A Description of the Relationships between Marine Mammals and the Hawaii-based Longline Fishery from 1994 to 2003

William A. Walsh[1]

Donald R. Kobayashi[2]

Affiliations:

(1) University of Hawaii

Joint Institute for Marine and Atmospheric Research

Pelagic Fisheries Research Program

Honolulu, Hawaii

(2) Pacific Islands Fisheries Science Center

NOAA Fisheries

Honolulu, Hawaii

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Summary

This report describes associations between protected marine mammals and the Hawaii-based longline fleet from March 1994 through August 2003. The associations include interactions, in which a marine mammal came into physical contact with longline gear, and sightings, which did not involve such physical contact. This report is intended to serve as a background document that will permit reasonable conjecture regarding the taxa most likely to be affected by the Hawaii-based longline fishery, the geographical distribution of any such effects, and the consequences of interactions between this fishery and protected marine mammals.

The data presented herein were drawn from the records gathered by the Hawaii Longline Observer Program from March 1994 through August 2003 (N=12745 observed sets). The interactions and sightings involved mammals from two orders (Cetacea, Pinnipedia), in at least six families, 19 genera, and 24 species. Most of the identified genera (12) and species (15) belonged to the family Delphinidae (i.e., true dolphins). Of the 21 identified cetacean species, 12 were sighted but were never involved in interactions. There were no interactions involving pinnipeds. The overall interaction rate was 0.4%, and mortality occurred on 10.9% of the interactions. Most (3 of 5) instances of mortality involved entanglements on deep sets. Additional results include tabulations and depictions of geographic and temporal patterns in sightings and interactions.

Introduction

This report describes occurrences involving protected marine mammal species and the Hawaii-based longline fleet from March 1994 through August 2003. These occurrences included interactions, in which a marine mammal made physical contact with longline gear, and sightings, which were observations of mammals in the absence of physical contact and sometimes included multiple animals (T. Swenarton, personal communication).

The results presented herein are of three types. First, the data summaries identify marine mammal taxa previously involved in interactions and sightings. Second, time series plots and an annual summary clarify intra- and interannual trends in interactions and sightings. Third, a map depicts the distribution of interactions. In addition, three appendices are provided. The first includes full operational records concerning each interaction; the second contains anecdotal information from fishery observers' notes that describe operational circumstances during interactions, including the condition of the animal involved and actions of those aboard; and the third contains maps of sightings for the commonly encountered taxa.

The objective of this report is to serve as a background document regarding possible effects of the Hawaii-based longline fishery on protected marine mammals. It is appropriate that such a document be prepared at this time because the fishery re-opened for swordfish-targeted activity in April 2004 following the promulgation of mandatory technical changes intended to reduce sea turtle interactions (i.e., Mustad hooks replaced by circle hooks; squid replaced by mackerel as bait). In addition, the Pacific Islands Region is a relatively new, independent entity within NOAA Fisheries, founded in April 2003, and encompasses the largest geographical management within the agency, so compilations of the relevant available may prove useful to fishery managers in decision-making regarding marine mammals. This report should support reasonable conjecture regarding the taxa most likely to be affected by the Hawaii-based longline fishery, the geographical distribution of such effects, and the consequences associated with interactions between this fishery and protected marine mammal species.

Methods

Data Sources

The principal source of the data presented herein is the records gathered by the Hawaii Longline Observer Program from March 1994 through August 2003 (Trips 1-1068; 12745 observed sets), as archived in the ORACLE database system maintained at the Pacific Islands Fisheries Science Center. The interactions data were extracted from the gear set/retrieval and the protected species tally tables. The protected species sightings data were extracted from a separate form, which reflects the fact that sightings can occur in transit and need not occur during any particular set. The detailed summary of interactions provided as Appendix 2 is from observer comments for individual interactions (also see Forney, 2003).

Analysis

Observer data summarizing interactions between marine mammals and longline gear were tabulated by the lowest possible taxon, year, location (see Exclusive Economic Zones, below), and type of longline set. The latter were categorized as shallow, with <15 hooks per float, or deep, with ≥15 hooks per float. Shallow and deep sets, in turn, were believed in most cases to correspond to swordfish- and tuna-targeted sets, respectively. Interactions were categorized by the species involved, the type of occurrence (i.e., hooking, entanglement), and the subsequent condition of the animal. Numbers of sightings were also tabulated in relation to the aforementioned descriptor variables.

Mapping

Interactions with and sightings of marine mammals as reported by longline observers were depicted in maps prepared with the GMT software program (Wessel and Smith 1991). The data were overlaid on a 2-minute resolution bathymetric background (Smith and Sandwell 1997).

Exclusive Economic Zones

The occurrence of marine mammal interactions, sightings, and longline fishing effort were tabulated in US exclusive economic zones (EEZs) using the standard definition of a 200 nautical mile boundary. The Hawaiian archipelago was split into a Northwestern Hawaiian Islands EEZ and a Main Hawaiian Islands EEZ at 161°W longitude. Circular regions were used as approximations for the Jarvis and Kingman/Palmyra EEZs to avoid overly complex computational algorithms. Consequently, the tabulations for these EEZs may be upwardly biased because the officially recognized EEZ polygons are not circular.

Results

Marine mammal interactions and sightings (Table 1) involved animals from two orders (Cetacea, Pinnipedia), in at least six families, 19 genera, and 24 species. Most of the identified genera (12) and species (15) belonged to the family Delphinidae (i.e., true dolphins). The large majority (90%) of all occurrences (*N*=477) consisted of sightings, and among these, 99% involved cetaceans. Of the 21 identified cetacean species, 12 were sighted but were never involved in interactions. There were no interactions involving pinnipeds. Operational details regarding all interactions are presented in Appendix 1.

Sightings of baleen whales (Suborder**:** Mysticeti) comprised a large fraction (23.6%) of the total number of occurrences, but interactions with these animals comprised only 1.5% of the total, equivalent to a 16:1 ratio of sightings:interactions. In contrast, sightings of and interactions with toothed whales (Suborder**:** Odontoceti) comprised 65.6% and 7.5% of all occurrences, respectively, a 9:1 sightings:interactions ratio.

Three delphinids were noteworthy with respect to the occurrence of interactions. Short-finned pilot whale, *Globicephala macrorhynchus*, and false killer whale, *Pseudorca crassidens*, had similar, relatively low sightings:interactions ratios (short-finned pilot whale: 5.4:1; false killer whale: 5.6:1), which reflected their involvement in 36.6% of all interactions. In fact, false killer whales were involved in more interactions than any other species. Risso's dolphin, *Grampus griseus*, was unique as the only identified mammal species with more interactions than sightings (interactions: 7; sightings: 3).

Identification of cetaceans during sightings was apparently an inherently difficult task for fishery observers. Of the total number of interactions and sightings, 11.9% were identified as "cetacean", 14.3% were identified as "whale", 8.2% were identified as "dolphin", and 9.0% were identified as *Delphinus* sp. Such uncertainty was not surprising because sightings could be affected by myriad factors, including ambient light levels, weather conditions, sea state, distance to the animal, degree of activity on the boat, and the level of experience of the observer. Appendix 2 provides unedited observer notes that describe interactions, including such relevant details as degree of activity on the boat and the behavior and condition of the animal involved.

Figure 1 presents a time series of interactions and sightings. The latter comprised either the large majority or the entirety of marine mammal events each year, particularly in 1994-1996. In the six years thereafter (1997-2002), however, the sightings:interactions ratios were relatively low (4-9.33), which reflected both high interaction rates in 1997 and 1999 and a declining sightings rate.

Annual summaries of observed interactions and sightings (Table 2) demonstrated that the number of species involved in interactions never exceeded seven in any year. This number is presented as a range for seven years because one or more animals could not be identified to species. The interaction rate (i.e., interactions/1000 sets) varied by nearly an order of magnitude between 1995 and 2003 (1.1-10.8), with the highest interaction rates in the two years (1997, 1999) with the lowest observer coverage. The interaction rate decreased after 2000 in response to the shift of effort to almost exclusively deep sets, whereas the sightings rate (i.e., sightings/trip) decreased throughout the study period. It should be noted that the interaction and sightings rates are expressed in different units (i.e., *N*/1000 sets vs. *N*/trip) because, as mentioned previously, sightings can occur during travel time, whereas interactions require contact with the longline gear.

