ1	677452.17	8614013.52	12.53249999	40.63318331	670409.07	8613637.70	12.53628335	40.56840000	3.94
PNQ11	659454.94	8617325.32	12.50351666	40.46741667	681039.62	8617590.24	12.49996665	40.66598332	12.04
PNQ12	681238.89	8621330.09	12.46614999	40.66760001	661782.10	8621086.29	12.46939997	40.48863337	10.82
PNQ13	663276.46	8624873.97	12.43508334	40.50218335	680963.31	8625061.85	12.43243332	40.66485004	9.87
PNQ14	681227.47	8628181.76	12.40421668	40.66709998	668804.55	8628546.23	12.40159998	40.55283333	6.97
PNQ15	662580.73	8632320.72	12.36779998	40.49539998	680850.35	8632229.42	12.36764996	40.66340004	10.18
PNQ16	680614.84	8636049.38	12.33313330	40.66101668	663733.61	8635894.63	12.33543330	40.50581669	9.44
PNQ17	663268.44	8639909.01	12.29916666	40.50133330	679082.31	8639779.57	12.29949998	40.64671662	8.83
PNQ18	679668.76	8643461.68	12.26618332	40.65189998	659062.13	8643176.94	12.26983336	40.46249997	11.52
PNQ19	663723.89	8647126.17	12.23389999	40.50514997	680264.45	8647158.48	12.23273335	40.65716666	9.22
PNQ2	680347.02	8650869.49	12.19918333	40.65771665	664723.75	8650815.25	12.20049997	40.51415000	8.72
PNQ21	662295.60	8654821.99	12.16440002	40.49163331	679206.71	8654543.68	12.16603330	40.64703330	9.44
PNQ22	678686.54	8658523.79	12.13008333	40.64203335	662367.18	8658283.91	12.13310000	40.49211665	9.10
PNQ23	663671.36	8661882.87	12.10049996	40.50391666	681007.60	8661913.31	12.09931663	40.66316664	9.65
PNQ24	680096.56	8665779.65	12.06441669	40.65458338	663732.97	8665499.71	12.06779995	40.50429997	9.11

Table 3. Aerial survey transect coordinates and lengths within the Rovuma Concession Block secondary survey area. X,Y coordinates are UTM Zone 37, WGS84 in meters; latitude/longitude coordinates are WGS84 in decimal degrees.

Transect	Start Point				End Point				Distance (nmi)
	X	Y	Latitude (°S)	Longitude (°E)	X	Y	Latitude (°S)	Longitude (°E)	
79	668642.87	8673016.56	11.99959999	40.54900915	681324.06	8673097.46	11.99819997	40.66545000	7.06
78	681008.67	8674810.36	11.98273332	40.66245918	665540.76	8674785.28	11.98376664	40.52043333	8.61
77	662848.31	8676997.56	11.96390001	40.49560003	680881.69	8676634.59	11.96624996	40.66119250	10.07
76	679909.25	8678854.75	11.94623325	40.65214255	662552.35	8678477.73	11.95053326	40.49280920	9.67
75	661715.74	8680399.55	11.93320001	40.48503330	678407.49	8680322.06	11.93304991	40.63827584	9.28
74	678263.66	8682406.30	11.91421664	40.63684249	661692.06	8682418.40	11.91494998	40.48471664	9.22
73	661219.32	8684139.14	11.89941663	40.48029255	679313.82	8684057.60	11.89923323	40.64639254	10.07
72	679623.03	8685678.24	11.88456657	40.64914252	662002.76	8686008.03	11.88248330	40.48739251	9.80
71	662796.91	8687674.05	11.86738338	40.49459998	680450.82	8687636.88	11.86681666	40.65663335	9.82
70	680848.29	8689260.69	11.85211658	40.66019250	664467.19	8689632.16	11.84960001	40.50983338	9.13
69	659816.42	8692020.41	11.82823336	40.46703337	680686.85	8691431.71	11.83249995	40.65859251	11.66
68	680598.06	8693303.61	11.81558332	40.65767585	659538.29	8693356.60	11.81616669	40.46441664	11.73
67	659066.68	8695209.99	11.79943330	40.45999996	681719.89	8695328.73	11.79721665	40.66785916	12.60
66	681923.70	8697221.03	11.78009993	40.66962582	660066.58	8697125.74	11.78206664	40.46908336	12.17
65	659404.98	8699133.12	11.76395005	40.46291663	679534.27	8698962.71	11.76448324	40.64760915	11.22
64	680608.28	8700875.69	11.74713329	40.65735914	659595.21	8700780.26	11.74905001	40.46458331	11.70
63	656395.31	8702736.13	11.73151668	40.43513329	682907.79	8702479.00	11.73251670	40.67836671	14.74
62	683689.99	8704598.32	11.71331662	40.68542581	656815.64	8704647.56	11.71421664	40.43890003	14.96
61	656538.83	8706304.44	11.69925001	40.43628332	684419.08	8706192.48	11.69886659	40.69202581	15.51
60	684546.07	8707978.30	11.68271660	40.69309247	657122.08	8708091.52	11.68306669	40.44155001	15.25
59	656914.49	8710503.89	11.66126668	40.43953335	683872.49	8709909.02	11.66529994	40.68680916	15.04
58	683315.97	8711538.48	11.65060004	40.68161664	656953.39	8711884.49	11.64878326	40.43982584	14.71
57	657113.81	8713612.88	11.63314998	40.44121667	682993.85	8713614.57	11.63185004	40.67855004	14.43
56	683085.54	8715430.10	11.61543326	40.67929249	659315.28	8715515.21	11.61584997	40.46131669	13.22
32	660063.66	8759559.96	11.21761665	40.46613332	690254.72	8759860.08	11.21341660	40.74257581	16.79
33	690213.97	8758202.81	11.22839995	40.74229252	658592.50	8758328.44	11.22881668	40.45271665	17.59
34	655536.58	8756007.74	11.24993336	40.42483336	689427.89	8756253.11	11.24606664	40.73520000	18.85
35	689891.94	8754539.39	11.26153327	40.73954245	655635.85	8754510.39	11.26346660	40.42580919	19.10
36	654647.20	8752339.91	11.28313336	40.41685004	689299.23	8752654.92	11.27859999	40.73421666	19.29

Table 3. (Continued).

Transect	Start Point				End Point				Distance (nmi)
	X	Y	Latitude (°S)	Longitude (°E)	X	Y	Latitude (°S)	Longitude (°E)	
37	689405.20	8750408.64	11.29889993	40.73530917	653770.96	8750611.31	11.29880000	40.40890002	19.83
38	652014.27	8748885.06	11.31448335	40.39288337	685964.40	8748891.23	11.31279996	40.70387580	18.93
39	686484.66	8746690.49	11.33266665	40.70875921	647793.20	8747255.08	11.32939997	40.35428329	21.58
0	650613.78	8745507.19	11.34508337	40.38019997	666780.45	8671666.38	12.01189992	40.53197583	75.99
0	665426.54	8669874.50	12.02816668	40.51963336	669009.79	8617788.82	12.49883337	40.55529997	34.65

