

**Marine Mammal Monitoring Surveys in Support of
“Valiant Shield” Training Exercises (Aug. 13-17, 2007)--
Final Report**



Photo by L. Mazucca

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Summary

Aerial surveys of marine mammal and turtle species were conducted during the period Aug. 13-17, 2007 following completion of the “Valiant Shield” naval exercises in waters off the Northern Mariana Islands. Surveys encompassed approximately 2,352 km of linear effort, with transect grids distributed randomly throughout a 163,300 km² target area (Area 2 in Appendix A). Size and placement of transect grids were limited by the range of the twin-engine aircraft (Cessna 337). Seastate conditions were excellent (mean Beaufort seastate = 2.2), however survey effort was limited on a daily basis due to unstable weather conditions. Survey crew consisted of a data recorder and two NOAA-trained observers. All surveys were conducted at 305 m (1000 ft) altitude at an average 100 knot groundspeed. The first day of survey effort involved circumnavigating the islands of Guam and Rota to detect any dead or stranded animals. None were detected. The remaining four survey days involved flying randomly distributed transect grids. A total of 8 sightings were recorded during the five-day period including 7 cetacean and 1 unidentified turtle species. Cetacean species sighted included a Bryde’s whale (*Balaenoptera edeni*), a Cuvier’s beaked whale (*Ziphius cavirostris*), spotted dolphins (*Stenella attenuata*), pygmy or dwarf sperm whale (*Kogia* spp.), roughtoothed dolphins (*Steno bredanensis*) and two sightings of unidentified dolphin species. No unusual behavior was detected.

Background

Valiant Shield 2007 was conducted as a joint U.S. military service training exercise during the period August 7-14 in the waters surrounding the Northern Mariana Islands (NMI). The aerial surveys reported here were conducted as part of a biological monitoring assessment following completion of the eight-day exercises. The mission was to detect, locate and identify all marine mammal and turtle species observed in the 163,300 km² target area located southeast of Guam (Appendix A).

A compilation of incidence data for marine mammals in the NMI region resulted in a list of 32 extant species, including 7 baleen whales, 22 odontocete, 2 pinniped and 1 sirenid species (DoN, 2007b) (Appendix B). The results of the MISTCS cruise (DoN 2007a) conducted in NMI waters during the period Jan-Apr 2007 also provided useful data concerning species indigenous to the area, including 15 cetacean (identified to genus) and one turtle species (Appendix C).

Method

Surveys were performed on five consecutive days during the period August 13-17, 2007 comprising a total linear effort of approximately 2,352 km. Survey protocol was based on

distance sampling methods, which is the standard accepted approach for estimating abundance of free ranging animal populations (Buckland et al. 2001).

Surveys followed pre-determined tracklines constructed to optimize area sampled within range limits of the aircraft (Figure 1). Basic trackline design consisted of two-three north-south systematic lines 111 km (60 nmi) long, set 18.5 km apart (10 nmi) with random lines connecting endpoints. Starting points for each grid were randomly chosen with the constraint that the resultant grid could not overlap with an area covered previously.

The survey aircraft was a twin-engine Cessna 337 Skymaster. The aircraft flew at a mean ground speed of 100 knots and an average altitude of 305m (1000 ft). Two NOAA-trained observers made sightings of all marine mammal and turtle species, one on each side of the aircraft. Sightings were called to a data recorder who noted the species sighted, number of individuals, presence or absence of a calf, angle to the sighting (using hand-held Suunto clinometers), and any apparent reaction to the aircraft. Additionally, GPS locations and altitude were automatically recorded onto a laptop computer at 30-sec intervals, as well as manually whenever a sighting was made. Environmental data (seastate, glare and visibility) were manually recorded at the start of each transect leg and whenever conditions changed. The two data sources (manual and computer) were later merged into a single data file. Species identifications were typically made by orbiting an initial sighting until sufficient diagnostic features were discernible to permit positive identification. When the initial sighting could not be recaptured upon orbiting, the species was recorded as “unidentified.”

Observers were “on-effort” when flying the pre-determined transects and “off-effort” when flying to and from transects (Table 1). Observers were instructed to watch during both on-effort and off-effort portions with the understanding that any off-effort sightings would be recorded separately.