Interactions caused five observed instances of mortality, equivalent to an overall mortality rate of 10.9% (5 of 46). Although the interactions consisted primarily of hookings (*N*=35; 76%) rather than entanglements (10; 22%), three of the five instances of mortality involved entanglements on deep sets, and a fourth occurred on a deep set when the animal was hooked but its entanglement status was unknown. The animals involved included two short-finned pilot whales, one bottlenose dolphin, one spotted dolphin, and one Blainville's beaked whale. The latter two instances of mortality occurred during the only interaction reported for the species.

Detailed observer notes (Appendix 2; also see Forney 2003) described 13 of the 21 interactions reported since 2001. Four involved hookings of false killer whales. Notes for two explicitly stated that the whale swam off, apparently unharmed, after cutting the leader, while those for the others described the whale breathing with no apparent trauma when near the boat, but did not describe post-release behavior. Four of the described interactions involved unidentified cetaceans (3 hookings; 1 apparent entanglement). In each case, the animal was observed to swim off after the leader was cut or the line severed. There were two entanglements (1 short-finned pilot whale; 1 humpback whale), both of which ended with the animal free and apparently unharmed. In contrast, one spotted dolphin was killed when the line wrapped around its beak. The notes do not clearly state whether it was the dropper or mainline involved, but do state that the animal was not hooked. A bottlenose dolphin and a Blainsville's beaked whale suffered mortality after entanglement about the flukes and hooking in the flukes, respectively.

Both the frequency and consequences of interactions were apparently influenced by the depth of sets (i.e., set type). Specifically, from 1995-1999 when both shallow and deep sets were permitted in the fishery, 16 interactions occurred on shallow sets, whereas only two occurred on deep sets. These values would correspond to interactions on 1.2% and 0.2% of the observed shallow and deep sets during those years, respectively. Despite the higher frequency of interactions, however, only one instance of mortality has ever been observed on a shallow set. Entanglements on deep sets may be particularly hazardous because the animal could be immobilized and drown, whereas hooking in the absence of entanglement should not preclude surfacing to breathe.

The distribution of interactions and sightings in the various exclusive economic zones (EEZs) exploited by this fishery is summarized in Table 3. The majority (62%) of all interactions occurred outside any EEZ. The frequency of these occurrences was 0.5% (29 interactions on 6173 observed sets). The highest frequency was observed in the Palmyra/Kingman EEZ (7 interactions on 801 observed sets; 0.9%). In contrast, interactions were never observed in the EEZ of either Jarvis Island or Johnston Atoll (pooled *N*=533 observed sets).

Figure 2 depicts the geographical distribution of all interactions throughout the study period. The distribution resembles an inverted triangle, with its base ca. 30˚-35˚N. Risso's dolphins were involved in a relatively high number of interactions (5) within a narrow latitudinal band (30.4˚-33.2˚N) across a broad longitudinal band (135.9˚-160.9˚W). In contrast, false killer whales were involved in interactions across 23.8 degrees of latitude (5.2˚-29.0˚N) but a smaller longitudinal range (149.0˚-166.5˚W). Short-finned pilot whales were involved in interactions across wide latitudinal and longitudinal ranges (6.5˚-35.9˚N; 142.1˚-170.1˚W).

Observer sightings contributed to the understanding of both the distributions and social behavior of marine mammals in areas exploited by the Hawaii-based longline fishery (Table 4; Appendix 3). For example, humpback whales (Figure A3a) were seen most commonly in January and February in the MHI EEZ as solitary animals or in small pods, reflecting use of Hawaiian waters as winter calving habitat. Sperm whales (Figure A3b), in contrast, were seen almost year-round, most often in the NWHI EEZ, and in slightly larger pods than

humpbacks. False killer whales (Figure A3c) were the most frequently sighted species, present in every EEZ except Jarvis, with no apparent seasonality. Short-finned pilot whales (Figure A3d) were the only species with a large fraction of sightings in the PK EEZ. Bottlenose dolphins, spinner dolphins, and spotted dolphins (Figures A3e-f) were all seen most frequently in the MHI EEZ. The latter two species had considerably larger pod sizes than bottlenose dolphins. In addition, spinner dolphins were never sighted in December-February, whereas the other two species were seen essentially throughout the year. Finally, common dolphins (*Delphinus* sp., Figure A3g) were frequently sighted across a broad longitudinal range in the northern areas exploited by this fishery (ca. 30º-45ºN). These animals were probably short-beaked dolphins, *D. delphis*, rather than *D. capensis*, on the basis of their pelagic distribution (Kinze 2001). If so, short-beaked dolphins would have been the third most frequently sighted species, with a low interaction rate and no observed instances of mortality.

Discussion

A total of 12745 observed sets deployed from March 1994 through August 2003 documented a low average frequency of interactions between marine mammals and the Hawaii-based longline fleet (0.4%), and an average mortality rate one-tenth that of the interactions (0.04%). In a typical year, with approximately 12000 sets deployed by this fleet, this suggests that approximately 48 interactions would occur, causing about five instances of mortality. These very rough approximations, however, are predicated upon the assumptions that all taxa are equally subject to interactions and mortality, which appear to be questionable. Short-finned pilot whales, spotted dolphins, and Blainville's beaked whales may exemplify species with relatively low tolerances to stress, whereas false killer whales, the species with the greatest numbers of interactions and sightings, may be much less susceptible to interaction-induced injury or mortality.

Reopening the swordfish sector of this fishery will probably lead to increased activity in northern areas (i.e., ≥30ºN). It is likely that fishing in these areas will lead to increased sightings, particularly of common and to a lesser extent bottlenose dolphins, and possibly interactions, which occur more than four times as often on shallow than deep sets. It is, however, not clear that any such changes would be accompanied by associated changes in mortality rates. Shallow sets are much less likely to cause mortality, and common dolphins were involved in only one interaction and never suffered associated mortality. Moreover, there was no obvious geographical pattern to the rare instances of mortality, which occurred across very broad geographic ranges (6.2º-35.9ºN; 142.1º-164.7ºW). Hence, swordfish-directed activity may have little if any effect on fishery-induced mortality of marine mammals.

References

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Acknowledgments

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Table 1. Summary of marine mammals (Class: Mammalia) interactions ('I') with or sightings ('S') by the Hawaii-based longline fleet from March 1994 through August 2003 as reported by the Hawaii Longline Observer Program. Entries include the order, suborder, family, common and scientific names, species code (as used by the Hawaii Longline Observer Program and in the ORACLE database), and type(s) and number of occurrence(s).

Order	Suborder	Family	Species	Code	Occurrence
Cetacea	Mysticeti	Balaenopteridae	Humpback whale, *Megaptera noveangliae*	MN	I: 2; S: 34
			Minke whale, *Balaenoptera acutorostrata*	BA	I: 0; S: 11
			Blue whale, *Balaenoptera musculus*	BM	I: 0: S: 3
			Fin whale, *Balaenoptera physalus*	BP	I: 0; S: 2
	-----	-----	Unidentified whale	UW	I: 5; S: 63
	Odontoceti	Physeteridae	Sperm whale, *Physeter macrocephalus*	PM	I: 1; S: 22
		Delphinidae	Risso's dolphin, *Grampus griseus*	GG	I: 7; S: 3
			Bottlenose dolphin, *Tursiops truncatus*	TT	I: 3; S: 22
			Spinner dolphin, *Stenella longirostris*	SL	I: 2; S: 13
			Spotted dolphin, *Stenella attenuata*	SA	I: 1; S: 14
			Striped dolphin, *Stenella coeruleoalba*	SC	I: 0; S: 3
			Short-finned pilot whale, *Globicephala macrorhynchus*	GM	I: 5; S: 27
			False killer whale, *Pseudorca crassidens*	PC	I: 10; S: 56
			Killer whale, *Orcinus orca*	OO	I: 0; S: 9
			Pygmy killer whale, *Feresa attenuata*	FA	I: 0; S: 2
			Short-beaked common dolphin, *Delphinus delphis*	DS	I: 0; S: 3
			Unidentified common dolphin, *Delphinus* sp.	DD	I: 1; S: 42
			Fraser's dolphin, *Lagenodelphis hosei*	LH	I: 0; S: 1
			Pacific white-sided dolphin, *Lagenodelphis obliquidens*	LO	I: 0; S: 4
			Northern right whale dolphin, *Lissodelphis borealis*	LB	I: 0; S: 1
			Roughtoothed dolphin, *Steno bredanensis*	SB	I: 0; S: 2
			Melonheaded whale, *Peponocephala electra*	PE	I: 0; S: 1

Table 1, continued.