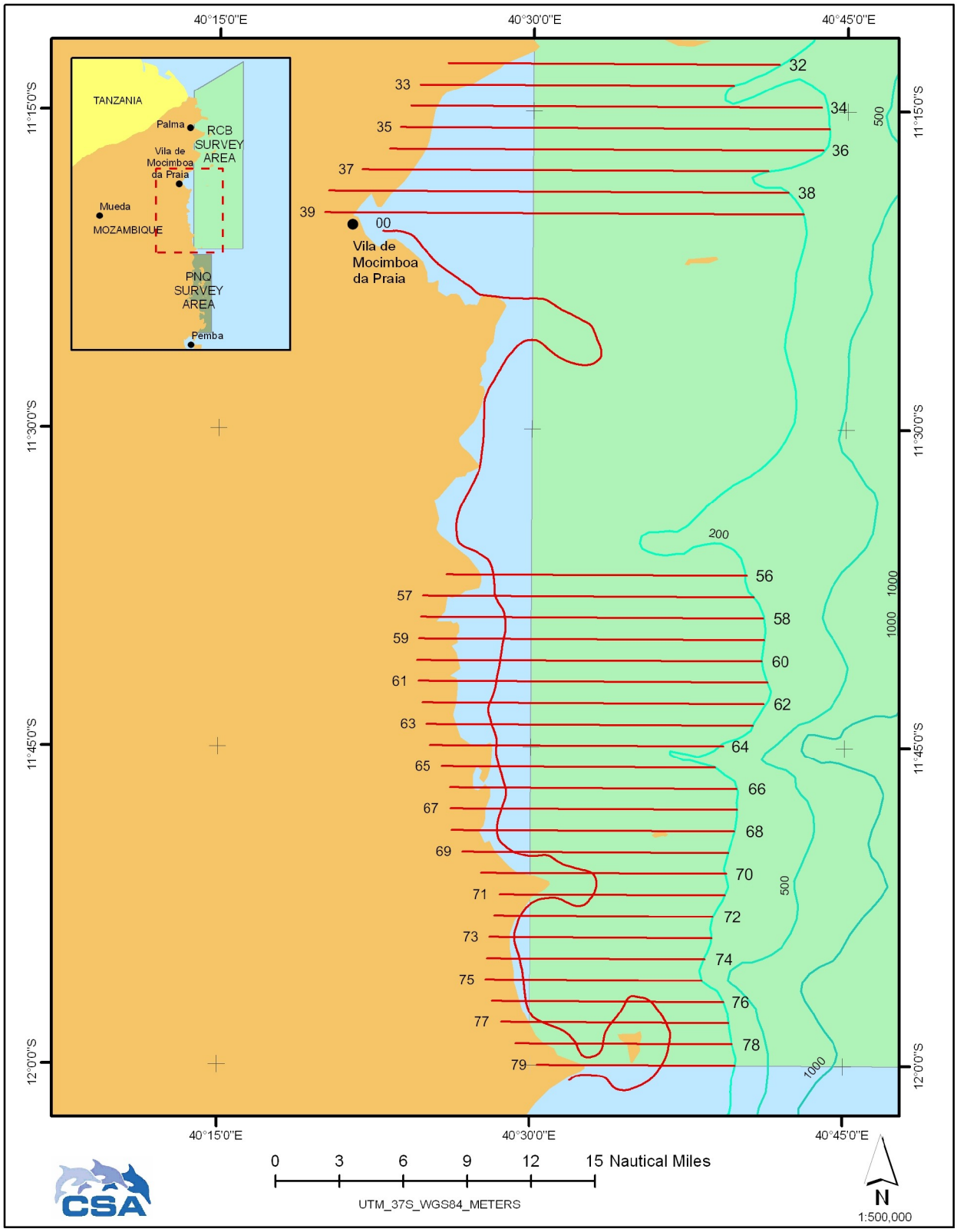

Figure 4. Rovuma Concession Block (RCB) secondary aerial survey transect layout.

Survey personnel comprised one pilot, one data recorder, and two observers. The data recorder was seated beside the pilot and the observers were seated in the rear seats of the aircraft (**Figure 5**). Survey personnel communicated through the aircraft's intercom system using individual headsets fitted with microphones.

Coordinates for transect start and end points were entered into the aircraft's global positioning system (GPS) receiver (Garmin GPS III®) prior to the onset of the survey. During the survey, the receiver's tracking display was used to maintain navigation of the aircraft along and between each transect. A laptop computer was interfaced with the GPS receiver to collect navigation and sightings data.

Survey altitude and speed were maintained at 500 ft and 80 kn, respectively. The data recorder announced and recorded the start and end points of each transect, and recorded navigation and sightings data on the laptop computer. Sightings data were announced by the observers at the time of the observation, using the following data sequence:

- Sighting right or left (i.e., North or South) of track;
- Sighting angle;
- Species or species group(s);
- Number(s) of individuals, and;
- Number(s) of mammal calves (when present).

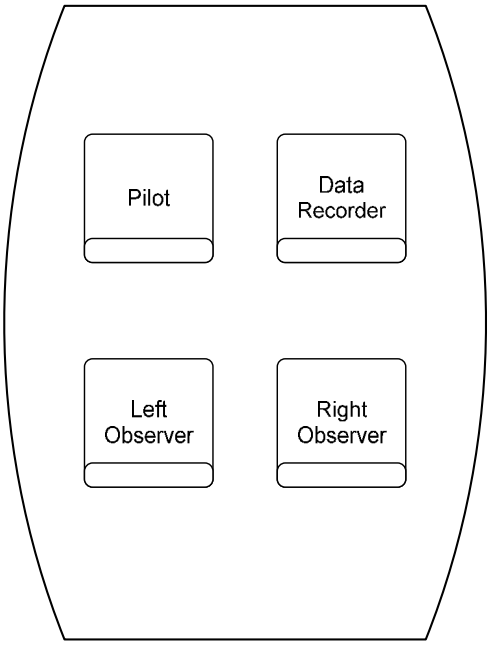

Figure 5. Cockpit layout of survey aircraft showing relative positions of survey personnel.

Sighting angle is the angle of declination of the sighting from horizontal and was measured by the observers using hand-held inclinometers (Suunto Model PM-5®). The recorded sighting angle was later used to calculate the offset, or perpendicular distance, of the sighted animal from the aircraft's recorded position at the time of the sighting and provides a standard method to correct for the actual position of the sighted animal (Musick et al., 1987; Barlow et al., 1988; Forney et al., 1991; Blaylock and Hoggard, 1994).

2.3 SURVEY SCHEDULE

Based on aircraft availability, there were 12 days allotted for the completion of the aerial survey. It was determined that there was no aviation fuel available north of Pemba; consequently, all flights were planned without a stop to replenish fuel. The aerial survey schedule for the RCB and PNQ survey areas is summarized in **Table 4**; the survey plans are presented in **Tables 5** and **6**, respectively.

The first objective of the survey was the completion of the RCB survey area. As shown in **Table 4** it was estimated that the completion of this objective would require four full survey days. Remaining survey days would then be devoted to the survey of the PNQ survey area. It was estimated that the PQN survey area would require two partial survey days for completion.

Table 4. Survey schedule summary.

Day	Date	Task
1	7 March 2007	Mobilize survey aircraft
2	8 March 2007	Rovuma Concession Block survey area (Survey day 1 of 4)
3	9 March 2007	Rovuma Concession Block survey area (Survey day 2 of 4)
4	10 March 2007	Rovuma Concession Block survey area (Survey day 3 of 4)
5	11 March 2007	Rovuma Concession Block survey area (Survey day 4 of 4)
6	12 March 2007	Parque Nacional Quirimbas survey area (Survey day 1 of 2)
7	13 March 2007	Parque Nacional Quirimbas survey area (Survey day 2 of 2)
8	14 March 2007	Contingency survey day
9	15 March 2007	Contingency survey day
10	16 March 2007	Contingency survey day
11	17 March 2007	Contingency survey day
12	18 March 2007	Contingency survey day; demobilize survey aircraft

Table 5. Aerial survey plan – Rovuma Concession Block*.

Survey Day	Transect ID	Transect Length (nmi)	Time (min)	Transect Time (min + 7-min turn)	Survey Time (cumulative min)	Survey Day Totals (h)
1	Transit (outbound)	60	24			
	79	9.3	7.0	14.0	14	Day 1
	77	11.2	8.4	15.4	29.4	Outbound Time – 0.4 h
	75	12.1	9.1	16.1	45.5	Survey Time – 3.5 h
	73	12.2	9.1	16.1	61.6	Inbound Time – 0.5 h
	71	11.9	8.9	16.0	77.6	Total Time – 4.4 h
	69	13.9	10.4	17.4	95	
	67	14.7	11.0	18.0	113	
	65	15.3	11.5	18.5	131.5	
	63	16.3	12.2	19.2	150.7	
	61	16.9	12.7	19.7	170.3	
	59	17.1	12.8	19.8	190.1	
	57	17.1	12.8	19.8	210	
	Transit (inbound)	82	33			
2	Transit (outbound)	84	34			
	55	17.0	12.8	19.8	19.8	Day 2
	53	18.2	13.6	20.6	40.4	Outbound Time – 0.6 h
	51	17.8	13.3	20.3	60.7	Survey Time – 3.6 h
	49	17.3	12.9	19.9	80.6	Inbound Time – 0.7 h
	45	17.3	13.0	20.0	100.6	Total Time – 4.9 h
	43	19.7	14.7	21.7	122.3	
	41	22.3	16.7	23.7	146	
	39	23.8	17.8	24.8	170.8	
	37	22.2	16.7	23.7	194.5	
	35	20.7	15.5	22.5	217	
	Transit (inbound)	102	41			

Table 5. (Continued).

Survey Day	Transect ID	Transect Length (nmi)	Time (min)	Transect Time (min + 7-min turn)	Survey Time (cumulative min)	Survey Day Totals (h)
3	Transit (outbound)	104	42			
	33	20.0	15.0	22.0	22	Day 3
	31	16.2	12.2	19.2	41.2	Outbound Time – 0.7 h
	29	16.9	12.7	19.7	60.9	Survey Time – 2.9 h
	23	12.7	9.5	16.5	77.4	Inbound Time – 0.8 h
	21	14.8	11.1	18.1	95.5	Total Time – 4.4 h
	19	16.8	12.6	19.6	115.1	
	17	16.5	12.4	19.4	134.5	
	15	15.8	11.9	18.9	153.4	
	13	14.6	11.0	18.0	171.4	
	Transit (inbound)	120	48			
4	Transit (outbound)	122	49			
	11	11.8	8.8	15.8	15.8	Day 4
	9	11.8	8.8	15.8	31.6	Outbound Time – 0.8 h
	7	15.3	11.5	18.5	50.1	Survey Time – 2.5 h
	5	17.8	13.3	20.3	70.4	Inbound Time – 0.9 h
	3	15.0	11.3	18.3	88.7	Total Time – 4.2 h
	1	12.3	9.2	16.2	104.9	
	81	17.1	12.8	19.8	124.7	
	83	18.2	13.6	20.6	145.3	
	Transit (inbound)	132	53			

* Assumes transit speed =150 kn and survey speed = 80 kn.