Table 1. Summary of Effort

Date	Survey Type	Total Hours Flown	On-Effort Hours	Off-Effort Hours	Mean Seastate
8/13/2007	circle islands	2.5	2.1	0.4	2.4
8/14/2007	transect	3.5	2.2	1.3	2.6
8/15/2007	transect	5.5	3.5	2.0	2.3
8/16/2007	transect	4.8	2.8	2.0	1.7
8/17/2007	transect	4.3	2.1	2.2	2.0
Totals:		20.6	12.7	7.9	2.2

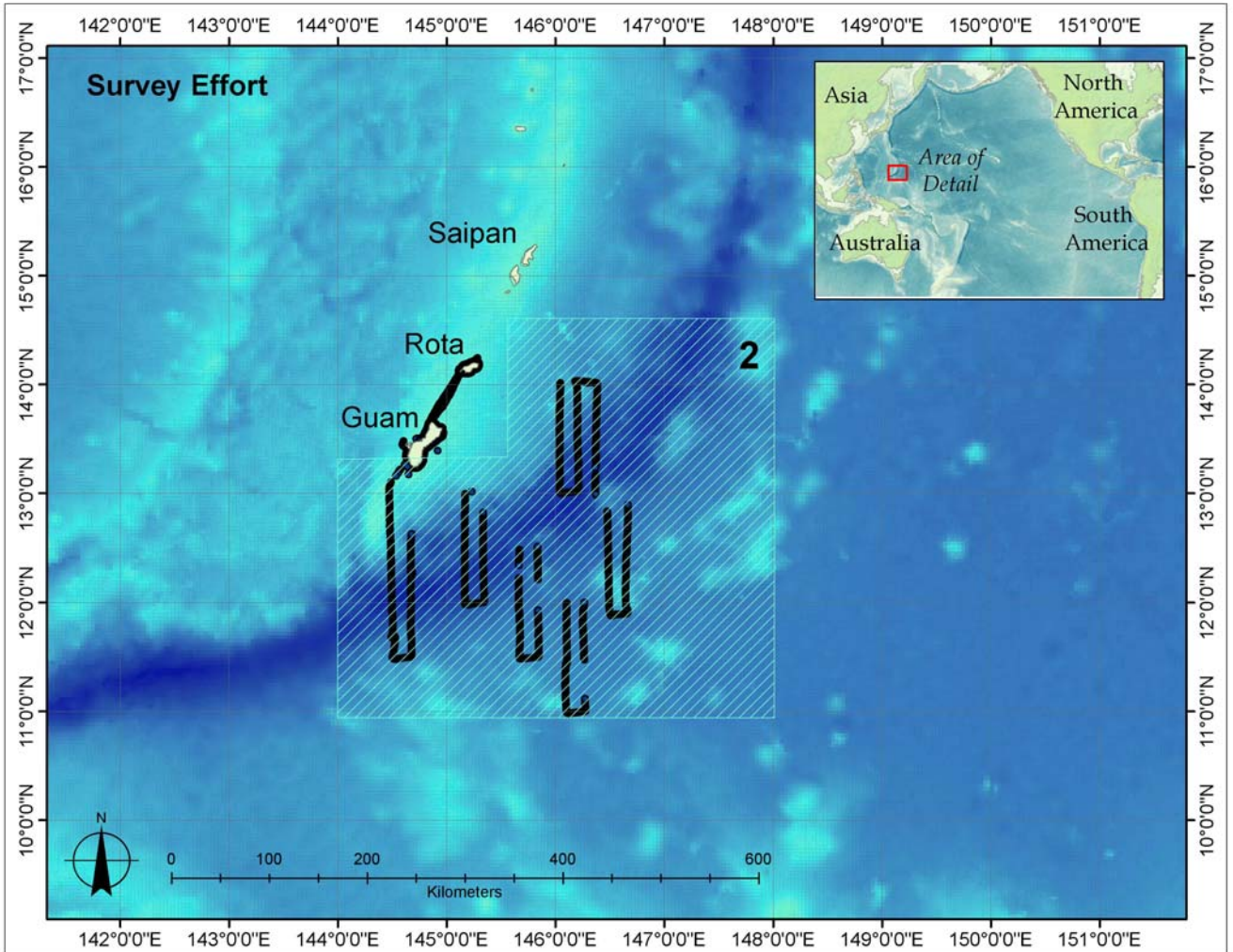


Figure 1. Survey Effort. Dark lines show survey effort based on GPS data. Target area (white cross-hatched region) was “area 2” from the Valiant Shield Monitoring Plan (Appendix A). The first of five survey days involved circumnavigating Guam and Rota; remaining surveys followed predetermined grids. Grids were constructed based on random startpoints with lines spaced 18.5 km (10 nmi) apart and extending 111 km (60 nmi). Breaks in lines indicate areas where GPS signal was temporarily lost.