Order	Suborder	Family	Species	Code	Occurrence
		Ziphiidae	Blainville's beaked whale, *Mesoplodon densirostris*	MD	I: 1; S: 0
			Unidentified beaked whale	ZU	I: 0; S: 1
		?	Unidentified dolphin	UD	I: 0; S: 38
		?	Unidentified cetacean	UC	I: 8; S: 49
Pinnipedia	-----	Phocidae	Hawaiian monk seal, *Monachus schauinslandi*	MS	I: 0; S: 1
	-----	Otariidae	California sea lion, *Zalophus californianus*	ZC	I: 0; S: 2
			Northern fur seal, *Callorhinus ursinus*	CU	I: 0; S: 2

Table 2. Annual summary of marine mammal interactions and sightings (all taxa pooled). Entries are the numbers of observed trips, sets, interactions ('I'), interactions/set*1000, interactions/trip, interaction type (i.e., hooking: 'H'; entanglement: 'E'; unknown: 'U'), condition code (i.e., injured: 'Inj'; dead: 'D'; unknown: 'U'), the set type (i.e., shallow: 'S'; deep: 'D') of each interaction, the number of species involved in interactions, sightings ('S'), and sightings/trip.

Year	Trips	Sets	I	I / 1000 sets	I / trip	I Type	Condition	Set Type	Species	S	S / trip
1994	49	509	0	-----	-----	-----	-----	-----	-----	74	1.5
1995	48	549	3	5.5	0.06	3 H	3 Inj	3 S	2	43	0.9
1996	53	642	3	4.7	0.06	H, E, U	Inj, D, U	1 D; 2 S	1-3	45	0.8
1997	40	499	4	8.0	0.10	4 H	4 Inj	4 S	3	32	0.8
1998	47	591	3	5.1	0.06	3 H	3 Inj	1 D; 2 S	1-3	26	0.6
1999	39	461	5	10.8	0.13	4 H, 1 E	5 Inj	5 S	3-5	20	0.5
2000	116	1432	7	4.9	0.06	5 H, 2 E	6 Inj, 1 D	3 D; 4 S	4-6	40	0.3
2001	234	2804	10	3.6	0.04	6 H, 4 E	9 Inj, 1 D	9 D; 1 S	5-7	73	0.3
2002	279	3500	9	2.6	0.03	7 H, 1 E 1 H+E	8 Inj, 1 D	9 D	3-5	54	0.2
2003	142	1758	2	1.1	0.01	1 H, 1 E	1 Inj, 1 D	2 D	1-2	22	0.2

Note: A range for the number of species (e.g., 1-3, 1996) indicates that one or more animals remained unidentified.

Table 3. Summary of marine mammal interactions with or sightings by the Hawaii-based longline fleet from March 1994 through August 2003 in the exclusive economic zones (EEZs) utilized by the Hawaii-based longline fishery. 'PK', 'MHI', and 'NWHI' refer to the Palmyra/Kingman EEZ, Main Hawaiian Islands EEZ and Northwestern Hawaiian Islands EEZ, respectively. Entries are annual totals for observed sets (left), interactions (center, 'I'), and sightings (right, 'S') in each EEZ. See Table 2 for pooled trip and set totals.

Year	Outside			P/K			Jarvis			Johnston			MHI			NWHI		
	Sets	I	S	Sets	I	S	Sets	I	S	Sets	I	S	Sets	I	S	Sets	I	S
1994	232	0	41	5	0	0	0	0	0	0	0	0	159	0	27	112	0	6
1995	265	3	12	0	0	0	0	0	0	1	0	0	170	0	20	113	0	11
1996	347	3	24	0	0	0	0	0	0	1	0	0	175	0	18	119	0	3
1997	352	3	18	4	0	0	0	0	0	9	0	0	68	1	12	66	0	2
1998	360	1	12	46	0	1	0	0	0	2	0	0	91	0	10	92	2	3
1999	210	4	10	24	0	0	0	0	0	0	0	0	131	0	8	96	1	2
2000	706	7	18	84	0	2	0	0	0	140	0	2	286	0	12	216	0	8
2001	981	4	14	257	3	14	0	0	0	108	0	1	1196	2	41	428	2	16
2002	1633	4	15	376	4	11	49	0	3	150	0	0	1182	1	11	229	0	14
2003	1087	0	9	5	0	0	6	0	0	83	0	2	453	2	10	166	0	3

Table 4. Summary of sightings of the seven most common identified species. Entries are the species, number of sightings, years and months sighted, mean pod sizes (with standard deviation), and the EEZs where sightings occurred.

Species	*N*	Years sighted	Months sighted	Months with most sightings	Pod size	EEZ sighted	EEZs with most sightings
Humpback whale	34	1994-1996, 1998-2002	1, 2, 3, 5, 6, 8, 9	1: 34%; 2: 26%	2.6±2.3	O, MHI, NWHI	MHI: 62%; O: 21%
Sperm whale	22	1994-1997, 2000-2001, 2003	1-8, 10, 12	4: 18%; 7: 18%	3.6±3.3	O, MHI, NWHI	MHI: 32%; NWHI: 36%
False killer whale	56	1994-1998, 2001-2003	1-7, 9-12	3: 14%; 6: 16%	5.5±5.5	O, PK, Johnston, MHI, NWHI	O: 32%; MHI: 25%
Short-finned pilot whale	27	1994, 1996, 1998-2003	1-3, 5-10, 12	2: 22%; 7: 19%	7.2±9.8	O, PK, MHI, NWHI	O: 33%; PK: 33%
Bottlenose dolphin	22	1994-1997, 1999-2000, 2002-2003	1-6, 9, 11, 12	1: 14%; 2: 14%; 6: 14%; 11: 14%	5.8±4.5	O, PK, Jarvis, MHI	MHI: 55%; O: 32%
Spotted dolphin	14	1994-1997, 2000-2003	1-6, 8, 10-11	6: 21%; 3: 14% 10: 14%	22.7±24.1	O, PK, MHI, NWHI	MHI: 64%; NWHI: 21%
Spinner dolphin	13	1994-1995, 1998, 2000-2002	3-11	6: 15%; 9: 15%; 10: 15%	23±9	Jarvis, MHI, NWHI	MHI: 85%

Figure 1

Marine Mammal Interactions and Sightings (1994-2003)

