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Injury Determinations for Cetaceans Observed Interacting with Hawaii and American Samoa Longline Fisheries during 2007-2011

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ABSTRACT

Cetacean interactions (i.e., hookings and entanglements) with the Hawaii and American Samoa longline fisheries observed during 2007-2011 were compiled, and the number of cetacean deaths, serious injuries, and non-serious injuries by fishery, species, and management area were assessed. These values form the basis of the mortality and serious injury estimates included in the stock assessment reports of stocks impacted by these fisheries. Injury determinations were made using a revised process for distinguishing serious from non-serious injuries (National Marine Fisheries Service, 2012). In the Hawaii deep-set fishery, 50 cetacean interactions were observed from 2007 to 2011; most involved false killer whales (48.0%), resulted in death or serious injury (73.5%), and occurred outside the U.S. exclusive economic zone, or EEZ (54.0%). In the Hawaii shallow-set fishery, 46 cetacean interactions were observed from 2007 to 2011; most involved Risso's dolphins (45.7%), resulted in death or serious injury (77.2%), and occurred outside the U.S. EEZ (91.3%). In the American Samoa deep-set fishery, 14 cetacean interactions were observed from 2007 to 2011; most involved rough-toothed dolphins (42.9%), resulted in death or serious injury (92.9%), and occurred within the U.S. EEZ (85.7%).

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INTRODUCTION

The Marine Mammal Protection Act (MMPA) mandates that incidental mortality and serious injury of marine mammals from commercial fishing operations be reduced to insignificant levels. A serious injury is defined in regulations as an injury that will likely result in mortality.[1] In 2012, the National Marine Fisheries Service (NMFS) clarified its interpretation of this definition as any injury that is more likely than not to result in mortality.[2] The process for distinguishing serious from non-serious injuries pursuant to the MMPA was also revised (NMFS, 2012).[3] These revisions were aimed at making the injury determination process more consistent and transparent, as well as providing additional guidance for cases that would have previously been classified as "cannot be determined." Estimates of mortality and serious injury by source are compiled and averaged over 5-year periods and included in the marine mammal stock assessment reports (SAR) required by the MMPA. There is a 2-year lag between the mortality and serious injury estimation period and the SAR year. The current SAR year (2013) requires estimates of mortality and serious injury from 2007 to 2011.

The pelagic longline fisheries based in Hawaii consist of a deep-set fishery targeting tunas and a shallow-set fishery targeting swordfish. A deep-set tuna fishery is also based in American Samoa. Observer coverage for the two deep-set fisheries is at least 20% annually (although prior to 2010 it was less than 10% for the American Samoa fishery), while the shallow-set fishery operates under 100% observer coverage. Interactions (i.e., hookings or entanglements) with protected species, including cetaceans, are documented by the on-board observers. Observer data are used to determine the number of cetacean deaths, serious injuries, and non-serious injuries by fishery, species, and management area.

The present report provides a summary of the mortality and injury severity of cetaceans observed interacting with Hawaii and American Samoa longline fisheries during 2007-2011. For the fully observed shallow-set fishery, the number of deaths and serious injuries represents total cetacean bycatch during this period. For the partially observed deep-set fisheries, the number of deaths and serious injuries is a sample of total cetacean bycatch, which must be quantitatively estimated. Estimates of total cetacean bycatch from 2007 to 2011 by fishery, species, and management area are in progress and will be reported elsewhere.

METHODS

Observer data on cetacean interactions in the Hawaii and American Samoa longline fisheries during 2007-2011 were extracted from the web-based Pacific Islands Region (PIR) Longline Observer Data System using the *Datatrawler* interface and compiled in a spreadsheet. These data include details about the trip (i.e., fishery type, duration, gear and bait used), the interaction

[1] 50 *CFR* 229.2
[2] NMFS Policy Directive PD 02-238
[3] 77 *Federal Register* 3233 (23 January 2012)

(i.e., date, time, location, duration, description of events, behavior of animal, nature of injury, amount and type of gear left on animal), and the species involved (i.e., length, identifying characteristics). Copies of the original data forms and, if available, photos and videos taken during the interaction were also obtained and reviewed.