Table 6. Aerial survey plan – Parque Nacional Quirimbas*.

Survey Day	Transect ID	Transect Length (nmi)	Time (min)	Transect Time (min + 7-min turn)	Survey Time (cumulative min)	Survey Day Totals (h)
1	Transit (outbound)	9.5	3.8			
	PNQ1	3.4	2.6	9.6	13.4	Day 1
	PNQ2	5.5	4.1	11.1	24.5	Outbound Time – 0.06 h
	PNQ3	2.5	1.9	8.9	33.4	Survey Time – 2.5 h
	PNQ4	4.7	3.5	10.5	43.9	Inbound Time – 0.2 h
	PNQ5	5.8	4.4	11.4	55.3	Total Time – 2.8 h
	PNQ6	5.9	4.4	11.4	66.7	
	PNQ7	6.3	4.7	11.7	78.4	
	PNQ8	6.6	5.0	12.0	90.4	
	PNQ9	5.3	4.0	11.0	101.4	
	PNQ10	11.8	8.9	15.9	117.3	
	PNQ11	13.2	10.0	16.9	134.3	
	PNQ12	12.4	9.3	16.3	150.6	
	Transit (inbound)	31.5	12.6			
2	Transit (outbound)	33.5	13.4			
	PNQ13	9.4	7.1	14.0	14	Day 2
	PNQ14	8.5	6.4	13.4	27.4	Outbound Time – 0.2 h
	PNQ15	9.7	7.3	14.3	41.7	Survey Time – 2.9 h
	PNQ16	10.9	8.2	15.2	56.9	Inbound Time – 0.4 h
	PNQ17	9.3	7.0	14.0	70.9	Total Time – 3.5 h
	PNQ18	12.7	9.5	16.5	87.4	
	PNQ19	11.9	8.9	15.9	103.3	
	PNQ20	8.5	6.4	13.4	116.7	
	PNQ21	9.2	6.9	13.9	130.6	
	PNQ22	9.1	6.8	13.8	144.4	
	PNQ23	9.5	7.1	14.1	158.5	
	PNQ24	9.3	7.0	14.0	172.5	
	Transit (inbound)	55.5	22.2			

* Assumes transit speed =150 kn and survey speed = 80 kn.

3.0 RESULTS

The aerial survey was performed from 8 to 13 March 2007. The survey of transects within the RCB and PNQ survey areas was completed sooner than originally planned (**Section 2.3**), primarily because of the low number of recorded sightings (i.e., survey time allotted for orbiting uncertain species and dugongs was not utilized). To make the best use of the remaining 2 days of budgeted time, a second, duplicative survey of two areas within the RCB survey area where dugongs historically had been sighted by local fishermen was made.

Marine mammals were identified to species level during the survey. It was not possible to identify sea turtles to species level because of their smaller size and avoidance behavior (diving) when approached by the survey aircraft. Five species of sea turtles occur in Mozambique: loggerhead (*Caretta caretta*), green (*Chelonia mydas*), hawksbill (*Eretmochelys imbricata*), olive ridley (*Lepidochelys olivacea*), and leatherback (*Dermochelys coriacea*) (Louro et al., 2006). Leatherback and loggerhead turtles are distinctive in appearance and generally readily identifiable from an aircraft at survey altitude and airspeed; these species were not observed during the survey.

The chronological sequence of tasks performed during the survey, with details of problems encountered and actions taken, is briefly described below in **Section 3.1**. Sightings data from the RCB and PNQ survey areas are presented in **Section 3.2**. The presentation of RCB data is further subdivided into the primary survey (which includes a full survey of the block) and the secondary survey of two sections of the RCB survey area.

3.1 CHRONOLOGY OF EVENTS

Wednesday, 7 March 2007

The survey team met with the pilot at the Pemba airport and organized the aircraft for the aerial survey. Survey and emergency protocols were discussed, and navigational data (start and end points of survey transects) were entered into the aircraft's hand-held GPS receiver.

Thursday, 8 March 2007

The aircraft departed Pemba at 08:53 h. Transects 79 to 47 were completed under excellent weather and sea state conditions. The aircraft arrived in Pemba at 14:18 h.

Friday, 9 March 2007

The aircraft departed Pemba at 08:32 h. Transects 45 to 19 were completed under excellent weather and sea state conditions. The aircraft arrived in Pemba at 13:11 h.

Saturday, 10 March 2007

The aircraft departed Pemba at 08:37 h. During the transit to the survey area, heavy thunderstorm development was observed to the north along the coast and adjacent nearshore waters. Consequently, the planned survey was cancelled and the aircraft returned to Pemba, arriving at 09:45 h. Weather services at Moçimboa da Praia verified that the area was under heavy rain showers, though areas to the south, including the PNQ, appeared to be workable. It was decided to attempt working within the PNQ survey area, which was originally scheduled to take place following the completion of the RCB survey area. The aircraft departed Pemba at

12:22 h and completed the survey of the PNQ survey area (at Transect PNQ24) at 15:23 h. Weather and sea state conditions were good to excellent during the survey. The aircraft arrived in Pemba at 16:20 h.

Sunday, 11 March 2007

Extensive thunderstorm activity was observed within coastal areas around Pemba within the early morning hours, although offshore conditions to the north appeared to be workable. The aircraft departed Pemba at 08:55 h. Transects 17 to 1, 81, and 83 were completed under good to excellent weather and sea state conditions. This completed the original planned survey of the RCB and PNQ survey areas. The aircraft arrived in Pemba at 13:50 h.

Monday, 12 March 2007

The aircraft departed Pemba at 08:38 h and completed Transects 79 to 56 with excellent weather and sea state conditions. The aircraft arrived arrived in Pemba at 13:32 h.

Tuesday, 13 March 2007

The aircraft departed Pemba at 09:14 h. Transects 32 to 39 were completed. The survey then continued southward over nearshore seagrass habitats to the southern edge of the RCB survey area. Following completion of this task, the aircraft returned to Pemba, arriving at 13:59 h. The aircraft was then demobilized.

3.2 DISTRIBUTIONS AND DENSITIES OF MARINE MAMMALS AND SEA TURTLES SIGHTED DURING THE SURVEY

3.2.1 Rovuma Concession Block Survey Area

Primary Survey

Sightings data of marine mammals and sea turtles observed during the primary survey of the RCB survey area are presented in **Table 7**. Sightings for each daily segment of the RCB survey area completed are plotted in **Figures 6** to **8**. A total of 268 marine mammals was sighted within the survey area. These included 24 hump-backed dolphins (*Sousa chinensis*), 44 bottlenose dolphins (*Tursiops* spp.), and 200 spinner dolphins (*Stenella longirostris*). A total of 49 unidentified sea turtles also were sighted within the RCB survey area.

Secondary Survey

Sightings data of marine mammals and sea turtles observed during the secondary survey of RCB areas are presented in **Table 8** and plotted in **Figures 9** to **11**. A total of 25 marine mammals was sighted within the areas surveyed, including 18 hump-backed dolphins and 7 bottlenose dolphins. A total of 51 unidentified sea turtles was sighted within the areas surveyed.

3.2.2 Parque Nacional Quirimbas Survey Area

Sightings data of marine mammals and sea turtles observed during the primary survey of the PNQ survey area are presented in **Table 9** and plotted in **Figure 12**. One marine mammal (hump-backed dolphin) was sighted within the survey area. A total of 114 unidentified sea turtles was also sighted within the PNQ survey area.

Table 7. Rovuma Concession Block aerial survey sightings data. X,Y coordinates are UTM Zone 37, WGS84 in meters; latitude/longitude coordinates are WGS84 in decimal degrees.