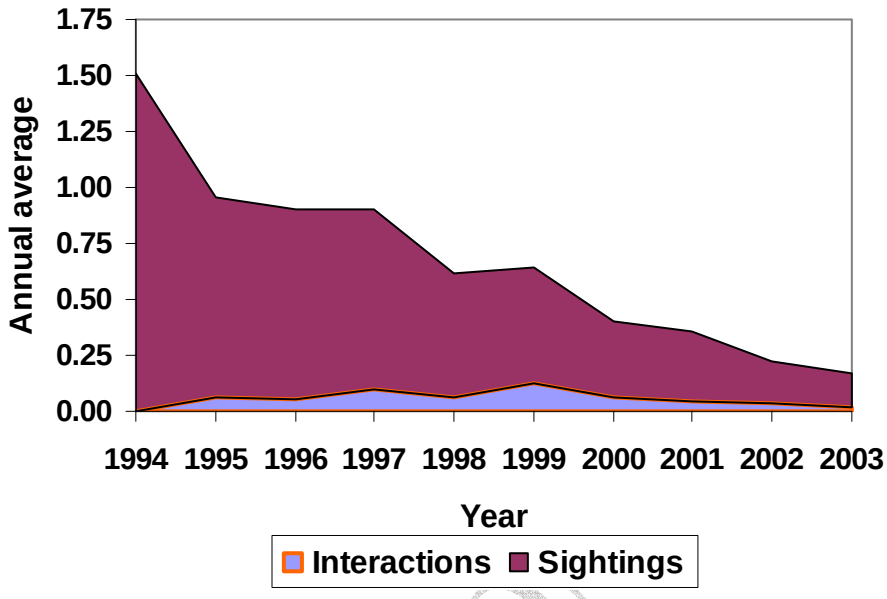
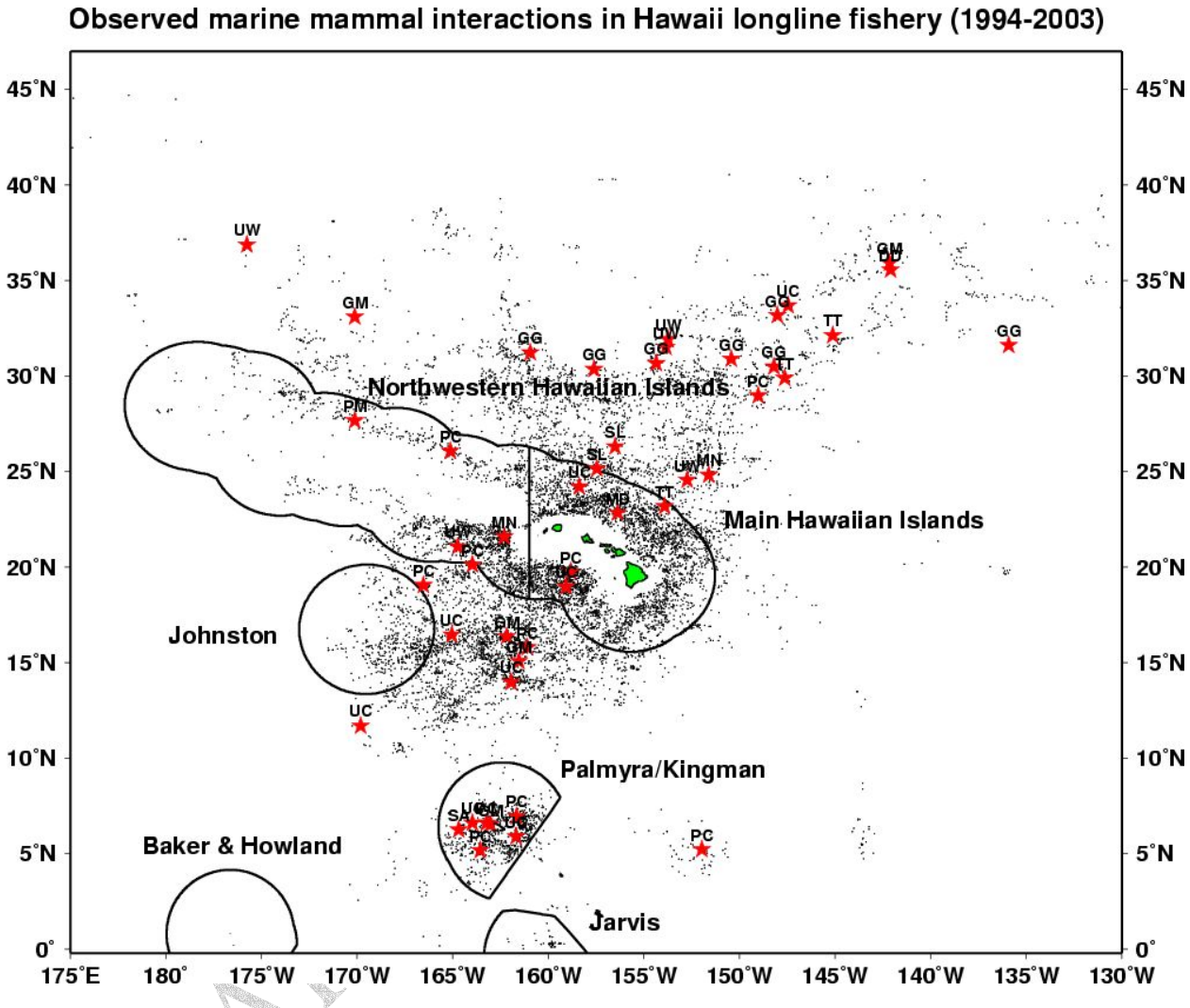


Figure 2



APPENDICES

Appendix 1. Listing of observed marine mammal interactions from March 1994 through August 2003. Entries include the year and month, the trip number assigned by the Hawaii Longline Observer Program, the set number, interaction location, species involved, and set type. Species codes conform to Table 1. Set types conform to Table 2.

Appendix 2. Compilation of fishery observer notes, if available, for longline sets with a marine mammal interaction. Entries include the trip number, set number, and photo sequence number.

Appendix 3. Maps of marine mammal sightings from March 1994 through August 2003.
Figure A3a. Humpback whales.
Figure A3b. Sperm whales.
Figure A3c. False killer whales.
Figure A4d. Short-finned pilot whales.
Figure A4e. Bottlenose dolphins.
Figure A4f. Several mammal species, all of which were sighted less than 20 times.
Figure A4g. Common dolphins, identified to the genus level (*Delphinus* sp.).

Appendix 1.

Year	Month	Trip	Set	Latitude (°N)	Longitude (°W)	Species	Set type
1995	3	61	2	30.9	150.4	GG	S
1995	3	63	1	30.5	148.2	GG	S
1995	3	63	11	29.9	147.6	TT	S
1996	5	126	3	14.0	162.0	UC	D
1996	8	134	9	36.9	175.8	UW	S
1996	12	148	5	35.9	142.1	GM	S
1997	3	160	12	30.7	154.4	GG	S
1997	3	161	1	30.4	157.6	GG	S
1997	4	164	25	26.3	156.5	SL	S
1997	8	173	11	19.8	158.8	PC	S
1998	1	191	3	31.5	153.9	UW	S
1998	4	201	20	26.1	165.1	PC	S
1998	11	228	10	21.1	164.7	UW	D
1999	1	239	11	31.9	153.7	UW	S
1999	1	240	6	32.1	145.1	TT	S
1999	2	242	9	31.2	160.9	GG	S
1999	5	257	8	27.7	170.1	PM	S
1999	12	270	3	33.7	147.5	UC	S
2000	1	284	2	31.6	135.9	GG	S
2000	5	302	1	24.6	152.8	UW	D
2000	7	305	2	33.1	170.1	GM	S
2000	10	323	13	16.5	165.0	UC	D
2000	10	331	5	15.1	161.5	GM	D
2000	11	348	8	25.2	157.5	SL	S
2000	12	353	19	35.6	142.1	DD	S
2001	1	387	16	19.0	159.1	UC	D
2001	1	392	3	20.1	164.0	PC	D
2001	1	400	2	33.2	148.0	GG	S
2001	2	418	5	5.2	163.6	PC	D
2001	2	433	3	21.6	162.3	MN	D
2001	3	446	1	19.1	166.5	PC	D
2001	8	526	1	6.5	163.0	GM	D
2001	9	535	11	16.4	162.2	GM	D
2001	10	558	6	11.7	169.8	UC	D
2001	10	559	5	6.3	164.7	SA	D
2002	2	656	17	7.0	161.7	PC	D
2002	2	663	10	5.2	152.0	PC	D
2002	3	695	11	6.6	163.2	PC	D
2002	4	725	10	22.8	156.4	MD	D
2002	6	792	8	5.9	161.7	UC	D
2002	7	804	4	6.6	164.0	UC	D
2002	7	808	3	15.8	161.1	PC	D
2002	9	850	2	29.0	149.0	PC	D
2002	10	860	12	24.8	151.6	MN	D
2003	2	962	2	23.2	153.9	TT	D

2003	4	993	11	24.2	158.4	UC	D

Appendix 2.

Shortfinned Pilot Whale
LL0535 11 1598
MAMMAL NOT VISIBLE IN PHOTOGRAPHS

False Killer Whale
LL0656 17 1628
False Killer whale Id characteristics include: Black , dark body coloration, dorsal fin was narrow and pointed the the tip, its position was about mid length of body, head was slender, conical shaped w/ no beak observed, overall body length was small about 7 ot 8 feet, It was observed prior to actually seeing the whale that bait stripping had occurred Approx 2 or 3 bouys proir to the hooked whale had bait completely stripped from the hooks or had only heads remaining.//photo?s were taken w/camera ABV-1 frames 8,7,6, The whale was pulled in as close to the boat as possible before cutting the leader line, Approx 2 feet of mono line w/ a weight 6 inches of wire and hook remaind attached to the whale as it was released.

False Killer Whale
LL0695 11 1682
THE WHALE WAS HOOKED IN THE MOUTH AND WAS ALIVE AND STRUGGLING WHEN THE HOOK WAS BEING RETRIEVED. AT LEAST TWICE DURING RETRIEVAL THE WHALE WAS ABLE TO SURFACE AND BREATHE. AS IT BECAME MORE DIFFICULT TO BRING THE WHALE CLOSER, THE LINE WAS CUT WITH ABOUT 10-12 FT. STILL ON THE HOOK. THE WHALE SWAM AWAY AND APPEARED IN GOOD SHAPE. WATER TEMP. WAS 83.0F, TIME WAS 20:10.POSITION 6'55.2N 163'19.8W. IDENTIFYING CHARACTERISTICS: ALL BLACK BODY , S-SHAPED PECTORAL FIN, DORSAL FIN AT MID-BODY AND IN A CRESCENT-SHAPED, IT WAS ABOUT 15-18' LONG WITH A BLUNT HEAD.