The PIR Observer Program assigned a species code to each interaction based on the species involved (Table 1). The species code UC (unidentified cetacean) was used when the species taken could not be identified by the observer and a biopsy sample was not collected. Species identification for pygmy and dwarf sperm whales (*Kogia* sp.) and beaked whales is difficult and thus a genus or family code was generally assigned to interactions involving those species. For some UC interactions, the description, sketches, photos, and videos recorded by the observer indicated one or more candidate (or probable) species. These probable species were identified and reported as part of the present assessment. Interactions that were determined to involve either false killer whales (*Pseudorca crassidens*) or short-finned pilot whales (*Globicephala macrorhynchus*) were assigned the species code BF ("blackfish") for injury determination and bycatch estimation. To maintain consistency with the bycatch estimation, cetacean interactions were considered to have occurred in the calendar year the fishing vessel returned to port. The geographic locations of the interactions were plotted and the exclusive economic zone (EEZ) and management area of the interaction determined. When interaction locations were not available, the begin location of the associated haul was used.

The observer recorded the condition of the animal involved in each interaction as either dead or injured. Injury severity (i.e., serious or non-serious) of each injured animal was subsequently determined using the revised guidelines and criteria presented in NMFS (2012). Specific factors were considered in the application of some of the injury categories to the interactions (see Appendix for details of how these categories were applied). When there was insufficient information to establish injury severity, the case was classified as "cannot be determined" (CBD). Injury determinations were made jointly by the authors of this report and, as instructed by NMFS (2012), sent for independent review to a NMFS Science Center staffer experienced in evaluating injury severity for cetaceans interacting with longline fisheries (Garrison, 2007). Any differences between the initial and reviewed determinations were discussed and reconciled jointly.

MMPA regulations direct commercial fishermen to submit a Marine Mammal Authorization Program (MMAP) Mortality/Injury Reporting Form (MMAP report) when their operations lead to incidental mortality or injury of marine mammals. The level of detail requested by these forms is much less than that of the observer data forms, limiting opportunities to determine injury severity. MMAP reports are not used for bycatch estimation because they are not obtained using a quantifiable sampling scheme, but they could potentially provide minimum estimates of mortality and serious injury for species not observed interacting with the fishery. In the PIR, MMAP reports are infrequently submitted and generally overlap with observed takes. However, all PIR MMAP reports were reviewed and any interactions involving unobserved species were noted.

RESULTS AND DISCUSSION

Injury Determination Review

A total of 110 cetacean interactions were observed in the three fisheries combined. Most (91.8%, *n* = 101) of these interactions involved injured animals and required injury determination and determination review. Initially, the independent reviewer classified a few interactions differently than the authors of this report. These interactions were then discussed by the three parties. In most cases, a relevant detail had not been fully considered, and the initial determination was unanimously confirmed. However, in one case (shallow-set interaction on 11/05/11; Table 2), the determination changed from "CBD or serious" to "serious" following input from the independent reviewer.

Hawaii Longline Fisheries

From 2007 to 2011, 50 cetaceans were observed interacting with the deep-set fishery, including 24 (48.0%) false killer whales, 8 (16.0%) unidentified cetaceans, 6 (12.0%) blackfish, 4 (8.0%) short-finned pilot whales, 3 (6.0%) Risso's dolphins (*Grampus griseus*), 2 (4.0%) common bottlenose dolphins (*Tursiops truncatus*), 1 (2.0%) sperm whale (*Physeter macrocephalus*), 1 (2.0%) pantropical spotted dolphin (*Stenella attenuata*), and 1 (2.0%) striped dolphin (*Stenella coeruleoalba*) (Tables 2-3). Four (8.0%) of the interactions were deaths, 32 (64.0%) were serious injuries, 9 (18.0%) were non-serious injuries, 1 (2.0%) involved prorating a large whale interaction as 0.75 serious (NMFS, 2012), and 4 (8.0%) were classified as CBD. A majority of the interactions (54.0%, *n* = 27) occurred outside the U.S. EEZ. Of the 23 interactions within the U.S. EEZ, most (95.7%, *n* = 22) occurred around the Hawaiian Archipelago, while one occurred around Palmyra Atoll. Hawaii EEZ takes were roughly evenly distributed north and south of the main Hawaiian Islands (MHI), while takes outside the U.S. EEZ were concentrated north of the MHI (Fig. 1). Cetacean interactions observed in the deep-set fishery during 2007-2011 were consistent with observed interactions from 2004 to 2008 (Forney, 2010) in terms of the primary species involved (i.e., false killer whales) and the number and species composition of takes, although takes outside the U.S. EEZ were more northerly distributed during the current period. Twelve MMAP reports were submitted by Hawaii deep-set longliners during 2007-2011. Eleven of the reports were associated with observed takes. The one exception was a report from an unobserved trip describing 2 hooked short-finned pilot whales, a species already accounted for by observed interactions.