Date	Species	Quantity	Calves	X	Y	Latitude (ºS)	Longitude (ºE)
8 March 2007	Turtle	1	--	674,923.66	8,687,502.07	11.86832794	40.60591241
	Turtle	1	--	679,564.45	8,691,402.27	11.83282613	40.64829416
	Turtle	2	--	678,592.62	8,691,445.35	11.83248840	40.63937358
	Turtle	1	--	680,187.25	8,694,839.06	11.80172526	40.65382295
	Turtle	1	--	681,255.82	8,694,946.41	11.80069764	40.66362193
	Turtle	1	--	682,137.32	8,695,069.66	11.79953606	40.67170346
	Turtle	1	--	682,506.23	8,699,142.22	11.76270167	40.67486531
	Turtle	2	--	682,019.96	8,698,739.62	11.76636720	40.67042609
	Turtle	2	--	681,513.75	8,699,121.00	11.76294682	40.66576114
	Turtle	1	--	680,458.41	8,699,124.72	11.76296959	40.65607887
	Turtle	1	--	680,072.81	8,698,701.91	11.76681221	40.65256404
	Turtle	1	--	675,213.34	8,698,639.74	11.76762919	40.60798342
	Hump-backed dolphin	2	--	659,635.98	8,702,734.47	11.73138090	40.46486407
	Hump-backed dolphin	3	--	673,714.39	8,706,275.26	11.69868107	40.59383446
	Turtle	1	--	680,083.06	8,713,372.00	11.63419707	40.65187094
	Turtle	1	--	672,595.28	8,717,387.50	11.59828180	40.58300060
	Turtle	1	--	678,242.89	8,721,119.32	11.56425803	40.63458856
	Hump-backed dolphin	3	1	665,803.83	8,725,290.12	11.52717290	40.52034124
	Turtle	1	--	677,673.18	8,725,492.58	11.52475319	40.62913725
	Turtle	1	--	681,344.37	8,728,379.41	11.49846611	40.66263639
	Bottlenose dolphin	6	--	684,445.42	8,732,443.07	11.46156804	40.69084065
9 March 2007	Turtle	1	--	681,482.43	8,747,322.10	11.32721845	40.66290440
	Turtle	1	--	680,557.83	8,746,632.15	11.33350314	40.65447072
	Turtle	1	--	684,917.52	8,751,012.29	11.29368097	40.69417419
	Hump-backed dolphin	3	1	671,516.72	8,758,089.20	11.23037900	40.57108515
	Turtle	1	--	688,765.23	8,772,819.92	11.09634194	40.72824498
	Bottlenose dolphin	5	--	690,241.98	8,772,664.28	11.09767107	40.74176941
	Turtle	1	--	687,963.07	8,784,282.10	10.99276727	40.72029947
	Turtle	1	--	680,577.36	8,783,930.66	10.99631924	40.65274068
	Turtle	1	--	678,430.20	8,783,991.77	10.99587298	40.63309126

Table 7. (Continued).

Date	Species	Quantity	Calves	X	Y	Latitude (ºS)	Longitude (ºE)
11 March 2007	Hump-backed dolphin	7	2	676,767.04	8,791,309.85	10.92979599	40.61751375
	Bottlenose dolphin	8	--	688,697.28	8,794,785.13	10.89778278	40.72646712
	Turtle	1	--	686,410.34	8,798,760.83	10.86195937	40.70534511
	Turtle	1	--	682,958.54	8,806,022.95	10.79648163	40.67341175
	Turtle	1	--	684,180.04	8,806,746.15	10.78988312	40.68454432
	Turtle	1	--	684,180.04	8,806,131.89	10.79543615	40.68457525
	Spinner dolphin	200	--	686,988.93	8,807,623.72	10.78180895	40.71018222
	Hump-backed dolphin	6	--	680,318.85	8,809,789.47	10.76256056	40.64908964
	Turtle	1	--	678,011.79	8,813,582.73	10.72837907	40.62781282
	Turtle	1	--	678,440.22	8,813,727.77	10.72704733	40.63172243
	Turtle	1	--	679,262.14	8,813,974.18	10.72478018	40.63922424
	Turtle	1	--	681,526.77	8,813,434.58	10.72954864	40.65995328
	Turtle	1	--	684,929.89	8,816,311.21	10.70337576	40.69091909
	Turtle	1	--	680,324.01	8,817,564.10	10.69227456	40.64875597
	Bottlenose dolphin	25	--	673,532.04	8,822,816.25	10.64511314	40.58642566
	Turtle	1	--	667,102.53	8,843,742.49	10.45621016	40.52672858
	Turtle	1	--	673,065.48	8,833,317.91	10.55019158	40.58167409
	Turtle	2	--	674,163.95	8,830,332.53	10.57713128	40.59184948
	Turtle	1	--	675,164.93	8,829,171.67	10.58757996	40.60105037
	Turtle	1	--	675,600.50	8,828,225.56	10.59611319	40.60507503
	Turtle	1	--	675,764.63	8,827,356.36	10.60396368	40.60661583
	Turtle	1	--	678,978.43	8,820,934.63	10.66186807	40.63629337
	Turtle	2	--	679,195.27	8,821,054.82	10.66077112	40.63826943
	Turtle	1	--	679,885.25	8,819,873.65	10.67141637	40.64463306
	Turtle	1	--	679,827.88	8,819,512.16	10.67468716	40.64412626

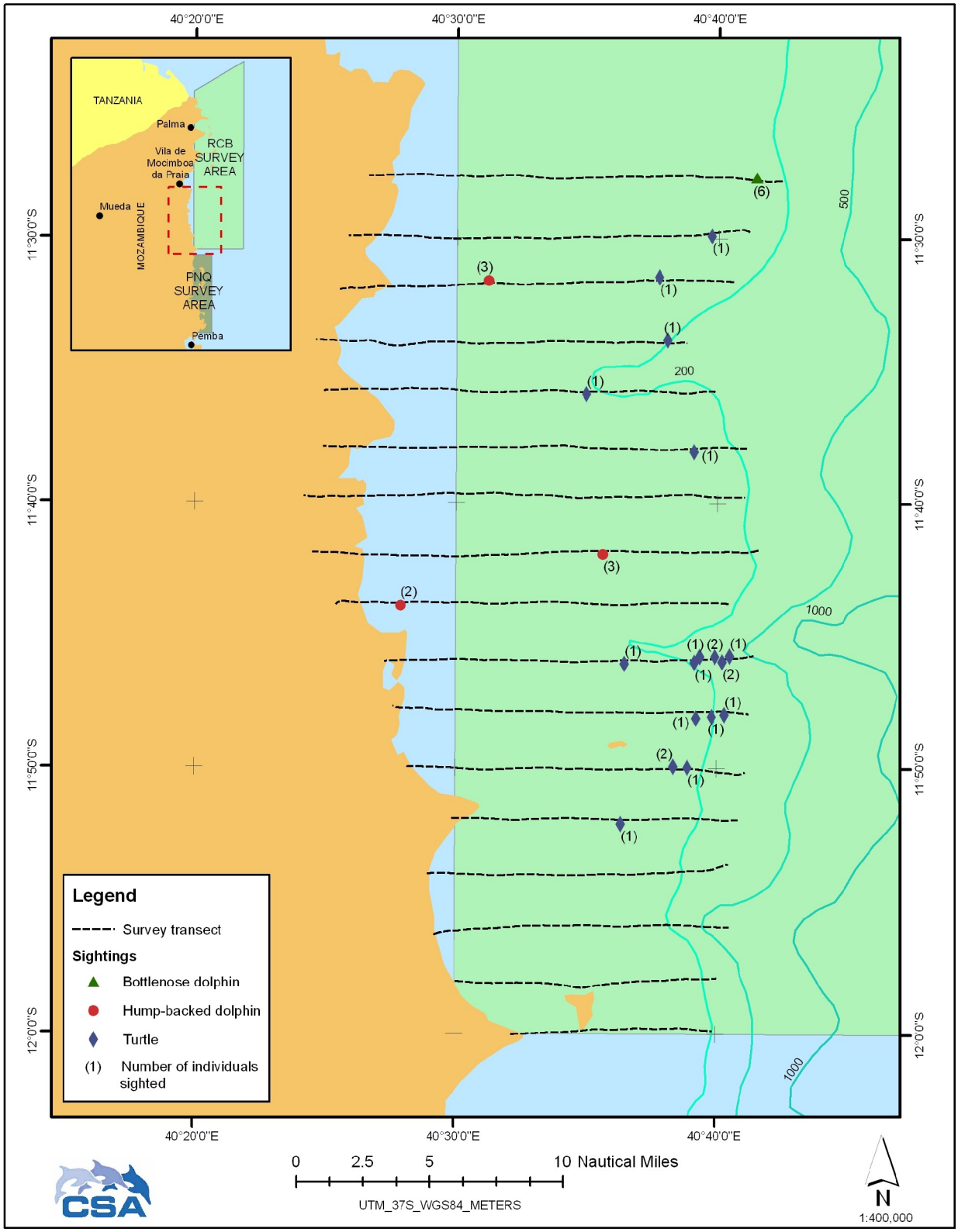

Figure 6. Marine mammal and sea turtle sightings within the Rovuma Concession Block (RCB) and adjacent nearshore waters on 8 March 2007.