False Killer Whale
LL0392 3 1422
At 1703 a False Killer whale was caught in the vicinity of floats 36,37,38. Before it was realized that a marine mammal was caught the crew was dealing with a big tangle sometimes cutting branch lines or tying them off to the rail. The whale surfaced about 4-5m from the boat it was hooked in the mouth and was tied off to the rail. The animal was 3-4 m in length with a black and a bulbous head it had a short based falcate dorsalfin. While it was tied off it swam around casually coming up for air often.

Unidentified Cetacean
LL0558 6 1599
The gear became severely tangled up after about float #85, the crew had been untangeling gear for about 45 minutes. I saw several floats together moving around about 50 meters from the vessel, as I got up and moved closer to the edge of the boat to see, the captain yelled for everyone to clear the deck, the mainline was going to snap, so I went to the far corner, someone yelled "whale" and I could barely see something greyish and whale-like, outside of the boat lights. The mainline snaped, the cetacean musht have quickly swam off because I only caught a glimpse of it. The captain identified it as a false killer whale and said it was tangeled or caught in the mainline.

Spotted Dolphin
LL0559 5 1600
ID Charcters: spots on belly; dark cape extending down almost to belly; strongly falcate dorsal fin.
Narrative: Hauling gear back in. Ata about 2220, while pulling up dropper lines, the dolphin came to the surface with the line wraped around its beak, but not hooked in the animal itself. Dolphin was dead when brought to surface. Took 6 pictures (frames 18-23) of the dolphin. Unfortunately, the crew removed the line from around the beak before pictures could be taken. Took measurements including total straight length, girth, and front flipper length. Put dolphin in hold overnight until able to call NMFS and determine if it should be returned or not. No permit so dolphin was returned overboard the following afternoon.

Blainville's Beaked Whale
LL0725 10 1704
POSITIVE IDENTIFICATION WAS NOT POSSIBLE AT TIME OF CATCH. THE CETACEAN HAD A SHORT BEAK. IT WAS CREAM IN COLOR WITH THE LOWER JAW BEING A LIGHTER COLORATION. IT WAS DEAD ON LINE, AND HOOKED IN FLUKE. ANIMAL WAS TO LARGE TO BE BROUGHT ABOARD, WHERE POSITIVE IDENTIFICATION COULD HAVE BEEN MADE. PICTURES TAKEN WITH CAMERA JKB1, FRAMES 18 AND 17. ANIMAL CAUGHT AT LAT. 2250.6 N, LON. 15637.6 W. POSITIVE ID FROM PHOTOS AS UNIDENTIFIED BEAKED WHALE.

Unidentified Cetacean
LL0792 8 1726
UC, NO HOOK NUMBER; FLOATER 5,6,7 TANGLED, HOWEVER THE CETACEAN WAS CLEAR OF THE TANGLE. HOOK POSITION NOT KNOWN. THE HOOK PULLED OUT WHEN THE CETACEAN WAS APPROXIMATLY 10 METERS OUT FROM THE DOOR. THE CETACEAN WAS SEEN TWICE; BOTH TIMES ONLY DORSAL FIN AND ARCHED BACK WAS VISIBLE IN POOR LIGHTING, IDENTIFICATION WAS NOT POSSIBLE. CETACEAN SEEN WHEN HOOKED AND SWIMMING AWAY. THE CETACEAN APPEARED TO SWIM AWAY WITH NO PROBLEM, HAVING NO GEAR ATTACHED, NO PHOTOS TAKEN.

Unidentified Cetacean
LL0804 4 1729
A 5 MINUTE ENCOUNTER OCCURRED AT 2040 (POSITION 637.1N 16418.7W) IN WHICH AN UNIDENTIFIED CETACEAN (GREY DORSALLY, SMALL IN SIZE (3 M.), SLIGHTLY FALCATE DORSAL FIN GREY IN COLOR, THE ANIMAL BROKE THE SURFACE REPEATEDLY TO BREATHE WITH GEAR TRAILING FROM ITS BODY AND OR PEHAPS ITS FLUKES. DISTANCE TO THE VESSEL WAS APPROX 15 M.. EVENTUALLY THE DOLPHIN BROKE THE LEADER AND SWAM FREE. APPARENTLY ONLY ONE HOOK WAS ENVOLVED. SEA CONDITIONS WERE FLAT W/ AN IMPERCEPTIBLE SWELL. THE CETACEAN WAS VERY ACTIVE WHILE STRUGGLING AGAINST THE MAINLINE AS WAS BROUGHT IN.

False Killer Whale
LL0850 2 1746
I first caught sight of the whale well below the surface (20 feet) just as crew started to haul branch line. It was obvios from the tension in the line that the catch was quite large and still alive. A struggling crew of three managed to get the whale to the surface in about three minutes. When it broke the surface it cleared its blow hole and made a high pitch squeaking sound for about four seconds then immediately dove. Struggling for another minute the crew managed to get the whale to the surface again and it repeated the high pitch squeaking. The crew cut the line just at the end of the leader, leaving about 12 inches of wire leader hanging from the mouth with the hook ingested. The whale dove immediately and was out of sight within 5 seconds, never to be seen again. Although the two moments that the whale surfaced were brief I was able to get a clear view of key characteristics. On both occasions the whale broke the surface moving slowly in a calm an gentle manner. I got a clear view of the entire length of the dorsal surface the first time out and a perfect profile view of the head the second time. There was no entanglement with either the branchline or mainline and there were no markings on the body to indicate a prior entanglement. The whale appeared healthy as it swam away.
KEY CHARACTERISTICS
1. Coloration- body color uniform solid black with no visible white markings of discoloration (ie) no sakkle patch, no eye patch, no coloration around lips
2. Dorsal fin - placement of dorsal fin at midpoint of body. Falcate with posterior margin arcing smoothly inward. Pointed tip. Base of dorsal not noticeably thick.
3. Head shape - bullet shaped profile. Smooth taper to tip of rounded mouth. No bulbous forehead as in pilot whale
4. Body shape - streamline and slim. Total length about 10 feet.
5. Behaviors - high pitch squeaking sound. Slow and gentle movements.
GEAR INFO

1. Bait - sardine, dyed blue
2. Hook and line - hook ingested. No entanglement wi

Humpback Whale
LL0860 12 1747
Position: 2428.8 N 15112.2 W. TIME BEGAN: 1645; TIME END:1833: DISTANCE TO VESSEL: APPROX 30FT. ID CHARACTERISTICS: APPROX 30FT LENGTH, LARGE BUSHY BLOW; DARK GREY-BLACK BODY; DISTINCTIVE DORSAL FIN (HUMP); KNOBBY HEAD. NARRATIVE: AS THE VESSEL APPROACHED THE RADIO BUOY BLOWS WERE SEEN AROUND THE FIRST FLOAT, WHICH WAS SIGNIFICANTLY CLOSER TO THE RADIO BUOY THAN IT SHOULD HAVE BEEN. THE WHALE APPEARED TO BE RESTING OR SCRATCHING ON THE FLOATLINE. AS THE VESSEL APPROACHED CLOSER THE WHALE DOVE AND MAINLINE (ONLY) COULD BE SEEN WRAPPED AROUND THE BASE OF THE FLUKE. THE WHALE PULLED THE FLOAT UNDERWATER BUT THE RADIO WAS BROKEN OFF FROM THE MAINLINE AFTER A FEW MINUTES. WE WERE ABLE TO LOCATE THE LINE AGAIN ABOUT 6 FLOATS DOWN THE GEAR (APPROX 45 METERS). AFTER HAULING BACK TO THE FIRST FLOAT, THE WHALE WAS AGAIN RESTING ON THE SURFACE AND WE WERE ABLE TO UNTANGLE ALL BUT APPROX 30 FEET OF MAINLINE FROM THE ANIMAL BEFORE THE LINE BROKE OFF AGAIN CLOSE TO THE ANIMAL'S BODY. THE ANIMAL SEEMED TIRED, BUT FINE WHEN THE VESSEL LEFT THE AREA. NO PICTURES WERE TAKEN DUE TO THE FACT THAT IT WAS DARK AND THE ANIMAL REMAINED SUBMERGED MOST OF THE TIME.