Results

During the five-day survey period (Aug. 13-17), a low-pressure weather system located northwest of the Northern Mariana Islands suspended normal prevailing trades which made for excellent seastate conditions due to light and variable winds (modal seastate = Beaufort 2, Figure 2). However, the same system created unstable weather conditions with nearly daily precipitation and occasional thunderstorms. As a result, daily survey effort was limited to available weather windows usually during morning hours.

Seastate and visibility conditions were generally excellent, with 70% of effort spent in Beaufort seastate 2 or better (mean = Beaufort 2.2; range Beaufort 1-4) (Figure 2). Visibility available to the observers was generally 20 km or better, with occasional restricted visibility due to rainfall.

The first survey day involved circumnavigating the islands of Guam and Rota to detect any stranded or near stranded marine mammals. None were detected on or near coastlines, despite excellent visibility.

Days 2-5 consisted of flying a series of six transect grids (Figure 1). A total of eight sightings were recorded, including seven cetacean species and one unidentified turtle species (Table 2) (Note: No off-effort sightings were recorded). The cetacean species consisted of one sighting each of a Bryde's whale (*Balaenoptera edeni*) (Figure 4), pygmy or dwarf sperm whales (*Kogia* spp.), pantropical spotted dolphins (*Stenella attenuata*), rough-toothed dolphins (*Steno bredanensis*), Cuvier's beaked whale (*Ziphius cavirostris*), and two sightings of unidentified dolphin species. The seven cetacean sightings across 2,352 km of linear effort corresponds to an encounter rate (ER) of .003 sightings/km.

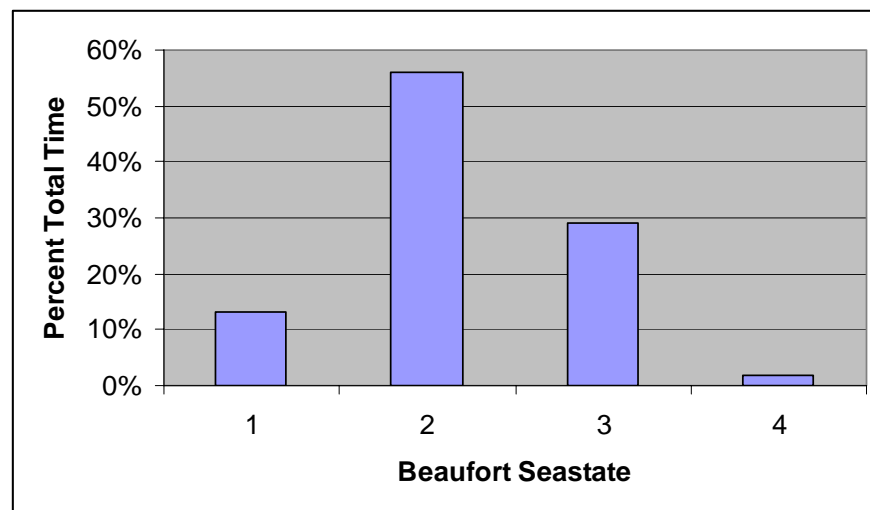


Figure 2. Beaufort Seastate. Survey conditions were excellent with a modal seastate of Beaufort 2, and range between Beaufort 1 and 4. Nearly 70% of survey time was spent in Beaufort 2 or better.