From 2007 to 2011, 46 cetaceans were observed interacting with the shallow-set fishery, including 21 (45.7%) Risso's dolphins, 8 (17.4%) common bottlenose dolphins, 3 (6.5%) false killer whales, 3 (6.5%) striped dolphins, 2 (4.3%) blackfish, 2 (4.3%) humpback whales (*Megaptera novaeangliae*), 2 (4.3%) unidentified cetaceans, 1 (2.2%) short-beaked common dolphin (*Delphinus delphis*), 1 (2.2%) Blainville's beaked whale (*Mesoplodon densirostris*), 1 (2.2%) pygmy or dwarf sperm whale, 1 (2.2%) unidentified Mesoplodont, and 1 (2.2%) unidentified beaked whale (Tables 2 and 4). Three (6.5%) of the interactions were deaths, 31 (67.4%) were serious injuries, 10 (21.7%) were non-serious injuries, and 2 (4.3%) involved

prorating a large whale interaction as 0.75 serious (NMFS, 2012). Most of the interactions (91.3%, *n* = 42) occurred outside the U.S. EEZ. All 4 interactions within the U.S. EEZ occurred around the Hawaiian Archipelago. All takes, whether inside or outside the U.S. EEZ, were roughly evenly distributed throughout the core shallow-set fishing area north of the MHI (Fig. 2). Cetacean interactions observed in the shallow-set fishery during 2007-2011 were consistent with observed interactions from 2004 to 2008 (Forney, 2010) in terms of the primary species involved (i.e., Risso's dolphins), species composition, and general distribution of the takes, although there were more interactions in the current period. Two MMAP reports were submitted by Hawaii shallow-set longliners during 2007-2011. Both reports were associated with observed takes.

American Samoa Longline Fishery

From 2007 to 2011, 14 cetaceans were observed interacting with the deep-set fishery, including 6 (42.9%) rough-toothed dolphins (*Steno bredanensis*), 5 (35.7%) false killer whales, 1 (7.1%) blackfish, 1 (7.1%) unidentified cetacean, and 1 (7.1%) Cuvier's beaked whale (*Ziphius cavirostris*) (Tables 5-6). Two (14.3%) of the interactions were deaths, 11 (78.6%) were serious injuries, and 1 (7.1%) was a non-serious injury. Most (85.7%, *n* = 12) occurred within the U.S. EEZ around American Samoa. The two interactions outside the U.S. EEZ occurred within the EEZ of the Cook Islands. American Samoa EEZ takes were concentrated in the western portion of the region (Fig. 3). Five MMAP reports were submitted by American Samoa deep-set longliners during 2007-2011. Three of the reports were associated with observed takes. Of the two reports covering unobserved takes, one describes two hooked short-finned pilot whales and the other recounts a hooked common bottlenose dolphin. Although insufficient details were provided to allow verification of these species identifications, neither pilot whales nor bottlenose dolphins were accounted for by observed interactions.

Future Considerations

As mentioned in Appendix A, the NMFS (2012) small cetacean injury category S15 was used in the case of a dependent animal left with a seriously injured mother but was not applied to animals of dependent size potentially released alone post-interaction, which is also encompassed by the category. S15 was not used in this respect because the category description does not currently include criteria for establishing when a dependent animal can be considered alone. With more guidance (e.g., an interaction time or distance amount that would likely lead to separation of an injured dependent), it may be possible to use this category more broadly in future injury assessments. Given that injury determinations are considered in 5-year periods, some of the determinations presented herein could change if the broader application of S15 occurred within the next 4 years. Specifically, the injury determination for one of the Hawaii deep-set interactions (06/25/08) and five of the Hawaii shallow-set interactions (01/22/08, 06/12/08, 04/13/10, 12/12/10, and 12/19/10) (Table 2) could change from non-serious to serious.