Shortfinned Pilot Whale
LL0526 1 1597 0636.2N 16310.9W, BEGIN 1655 END 1710, DURING GEAR RETRIEVAL, 200M TO VESSEL, CONTINUAL SURFACING OF WHALE. CREW CONTINUED TO SLOWLY PULL IN GEAR. NO OTHER SPECIES IN SIGHT. AFTER 15 MINUTES WHALE SET ITSELF FREE AND WHALE DISAPPEARED. NO INDICATION OF INJURY. GEAR WAS NOT MISSING NOR PARTED.

Bottlenose Dolphin
LL0962 2 1830
Dolphin came up with mainline wrapped around flukes.There was a branch line also wrapped around the flukes but the animal was not hooked. After securing the animal on deck I took the position2313.9N and 15359.5W. Using the Leatherwood guide I determined it to be a Bottlenose Dolphin. It had a short snout with a definite demarcation between the snout and the melon. The body was uniformly black dorsally going to gray on the ventral surface, no spots, stripes or cape markings. The tooth count was 21/side upper 18/side lower photos were taken with NMFS camera 962 #1 left side head #2 left side tail. #3 left side scar #4 left side close up of head #5 right side head #6right side tail #7 genital slit. Animal was returned to sea.

Unidentified Cetacean
LL0993 11 1851
Caught near end of haul. Darkness, rain and roughness of sea made species identification too difficult. Two pictures were taken of the whale: Camera DL2; Frames 25, 24. Whale was alive and fighting vigorously making it impossible to bring it near boat. Whale looked to be approx. 3m in length. Dorsal fin was small and toward the rear of animal. Whale seemed to be grayish in color and have rather smooth skin. Head was never seen clearly (but may be in pictures). Little more was able to be discerned about the whale's appearance due to sighting conditions. Whale was not seen previous to hooking. It surfaced around 5 times as the crew tried to pull it near the boat. The whale was fighting lively and the crew was unable to pull it close. When given the OK to cut it loose, the crew pulled it in as close as possible (approx. 10m from boat) and cut line.