Table 2. Summary of Sightings (Note: no off-effort sightings occurred)

Species	No. Indiv.	Date	Time	Position		Seastate
				Latitude (deg, min)	Longitude (deg, min)	
Bryde's whale (<i>Balaenoptera edeni</i>)	1	8/15/2007	10:14	13° 16.02'	146° 22.45'	2
Pygmy or dwarf sperm whale (<i>Kogia</i> spp.)	3	8/16/2007	11:37	13° 23.61'	144° 55.13'	1
Spotted dolphins (<i>Stenella attenuata</i>)	30	8/17/2007	9:01	11° 26.79'	146° 6.44'	2
Rough-toothed dolphins (<i>Steno bredanensis</i>)	8	8/14/2007	14:02	11° 40.99'	144° 30.38'	2
Cuvier's beaked whale (<i>Ziphius cavirostris</i>)	1	8/14/2007	14:47	12° 16.96'	144° 40.34'	3
Unidentified dolphin species	25	8/15/2007	9:40	14° 0.99'	146° 17.37'	2
Unidentified dolphin species	2	8/17/2007	7:54	13° 1.02'	145° 13.90'	2
Unidentified turtle species	1	8/16/2007	8:30	12° 13.04'	145° 10.13'	3

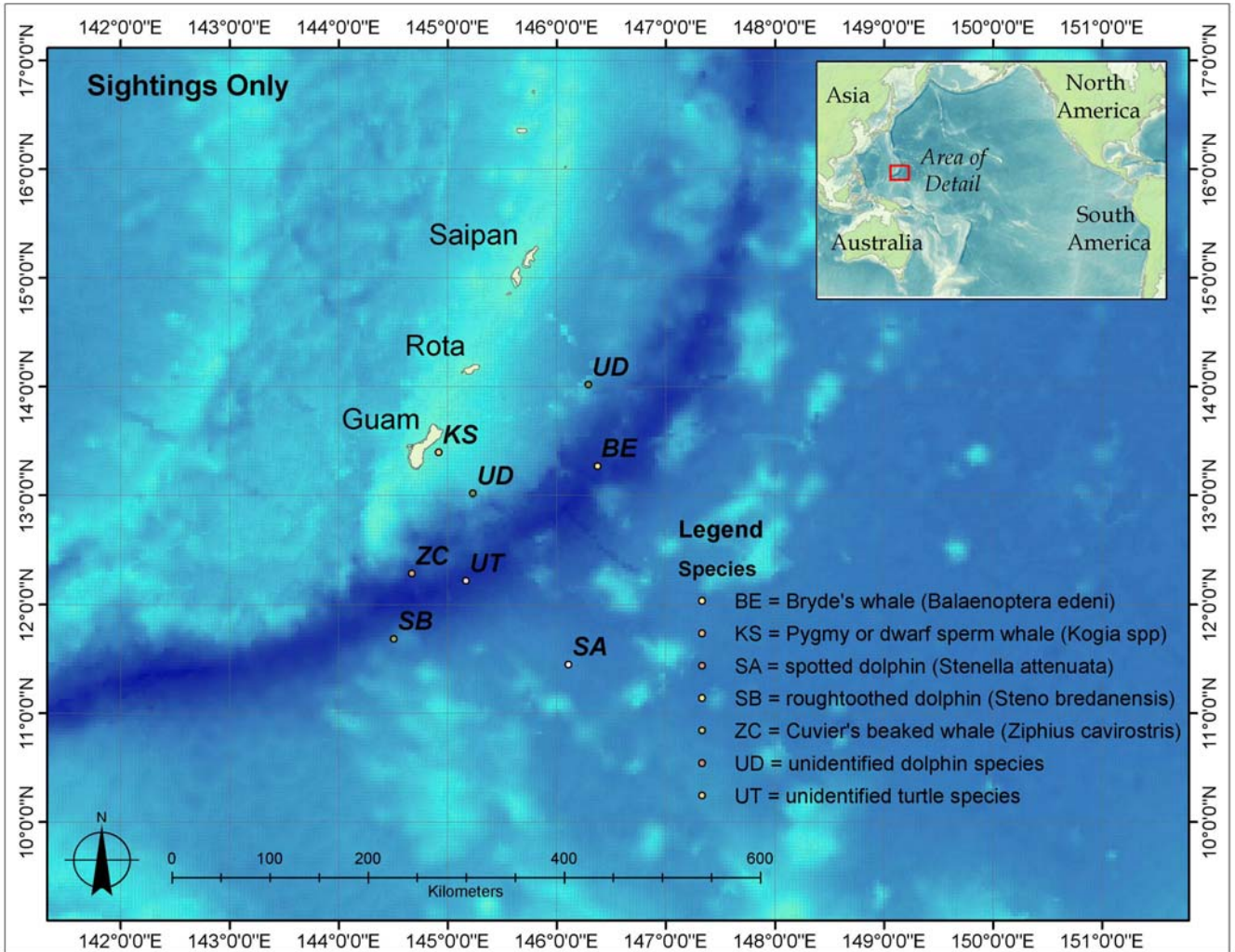


Figure 3. Locations of sightings (based on GPS data) including 7 cetacean and one unidentified turtle species. Spatially, sightings tended to occur in vicinity of Marianas Trench (dark blue water).



Figure 4. Bryde's whale sighted on Aug. 15, 2007 (Table 2). Other than the clear balaenopterid shape, primary diagnostic feature was the three ridges visible on the ventral surface of the head (see Leatherwood et al. 1979).

Discussion

All five positively identified cetacean species (Table 2) were among those listed in the Valiant Shield 2007 Marine Species Monitoring Plan as indigenous to the Northern Marianna Island (NMI) region (Appendix B). Four of the five positively identified species corresponded to those seen during the MISTCS cruise. The *Kogia* spp sighting (either pygmy or dwarf sperm whale) reported here was not included in the list of species sighted during that cruise (Appendix C).