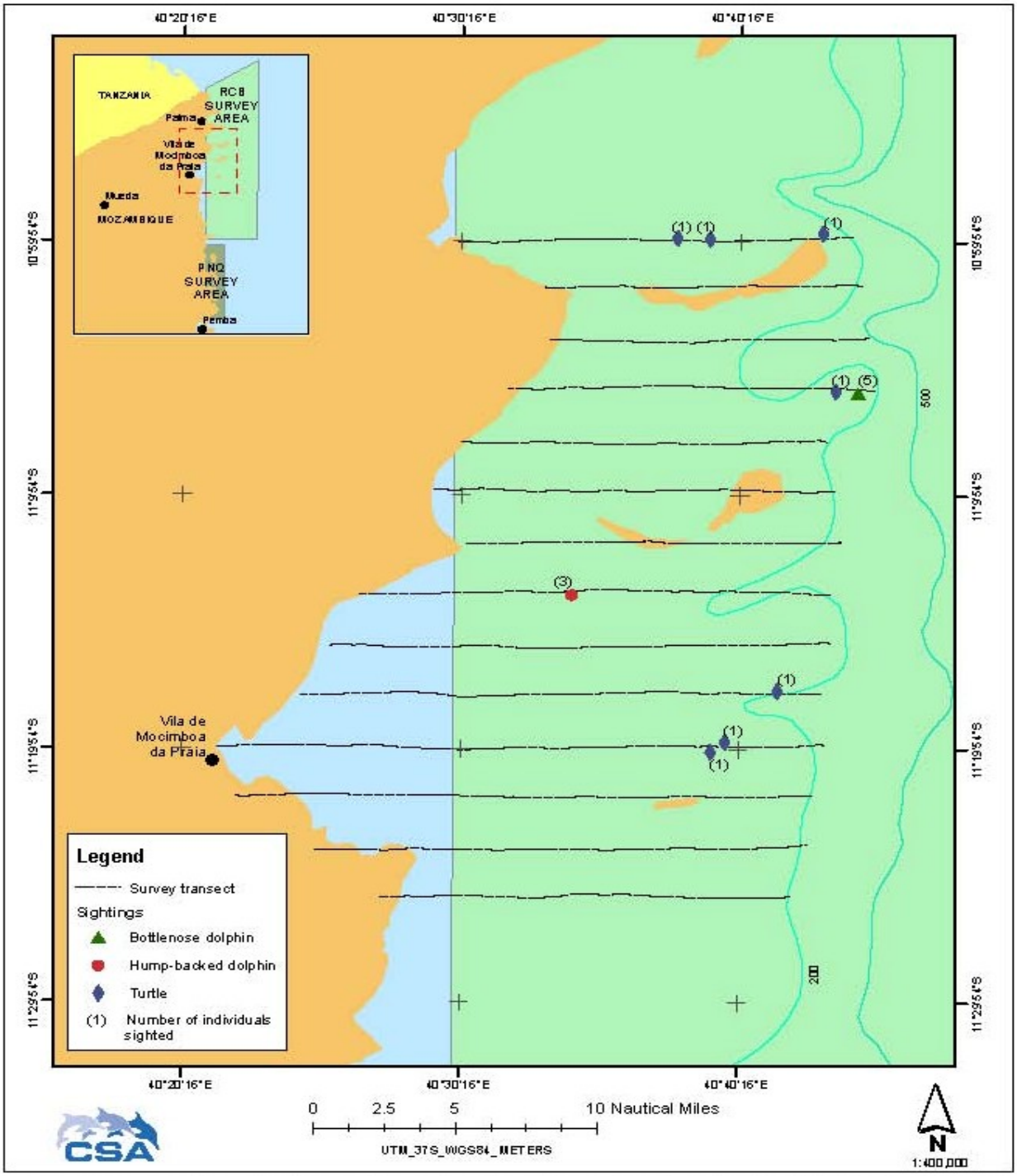

Figure 7. Marine mammal and sea turtle sightings within the Rovuma Concession Block (RCB) and adjacent nearshore waters on 9 March 2007.

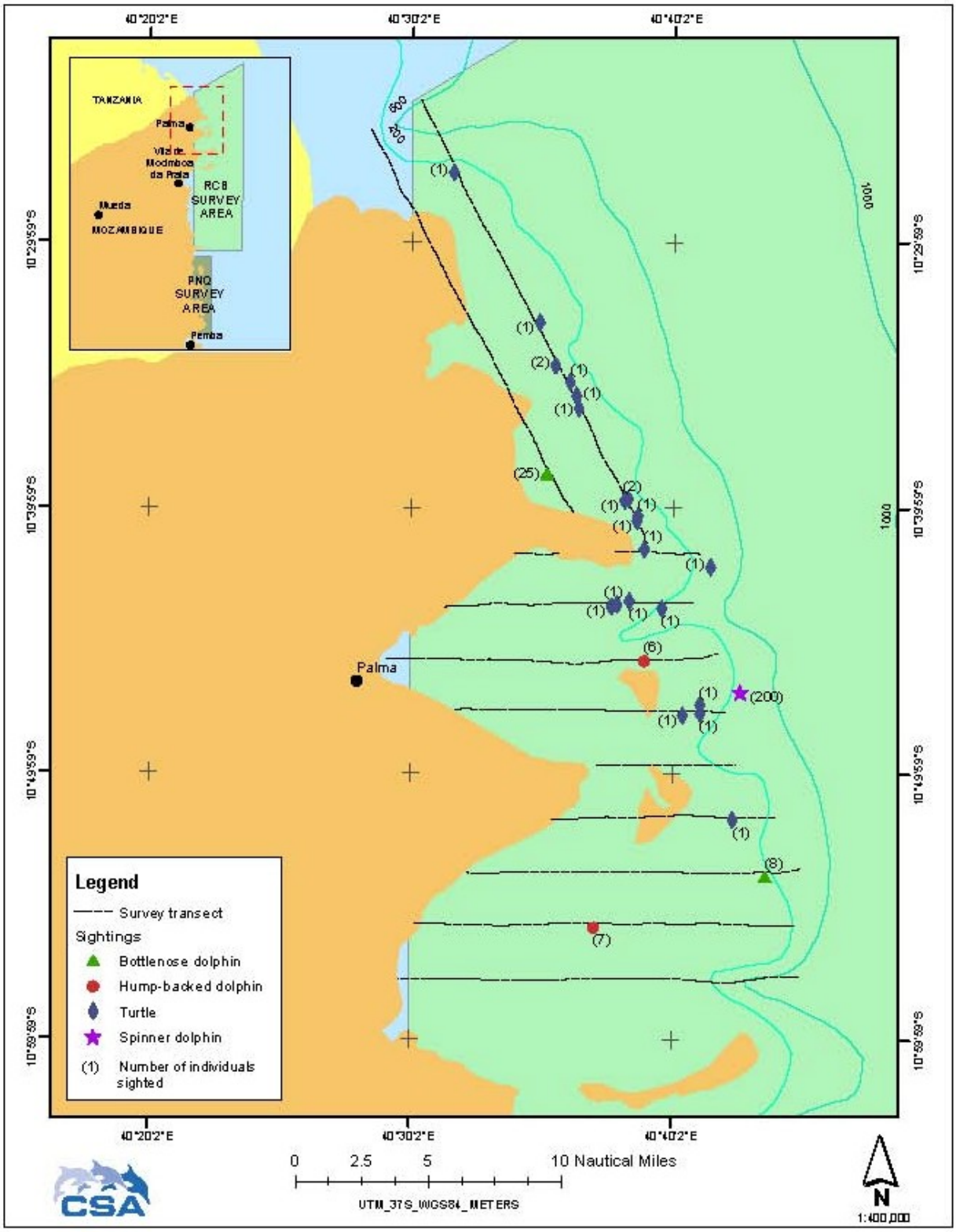

Figure 8. Marine mammal and sea turtle sightings within the Rovuma Concession Block (RCB) and adjacent nearshore waters on 11 March 2007.

Table 8. Rovuma Concession Block secondary aerial survey sightings data. X,Y coordinates are UTM Zone 37, WGS84 in meters; latitude/longitude coordinates are WGS84 in decimal degrees.

Date	Species	Quantity	Calves	X	Y	Latitude (ºS)	Longitude (ºE)
12 March 2007	Turtle	1	--	677,606.29	8,673,348.14	11.99613495	40.63129867
	Turtle	1	--	678,554.68	8,674,814.16	11.98283173	40.63992700
	Turtle	2	--	677,812.28	8,674,880.88	11.98226841	40.63310678
	Turtle	1	--	678,419.30	8,676,494.75	11.96764701	40.63859238
	Turtle	1	--	680,685.04	8,676,857.87	11.96424228	40.65937471
	Turtle	2	--	676,905.32	8,678,654.43	11.94820486	40.62457548
	Turtle	1	--	676,349.87	8,678,564.14	11.94905050	40.61948089
	Turtle	1	--	672,787.95	8,680,578.73	11.93102532	40.58667343
	Turtle	1	--	662,848.32	8,682,207.24	11.91680281	40.49534178
	Turtle	1	--	676,301.99	8,685,985.27	11.88196744	40.61864380
	Turtle	1	--	670,478.97	8,686,086.81	11.88135072	40.56519109
	Turtle	1	--	677,472.80	8,690,019.12	11.84544047	40.62917359
	Turtle	1	--	676,886.97	8,689,702.36	11.84833480	40.62381419
	Turtle	1	--	678,594.42	8,691,369.02	11.83317831	40.63939421
	Turtle	1	--	679,248.74	8,691,689.11	11.83025000	40.64538146
	Turtle	1	--	679,521.59	8,691,260.75	11.83410772	40.64790851
	Turtle	1	--	679,572.83	8,693,503.17	11.81383411	40.64825739
	Turtle	1	--	678,776.35	8,693,166.75	11.81691759	40.64096689
	Turtle	1	--	679,350.44	8,695,566.65	11.79519259	40.64610540
	Turtle	1	--	679,320.50	8,695,138.62	11.79906347	40.64585375
	Turtle	1	--	679,828.54	8,697,134.91	11.78099049	40.65040750
	Turtle	2	--	679,133.64	8,696,676.03	11.78517555	40.64405645
	Turtle	3	--	679,160.67	8,697,062.61	11.78167952	40.64428366
	Bottlenose dolphin	6	--	676,057.12	8,697,029.76	11.78213950	40.61580991
	Turtle	6	--	678,715.25	8,698,767.51	11.76629113	40.64010550
	Turtle	1	--	676,383.21	8,702,656.40	11.73125818	40.61850463
	Turtle	1	--	674,199.50	8,705,920.11	11.70186686	40.59830259
	Turtle	1	--	679,199.10	8,706,292.37	11.69824225	40.64414168
	Turtle	1	--	680,984.26	8,706,036.30	11.70046267	40.66052945

Table 8. (Continued).