Figure A3 a

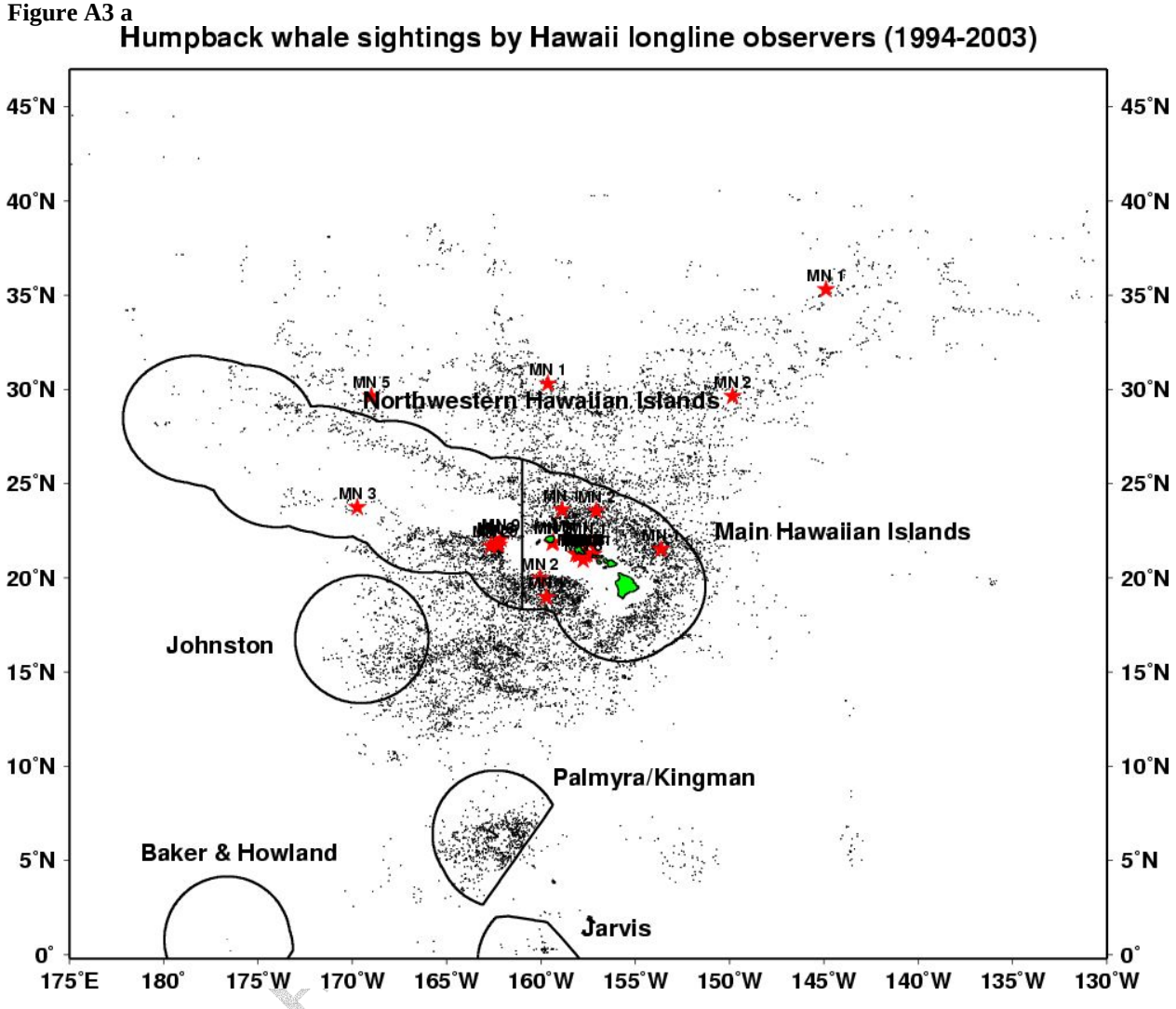


Figure A3 b

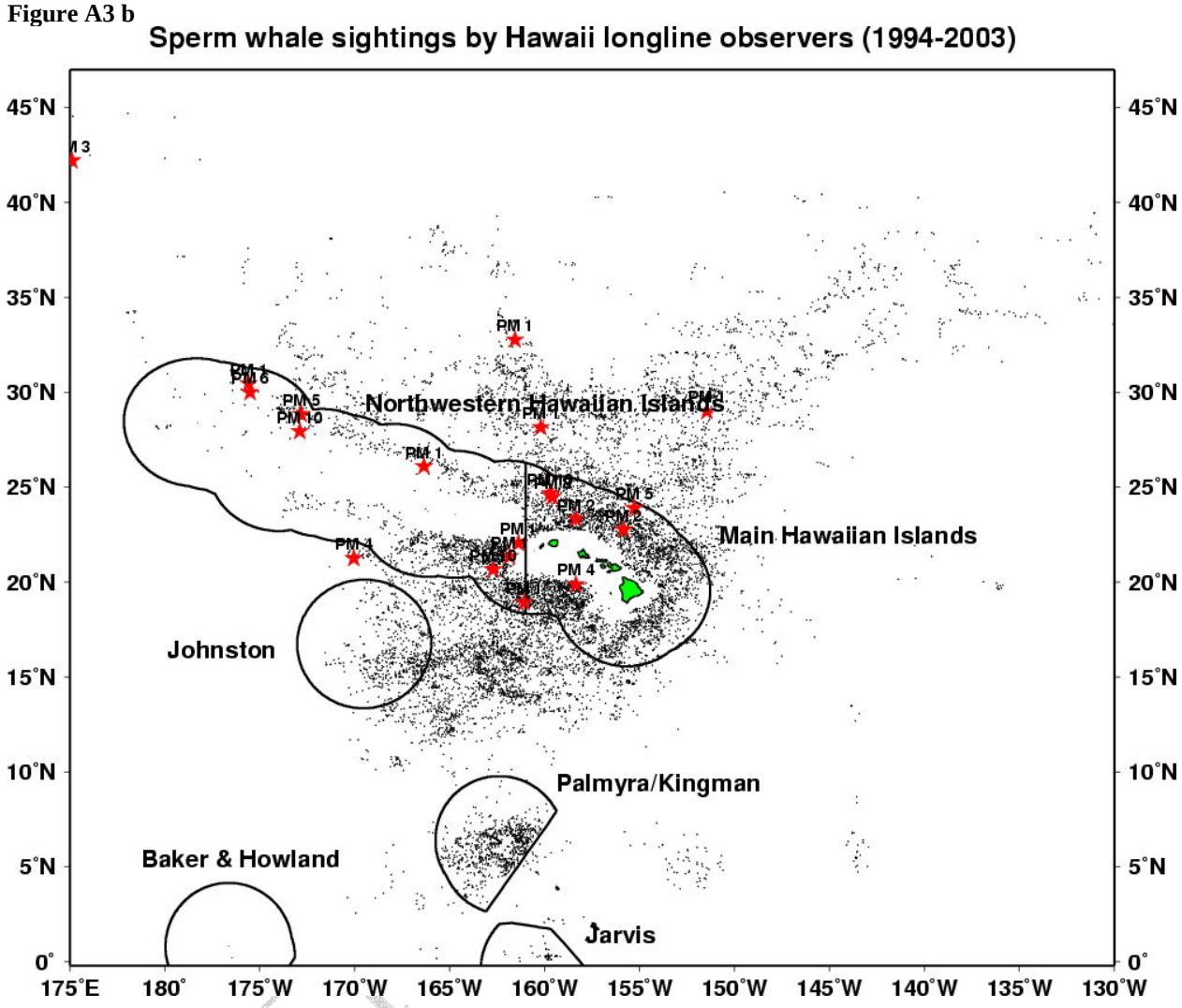
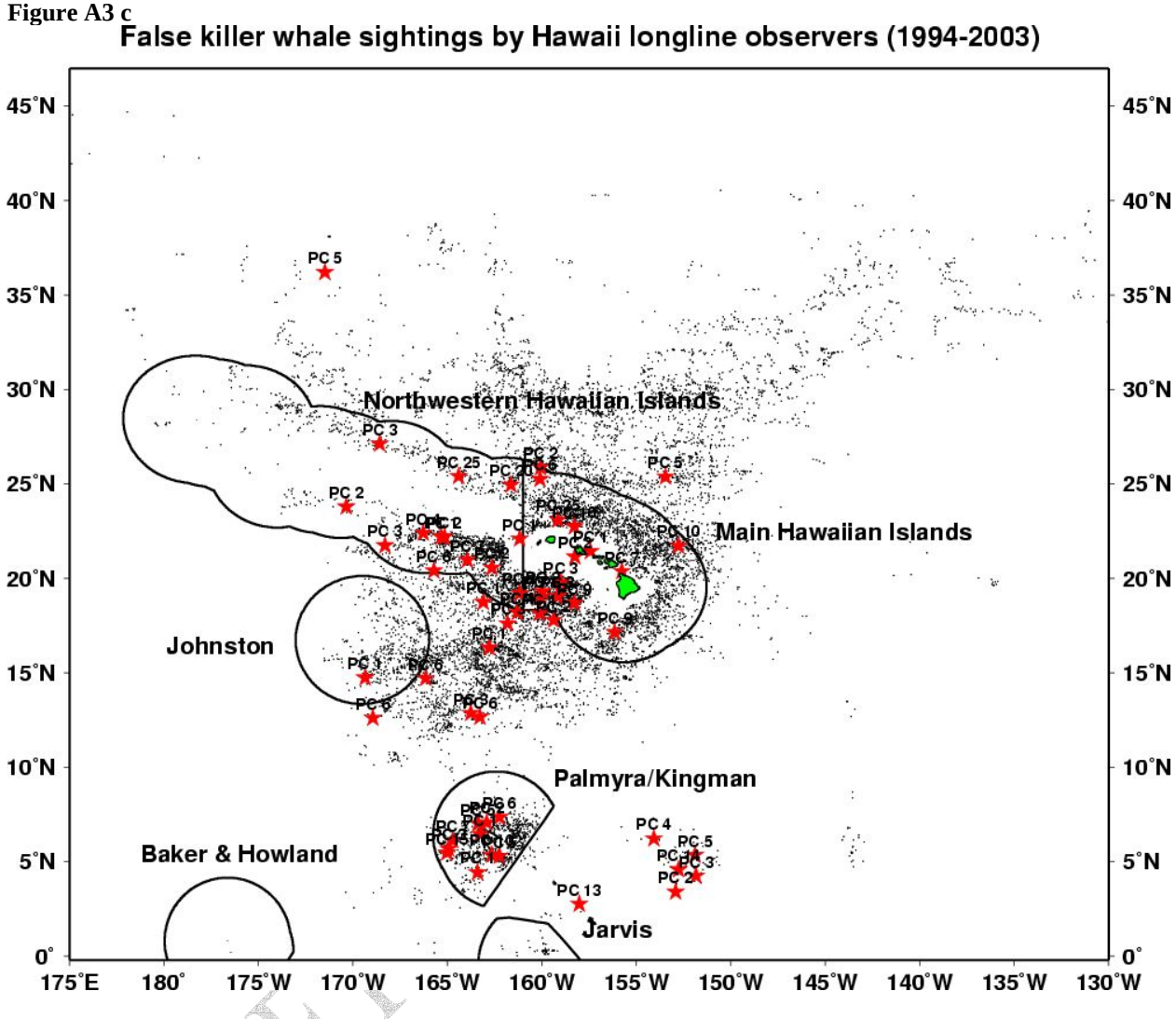


Figure A3 c



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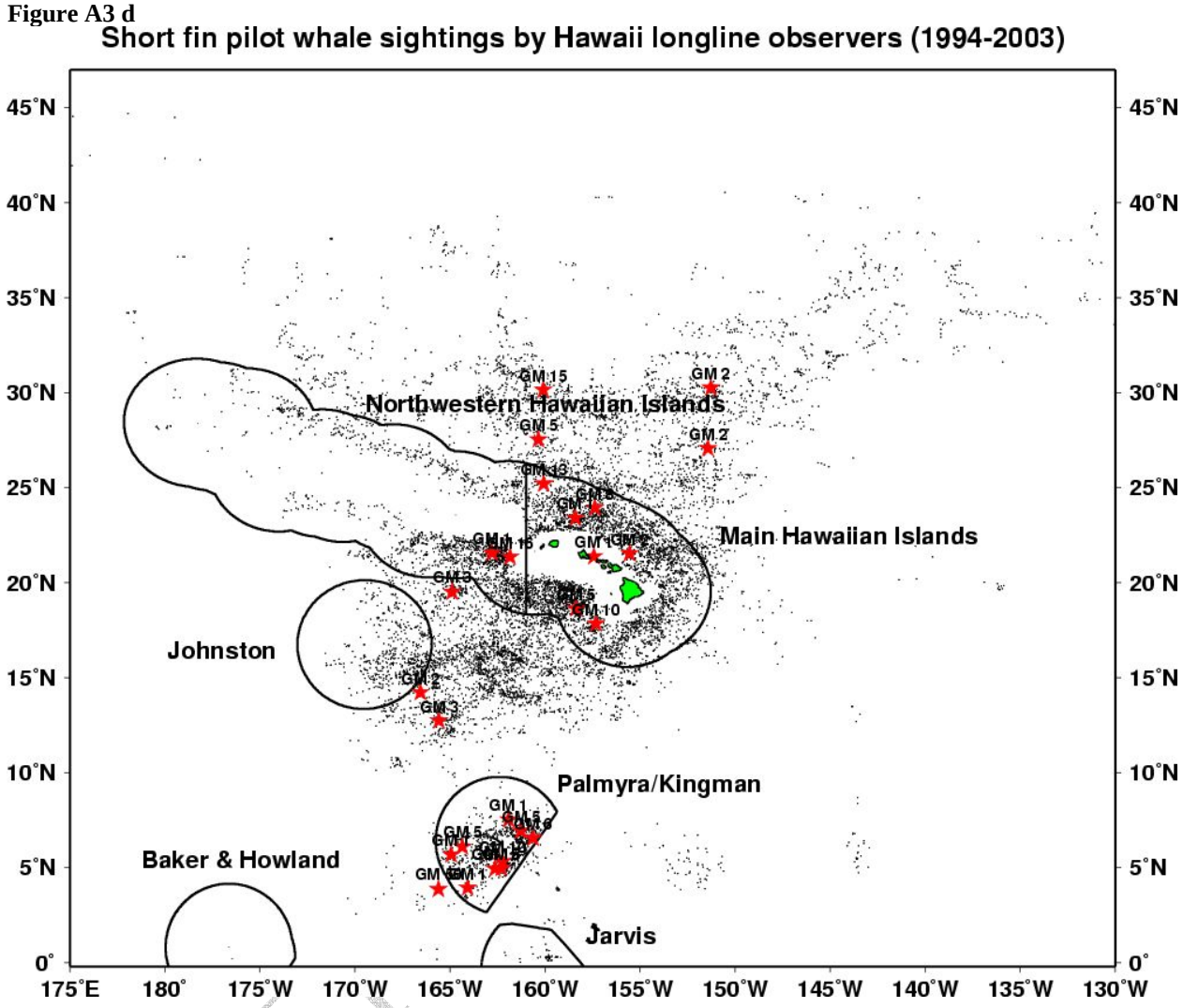