As concerns density of sightings, the 7 cetacean sightings across 2,352 km of linear effort correspond to an encounter rate (ER) of .003 sightings/km. This ER is nearly identical to that derived from aerial surveys of cetacean species in Hawaiian waters during summer months (.004 sightings/km) (Mobley, 2006). Sighting rates in tropical areas such as Hawaii and Guam are

typically low compared to higher latitude regions due to the relatively low productivity found in tropical waters (Barlow, 2006).

By comparison the MISTCS cruise results recorded 123 sightings across 11,036 km of effort, producing an ER of .011 sightings/km, approximately 3.5 times greater density than that reported here. When evaluating the difference between these two rates, one should bear in mind that they resulted from different platforms (shipboard vs aerial) covering different areas. Among the factors that affect the comparability of these density estimates include (shipboard vs aerial surveys): a) discrepancy in areas surveyed (584,800 km² vs 163,300 km²); b) different rates of travel (8-10 knots vs 100 knots); and c) different altitudes of observers (10-20 m vs 305 m aerial), among other factors. Thus the greater density of sightings recorded during the MISTSC cruise does not necessarily indicate actual greater densities of animals at that time.

In summary, these surveys provided no evidence of impact of Valiant Shield activities on resident populations of cetaceans in the study area. Cetacean densities observed here were similar to summer densities seen in at least one other tropical area (Hawaii), and no unusual behavior or event (e.g., unusual aggregations or near strandings) was observed. This statement should not be interpreted as evidence of no impact, merely that no such evidence was detected during these 13 hrs of surveys.