Date	Species	Quantity	Calves	X	Y	Latitude (ºS)	Longitude (ºE)
12 March 2007 (continued)	Turtle	1	--	682,307.03	8,706,284.15	11.69815163	40.67264879
	Turtle	1	--	664,308.68	8,710,319.08	11.66258990	40.50736064
	Turtle	1	--	666,272.02	8,710,306.80	11.66260594	40.52536841
	Turtle	1	--	680,493.00	8,710,084.22	11.66389640	40.65580613
	Turtle	1	--	680,493.00	8,709,623.39	11.66806221	40.65583084
	Bottlenose dolphin	1	--	679,571.87	8,713,832.13	11.63006439	40.64715877
	Turtle	2	--	680,324.25	8,713,801.02	11.63030611	40.65405978
	Turtle	1	--	675,527.04	8,715,019.29	11.61954201	40.61000544
13 March 2007	Hump-backed dolphin	4	--	677,865.22	8,759,793.59	11.21465874	40.62913465
	Turtle	1	--	683,053.33	8,759,824.24	11.21411845	40.67663895
	Turtle	1	--	672,254.01	8,756,045.76	11.24881685	40.57793739
	Turtle	1	--	670,035.12	8,754,150.52	11.26605785	40.55770860
	Turtle	1	--	684,978.65	8,752,149.93	11.28339367	40.69467373
	Hump-backed dolphin	2	--	677,457.61	8,750,402.32	11.29957796	40.62587874
	Hump-backed dolphin	2	--	672,331.62	8,678,759.21	11.94749729	40.58257965
	Hump-backed dolphin	10	--	672,407.50	8,679,189.59	11.94360275	40.58325369
	Turtle	1	--	675,632.50	8,674,625.02	11.98469725	40.61310604

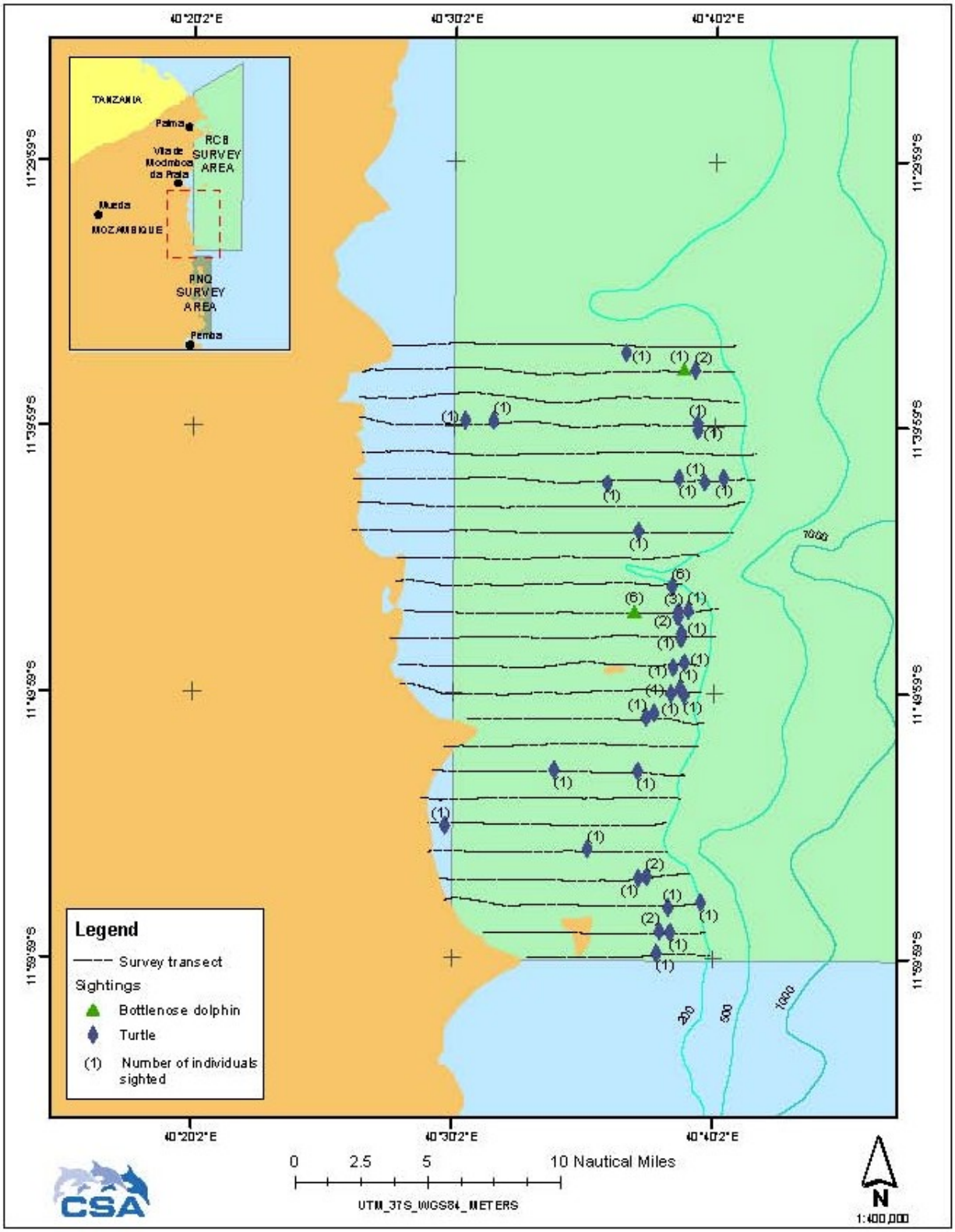

Figure 9. Marine mammal and sea turtle sightings within the Rovuma Concession Block (RCB) and adjacent nearshore waters (secondary survey) on 12 March 2007.