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Table 1.--Species code, common name, and scientific name of cetaceans relevant to the 2007-2011 observation period of Hawaii and American Samoa longline fisheries.

Code	Common name	Scientific name
BB	Sei whale	*Balaenoptera borealis*
BE	Bryde's whale	*Balaenoptera edeni*
BF	"Blackfish" = PC or GM	
BM	Blue whale	*Balaenoptera musculus*
BP	Fin whale	*Balaenoptera physalus*
DD	Short-beaked common dolphin	*Delphinus delphis*
GG	Risso's dolphin	*Grampus griseus*
GM	Short-finned pilot whale	*Globicephala macrorhynchus*
MD	Blainville's beaked whale	*Mesoplodon densirostris*
MN	Humpback whale	*Megaptera novaeangliae*
PC	False killer whale	*Pseudorca crassidens*
PM	Sperm whale	*Physeter macrocephalus*
SA	Pantropical spotted dolphin	*Stenella attenuata*
SB	Rough-toothed dolphin	*Steno bredanensis*
SC	Striped dolphin	*Stenella coeruleoalba*
SL	Spinner dolphin	*Stenella longirostris*
TT	Common bottlenose dolphin	*Tursiops truncatus*
UC	Unidentified cetacean	
UK	Pygmy or dwarf sperm whale	*Kogia* sp.
UM	Mesoplodont beaked whale	*Mesoplodon* sp.
ZI	Cuvier's beaked whale	*Ziphius cavirostris*
ZU	Unidentified beaked whale	Ziphiid whale

Table 2.--Injury determinations for cetaceans observed interacting with Hawaii longline fisheries during 2007-2011, using the most recent established criteria for distinguishing serious from non-serious injury of cetaceans (Tables 1-2 in NMFS, 2012). Interactions are in order of trip number (confidential data; not shown). SS = shallow-set fishery; DS = deep-set fishery; CBD = cannot be determined. Hawaii (P) and Hawaii (I) indicate takes of false killer whales or potential false killer whales that were within the range of the Pelagic Stock or main Hawaiian Islands Insular Stock of false killer whales, respectively. Species codes are defined in Table 1. Animal size estimates were generally made by the observers in ft, so are reported in this unit for consistency. Gear measurement units (ft or m) are reported as made by the observers.