Acknowledgements

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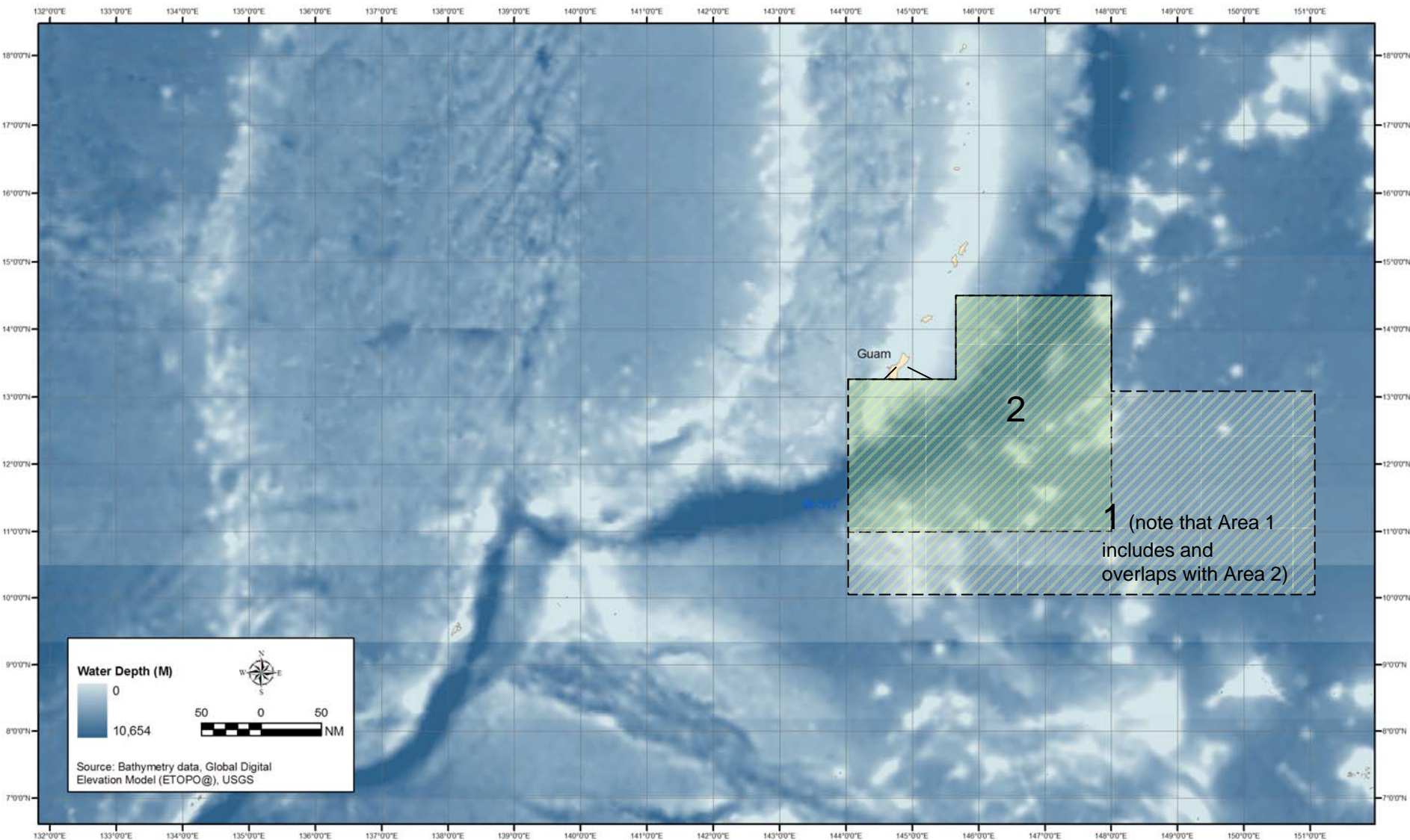
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APPENDIX A. Mission of aerial surveys was to sample Area 2 shown here comprising approximately 47,600 sq nautical miles (nmi) of area. Given the range limitations of the aircraft used, this area was randomly sampled using smaller transect grids.

Table 1. Marine mammal species with potential to occur in the Mariannas Islands, per 2005 literature search and MISTCS survey data.