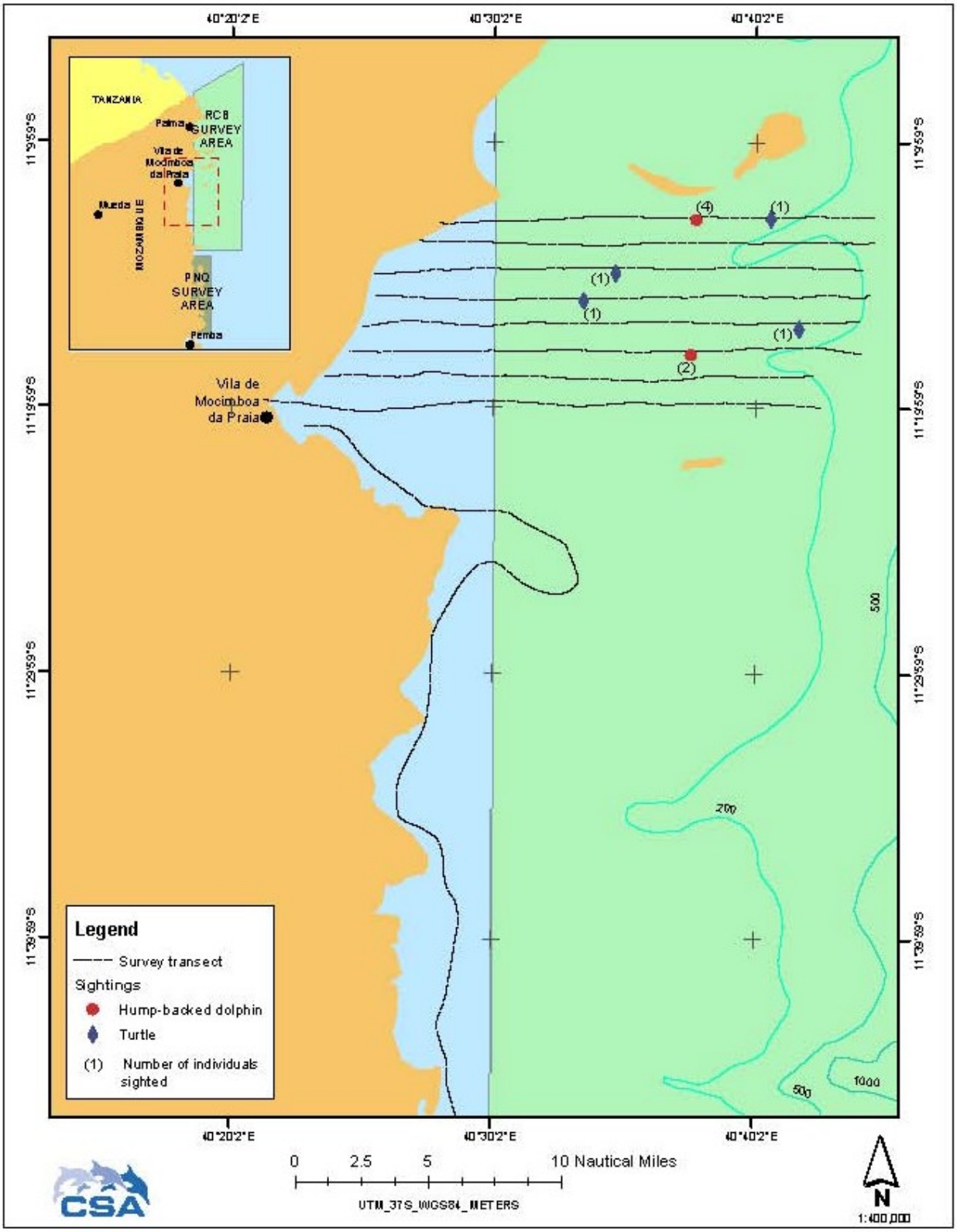

Figure 10. Marine mammal and sea turtle sightings within the Rovuma Concession Block (RCB) and adjacent nearshore waters (secondary survey) on 13 March 2007 (segment 1 of 2).

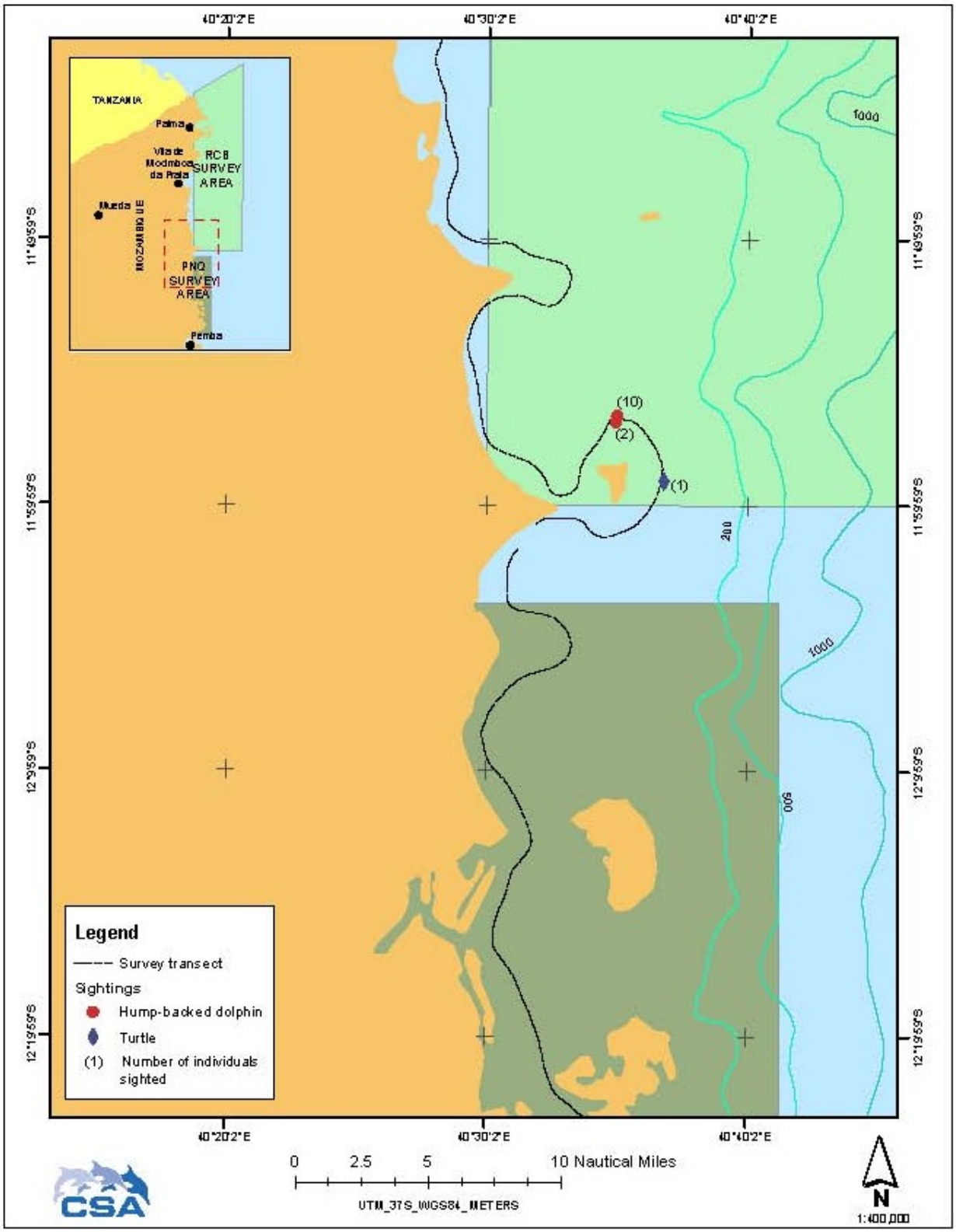

Figure 11. Marine mammal and sea turtle sightings within the Rovuma Concession Block (RCB) and adjacent nearshore waters (secondary survey) on 13 March 2007 (segment 2 of 2).

Table 9. Parque Nacional Quirimbas (PNQ) aerial survey sightings data. X,Y coordinates are UTM Zone 37, WGS84 in meters; latitude/longitude coordinates are WGS84 in decimal degrees.

Date	Species	Quantity	Calves	X	Y	Latitude (ºS)	Longitude (ºE)
10 March 2007	Turtle	1	--	677,611.10	8,595,436.19	12.70041669	40.63571175
	Turtle	1	--	676,164.82	8,602,750.11	12.63438572	40.62197784
	Turtle	1	--	678,190.58	8,606,128.48	12.60373373	40.64042944
	Turtle	3	--	676,078.68	8,610,300.51	12.56613984	40.62075598
	Turtle	2	--	676,189.40	8,609,998.71	12.56886176	40.62179195
	Turtle	1	--	676,571.35	8,613,629.57	12.53601980	40.62510072
	Turtle	1	--	676,007.72	8,614,063.11	12.53213218	40.61989024
	Turtle	1	--	671,542.61	8,617,292.56	12.50318381	40.57862912
	Turtle	1	--	672,602.39	8,617,390.20	12.50224385	40.58837379
	Turtle	1	--	673,284.72	8,616,962.68	12.50607134	40.59467493
	Turtle	1	--	675,580.45	8,617,037.78	12.50526654	40.61579160
	Turtle	1	--	676,275.29	8,617,617.35	12.49998913	40.62215143
	Turtle	1	--	676,769.73	8,617,645.86	12.49970398	40.62669856
	Turtle	1	--	678,227.74	8,617,061.27	12.50490694	40.64014518
	Turtle	1	--	667,992.95	8,620,875.56	12.47098384	40.54577930
	Turtle	1	--	665,332.59	8,621,323.03	12.46707780	40.52128262
	Turtle	1	--	678,378.85	8,625,186.49	12.43145179	40.64107301
	Turtle	2	--	679,232.40	8,624,908.58	12.43391621	40.64893917
	Turtle	1	--	679,696.28	8,624,780.23	12.43505039	40.65321296
	Turtle	1	--	679,647.64	8,628,734.95	12.39930510	40.65253996
	Turtle	3	--	678,909.03	8,628,340.15	12.40291512	40.64577002
	Turtle	10	--	678,531.03	8,628,620.45	12.40040245	40.64227795
	Turtle	1	--	678,070.84	8,632,560.31	12.36481398	40.63782380
	Turtle	1	--	678,065.50	8,632,237.48	12.36773248	40.63779288
	Turtle	2	--	678,351.23	8,632,639.90	12.36407900	40.64039749
	Turtle	1	--	678,623.02	8,632,193.33	12.36810065	40.64292180
	Turtle	1	--	676,986.67	8,636,267.78	12.33136018	40.62764772
	Turtle	1	--	667,063.46	8,636,037.95	12.33396693	40.53642528
	Turtle	2	--	665,343.29	8,639,967.42	12.29853325	40.52040484

Table 9. (Continued).