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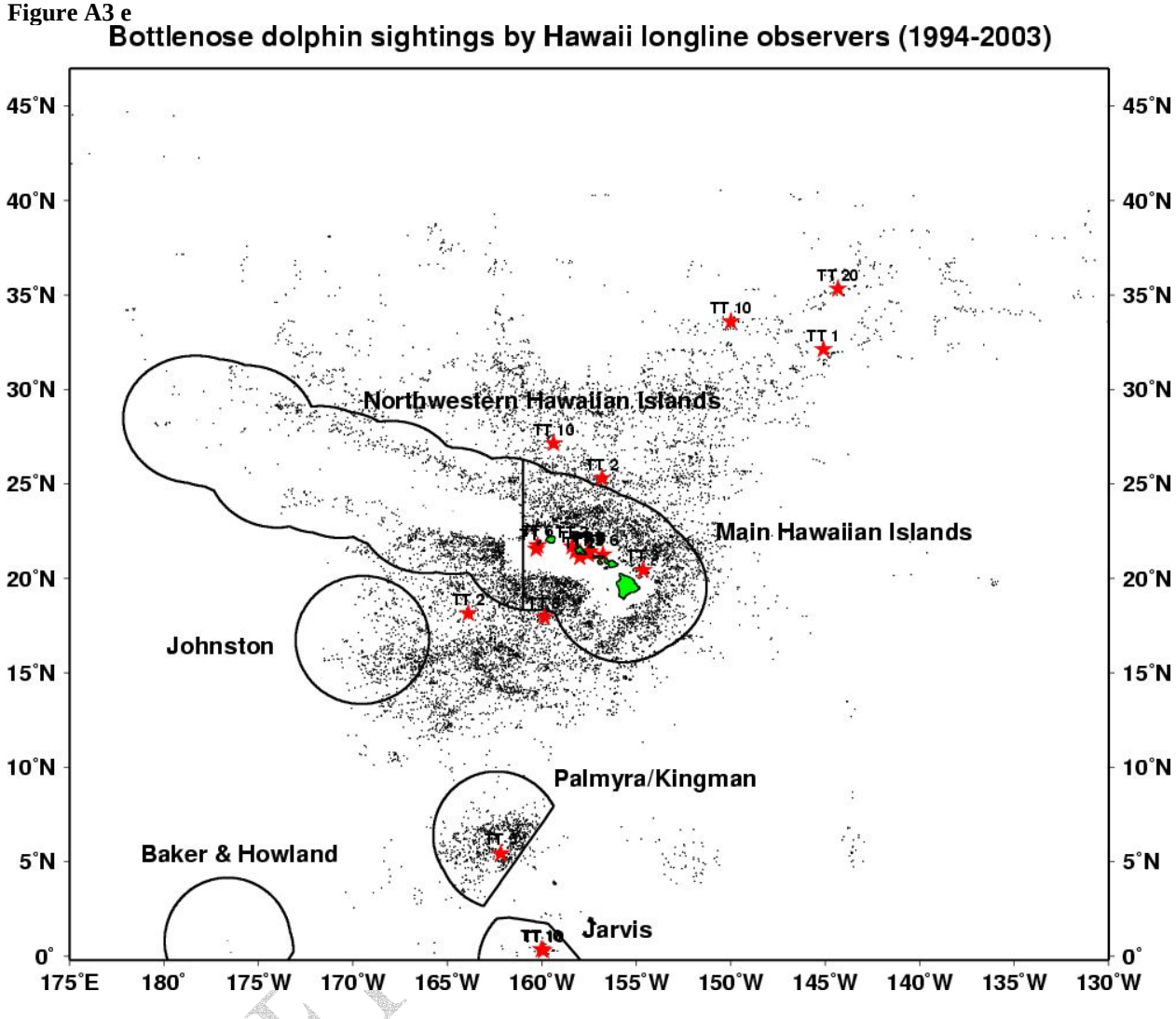

Figure A3 f

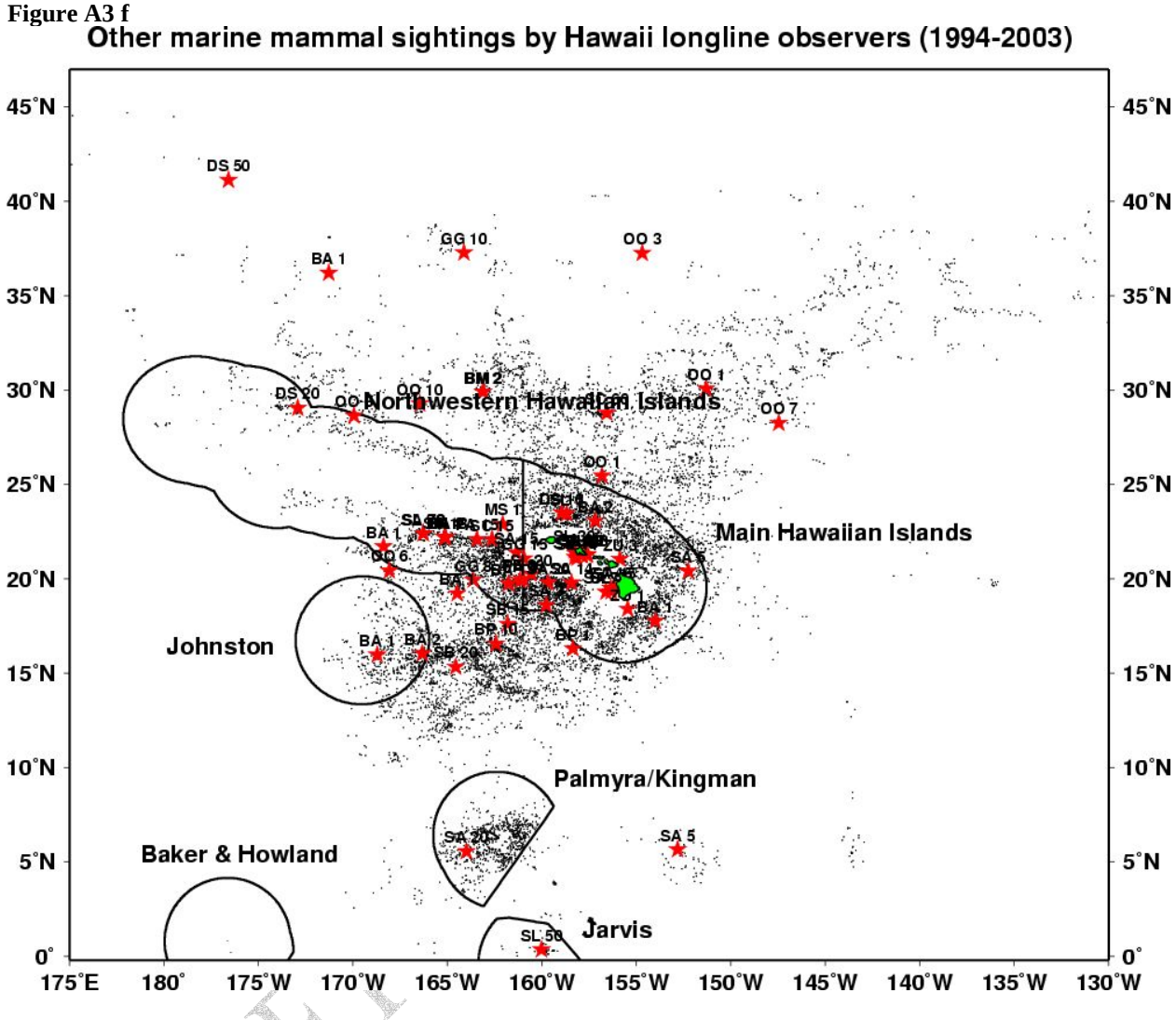

Figure A3 g