Common Name	Scientific Name	Status	Occurrence
Order Cetacea			
Suborder Mysticeti (baleen whales)			
Family Balaenidae (right whales)			
North Pacific right whale	<i>Eubalaena japonica</i>	Endangered	Rare
Family Balaenopteridae (rorquals)			
Humpback whale	<i>Megaptera novaeangliae</i>	Endangered	Regular
Minke whale	<i>Balaenoptera acutorostrata</i>		Regular
Sei whale	<i>Balaenoptera borealis</i>	Endangered	Regular
Fin whale	<i>Balaenoptera physalus</i>	Endangered	Rare
Blue whale	<i>Balaenoptera musculus</i>	Endangered	Rare
Bryde's whale	<i>Balaenoptera edeni/brydei*</i>		Regular
Suborder Odontoceti (toothed whales)			
Family Physeteridae (sperm whales)			
Sperm whale	<i>Physeter macrocephalus</i>	Endangered	Regular
Family Kogiidae (pygmy sperm whales)			
Pygmy sperm whale	<i>Kogia breviceps</i>		Regular
Dwarf sperm whale	<i>Kogia sima</i>		Regular
Family Ziphiidae (beaked whales)			
Cuvier's beaked whale	<i>Ziphius cavirostris</i>		Regular
Blainville's beaked whale	<i>Mesoplodon densirostris</i>		Regular
Ginkgo-toothed beaked whale	<i>Mesoplodon ginkgodens</i>		Rare
Hubbs' beaked whale	<i>Mesoplodon carlhubbsi</i>		Extralimital
Longman's beaked whale	<i>Indopacetus pacificus</i>		Regular
Family Delphinidae (dolphins)			
Rough-toothed dolphin	<i>Steno bredanensis</i>		Regular
Common bottlenose dolphin	<i>Tursiops truncatus</i>		Regular
Indo-Pacific bottlenose dolphin	<i>Tursiops aduncus</i>		Extralimital
Pantropical spotted dolphin	<i>Stenella attenuata</i>		Regular
Spinner dolphin	<i>Stenella longirostris</i>		Regular
Striped dolphin	<i>Stenella coeruleoalba</i>		Regular
Short-beaked common dolphin	<i>Delphinus delphis</i>		Rare
Risso's dolphin	<i>Grampus griseus</i>		Regular
Melon-headed whale	<i>Peponocephala electra</i>		Regular
Fraser's dolphin	<i>Lagenodelphis hosei</i>		Regular
Pygmy killer whale	<i>Feresa attenuate</i>		Regular
False killer whale	<i>Pseudorca crassidens</i>		Regular
Killer whale	<i>Orcinus orca</i>		Regular
Short finned pilot whale	<i>Globicephala macrorhynchus</i>		Regular
Order Carnivora			
Suborder Pinnipedia (seals, sea lions, walruses)			
Family Phocidae (true seals)			
Hawaiian monk seal	<i>Monachus schauinslandi</i>	Endangered	Extralimital
Northern elephant seal	<i>Mirounga angustirostris</i>		Extralimital
Order Sirenia			
Family Dugongidae (dugongs)			
Dugong	Dugong dugon	Endangered	Extralimital

Table 2. Summary of all visual sightings from MISTCS 2007 survey by species for each leg. These data include the off-effort sightings made on 18 February 2007 (humpback whale focal study) in parentheses. The total number of sightings reported includes those sightings which had more than one species and are not differentiated in this table.

Scientific Name	Common Name	Leg 1	Leg 2	Leg 3	Leg 4	Total
* <i>Balaenoptera borealis</i>	Sei Whale	10	3	2	1	16
<i>Balaenoptera edeni</i>	Bryde's Whale	3	6	6	3	18
<i>Balaenoptera borealis/edeni</i>		1	1	1		3
<i>Balaenoptera spp.</i>		1	4	2	3	10
* <i>Megaptera novaeangliae</i>	Humpback Whale.		(1)			(1)
* <i>Physeter macrocephalus</i>	Sperm Whale	3	8 (2)	7	3	23 (2)
<i>Globicephala macrorhynchus</i>	Short-finned Pilot Whale		1	2	2	5
<i>Peponocephala electra</i>	Melon-headed Whale	1		1		2
<i>Feresa attenuata</i>	Pygmy Killer Whale			1		1
<i>Peponocephala/Feresa</i>			1		1	2
<i>Pseudorca crassidens</i>	False Killer Whale		4	6		10
<i>Stenella attenuata (offshore)</i>	Pantropical Spotted Dolphin	5	4 (1)	5	2	16 (1)
<i>Stenella coeruleoalba</i>	Striped Dolphin		8	2		10
<i>Stenella longirostris (Gray's)</i>	Spinner Dolphin		1			1
<i>Steno bredanensis</i>	Rough-toothed Dolphin		1	1		2
<i>Tursiops truncatus</i>	Common Bottlenose Dolphin	1	1	2		4
<i>Tursiops/Steno</i>			1			1
<i>Mesoplodon spp.</i>	Beaked Whale		2			2
Ziphiid whale	Beaked Whale		1			1
unid. small delphinid		3	4 (1)	4	2	13 (1)
unid. medium delphinid			1			1
unid. large delphinid			1			1
unid. dolphin		1				1
unid. small whale				1		1
unid. large whale			2	1	1	4
unid. whale		1				1
unid. cetacean		1				1
<i>Eretmochelys imbricata</i>	Hawksbill Turtle				1	1
Total		30	55 (5)	44	19	148 (5)

*Asterisk indicates species protected under the Endangered Species Act.