Date	Species	Quantity	Calves	X	Y	Latitude (ºS)	Longitude (ºE)
10 March 2007 (continued)	Turtle	1	--	667,752.47	8,639,467.35	12.30292980	40.54257911
	Turtle	1	--	668,615.47	8,639,878.97	12.29916393	40.55049103
	Hump-backed dolphin	1	--	669,022.59	8,639,543.91	12.30217158	40.55425151
	Turtle	2	--	669,019.52	8,639,573.09	12.30190796	40.55422174
	Turtle	2	--	670,515.10	8,639,553.14	12.30200980	40.56797184
	Turtle	1	--	671,159.23	8,639,341.78	12.30388641	40.57390475
	Turtle	3	--	672,885.12	8,639,982.99	12.29799827	40.58973616
	Turtle	1	--	673,273.09	8,639,606.53	12.30138059	40.59332322
	Turtle	2	--	673,793.43	8,639,917.45	12.29854206	40.59808968
	Turtle	4	--	674,021.87	8,639,947.51	12.29825805	40.60018805
	Turtle	1	--	674,691.61	8,639,573.60	12.30160196	40.60636537
	Turtle	4	--	674,638.12	8,639,911.33	12.29855190	40.60585510
	Turtle	5	--	675,228.57	8,639,694.34	12.30048147	40.61129493
	Turtle	1	--	675,787.31	8,639,754.19	12.29991014	40.61642802
	Turtle	1	--	676,083.44	8,640,223.94	12.29564770	40.61912429
	Turtle	1	--	676,297.67	8,639,838.69	12.29911852	40.62111497
	Turtle	1	--	679,063.07	8,643,967.83	12.26164149	40.64630439
	Turtle	1	--	677,745.59	8,643,831.61	12.26294528	40.63420254
	Turtle	2	--	676,384.44	8,643,233.07	12.26843010	40.62172467
	Turtle	1	--	676,005.50	8,643,563.52	12.26546355	40.61822334
	Turtle	1	--	675,325.05	8,643,119.86	12.26951091	40.61199329
	Turtle	1	--	672,226.10	8,643,061.16	12.27020760	40.58351145
	Turtle	1	--	667,403.37	8,643,003.35	12.27098275	40.53918386
	Turtle	1	--	667,403.37	8,643,549.97	12.26604134	40.53915518
	Turtle	3	--	666,841.22	8,643,073.22	12.27038010	40.53401284
	Turtle	3	--	677,546.09	8,650,561.04	12.20212522	40.63199545
	Turtle	5	--	677,162.06	8,650,898.97	12.19909136	40.62844781
	Turtle	3	--	676,622.77	8,650,974.10	12.19844146	40.62348800
	Turtle	1	--	674,766.18	8,654,387.99	12.16768092	40.60624159

Table 9. (Continued).

Date	Species	Quantity	Calves	X	Y	Latitude (ºS)	Longitude (ºE)
10 March 2007 (continued)	Turtle	1	--	675,785.54	8,654,836.39	12.16357292	40.61558324
	Turtle	1	--	676,152.99	8,654,480.11	12.16677380	40.61897890
	Turtle	1	--	676,125.69	8,654,702.43	12.16476558	40.61871590
	Turtle	1	--	674,957.35	8,658,448.32	12.13096651	40.60777773
	Turtle	2	--	674,072.97	8,657,982.95	12.13522038	40.59967800
	Turtle	1	--	673,771.82	8,658,456.62	12.13095448	40.59688578
	Turtle	3	--	673,257.99	8,658,376.96	12.13170176	40.59216946
	Turtle	1	--	672,644.59	8,658,395.44	12.13156704	40.58653310
	Turtle	1	--	671,111.48	8,658,519.43	12.13052650	40.57244161
	Turtle	1	--	676,309.07	8,662,088.69	12.09798639	40.61999745
	Turtle	1	--	675,546.98	8,665,614.56	12.06615423	40.61280613

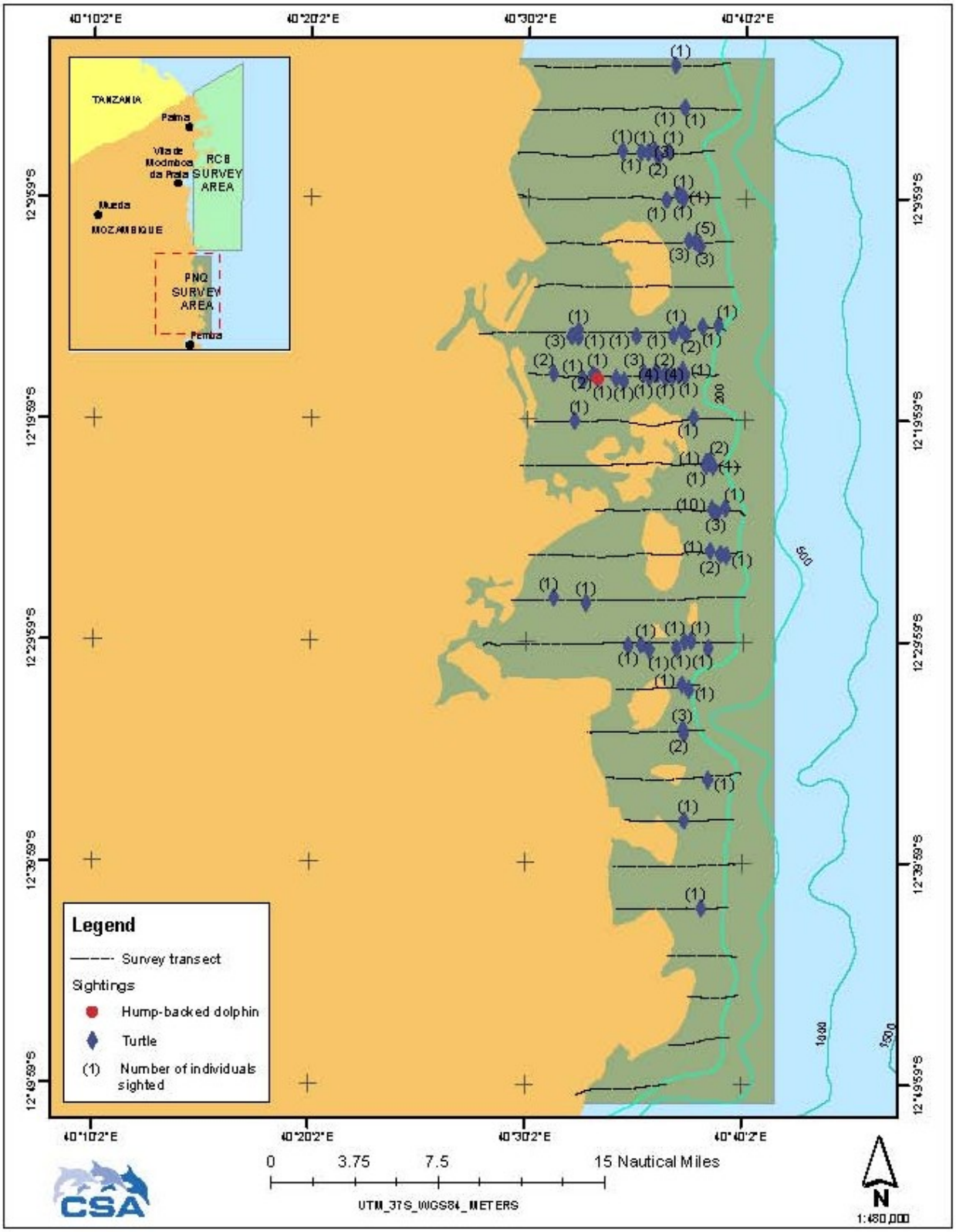

Figure 12. Marine mammal and sea turtle sightings within the Parque Nacional Quirimbas (PNQ) survey area on 10 March 2007.

4.0 DISCUSSION

Dugongs were not sighted within the RCB and PNQ survey areas or during daily transits to and from these areas. It is important to note that dugongs were also not sighted within areas selected for the secondary survey of the RCB where historic sightings of this species had been reported. It is important to note that data collected during the survey do not represent potential temporal movements of dugongs into the RCB or PNQ survey areas. Nevertheless, from these data it may be assumed that dugongs are extremely rare within the RCB. However, it is possible that individuals or small groups of dugongs may venture into the RCB or PNQ from known populations off southern Mozambique, such as Maputo Bay (near Inhaca Island), Inhambane Bay, Pomene, and Save River (Bazaruto Bay area) (Guissamulo, 2007).

Generally, bottlenose and hump-backed dolphins were observed within the RCB survey area in relatively small groups. Bottlenose dolphins were sighted in groups of 1 to 25 individuals (mean = 8.5), generally near the eastern ends of the survey transects, offshore of the barrier islands. In contrast, hump-backed dolphins were sighted in groups of 1 to 10 individuals (mean = 4.0), generally between the shoreline and the barrier islands. One large group (estimated at 200 individuals) of spinner dolphins was sighted off the continental shelf break, east of the town of Palma. Only one dolphin (hump-backed dolphin) was sighted during the survey of the PNQ.

Sea turtles were generally scattered throughout the RCB survey area, although some aggregations of individual turtles were observed near the shelf break between the islands of Macaloé and Medjumbe. The aggregations were more apparent in the sightings data collected during the secondary survey of this area when surveying with 1-nmi transect spacing (**Figure 4**). Sea turtles were much more abundant in the PNQ survey area (114 individuals) than in the RCB area (49 sighted during the initial survey of the entire RCB and 51 sighted during the secondary survey).

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