Fishery type	EEZ area	Vessel return year	Take date	Species code	Probable species code	Estimated size (ft)	Recorded condition	Injury determination	Injury categories	Interaction details and case-specific factors
SS	Outside	2007	02/22/07	TT	TT	9	Injured	Serious	S5a, S6	Hooked in mouth; cut free with hook and 1-ft mono line attached
SS	Outside	2007	02/21/07	GG	GG	5	Injured	Serious	S5a, S6	Hooked in mouth; cut free with hook and 4-ft branchline attached
SS	Outside	2007	03/24/07	GG	GG	10-13	Injured	Serious	S5a, S6	Hooked in mouth; broke free with presumably hook and 3-ft line attached
SS	Outside	2007	03/26/07	TT	TT	12	Injured	Serious	S5a, S6	Hooked in mouth; cut free with hook and 3-ft line attached; dependent calf in close proximity
SS	Outside	2007	03/26/07	TT	TT	4	Injured	Serious	S15	Dependent calf of seriously injured mother recorded in previous line
SS	Outside	2007	03/22/07	GG	GG	6.5	Injured	Serious	S5a, S6	Hooked in mouth; cut free with hook and 2-m line attached
SS	Hawaii	2007	03/29/07	TT	TT	9	Injured	Serious	S2 or S5a, S6	Hooked in mouth (possibly ingested); cut free with hook and 6-ft branchline attached
DS	Outside	2007	05/06/07	UC	UC	9	Injured	Non-serious	S7b	Entangled in unknown body location, but all gear retrieved so animal likely freed itself; observed interaction was brief (unlikely to have caused capture myopathy) and no evidence of associated injury
DS	Palmyra	2007	04/19/07	PC	PC	10	Injured	Serious	S2 or S5a, S6	Hooked in mouth (possibly ingested); broke free with hook and 3-ft leader attached
DS	Hawaii (P)	2007	05/23/07	PC	PC	8-10	Injured	Non-serious	S5c	Hooked in unknown body location, but straightened hook and was freed; observed interaction was brief (unlikely to have caused capture myopathy) and no evidence of additional injuries
DS	Outside	2007	09/16/07	PC	PC	10	Injured	Non-serious	S5c	Hooked in unknown body location, but pulled free of hook; observed interaction was brief (unlikely to have caused capture myopathy) and no evidence of additional injuries
DS	Outside	2007	11/15/07	GM	GM	10	Injured	Serious	S5a, S6	Hooked in mouth; cut free with hook, leader, and 7-m line attached
DS	Hawaii	2007	10/31/07	UC	UC	7	Injured	Serious	S6	Hooked in unknown body location; broke free with hook, 0.5-m leader, weight, and 5- m line attached
DS	Hawaii (P)	2007	12/07/07	PC	PC	8	Injured	Serious	S5a, S6	Hooked in mouth; cut free with hook, leader, and 15-ft line attached
DS	Outside	2007	12/24/07	GG	GG	8.5	Dead	Dead	n/a	Hooked in tail
SS	Outside	2008	12/29/07	MN	MN	Not specified	Injured	Non-serious	L3	Entangled/caught on mainline in unknown body location, but observations indicate line was loosely wrapped or animal freed itself
SS	Outside	2008	01/22/08	UK	UK	5	Injured	Non-serious	S5c	Hooked in lip, but pulled free of hook; observed interaction was brief (unlikely to have caused capture myopathy) and no evidence of additional injuries
SS	Outside	2008	02/14/08	GG	GG	Not specified	Injured	Serious	S2 or S5a, S6	Hooked in mouth (possibly ingested); cut free with hook and 7-m mono leader attached
SS	Outside	2008	03/02/08	GG	GG	10	Injured	Serious	S5a, S6	Hooked in mouth; cut free with hook, 80-g weight, and 14.5-m mono line attached

Table 2 (continued).

Fishery type	EEZ area	Vessel return year	Take date	Species code	Probable species code	Estimated size (ft)	Recorded condition	Injury determination	Injury categories	Interaction details and case-specific factors
SS	Outside	2008	03/15/08	SC	SC	Not specified	Injured	Serious	S2 or S5a, S6 or S8a	Hooked in mouth (possibly ingested) and entangled around beak; cut free with hook and constricting 2-ft line attached
SS	Outside	2008	03/28/08	GG	GG	9	Injured	Serious	S5a, S6	Hooked in mouth; cut free with hook and 10-ft mono leader attached
DS	Hawaii (P)	2008	04/13/08	UC	BF	Not specified	Injured	Serious	S6	Hooked in unknown body location; cut free with hook, 0.6-m wire leader, 45-g weight, and 7-m branchline attached
DS	Hawaii (P)	2008	04/23/08	PC	PC	10	Injured	Serious	S5a, S6	Hooked in mouth; cut free with hook, 0.5-m wire leader, 45-g weight, and 3-m branchline attached
DS	Outside	2008	05/05/08	SA	SA	5.2	Dead	Dead	n/a	Entangled in branchline, with line indentations around beak, behind pectoral fins, and dorsal fin
DS	Hawaii (P)	2008	05/03/08	UC	BF	12	Injured	Serious	S6	Hooked and entangled in unknown body location(s); broke free with hook, 0.7-m wire leader, 45-g weight, and 10-m branchline attached
DS	Outside	2008	05/14/08	UC	UC	6	Injured	CBD	Possibilities: one or more of S5a, S5d, S6, S8a, or S8b	Hooked and/or entangled in unknown body location(s); broke free with hook, 0.4-m leader, and potentially some portion of 10.5 -m branchline (report is inconsistent about recovery of branchline) attached
DS	Outside	2008	06/19/08	GG	GG	9	Injured	Serious	S5a, S6	Hooked in mouth; broke free with hook, 0.5-m leader, 45-g weight, and 2.5-m branchline attached
DS	Outside	2008	06/20/08	GM	GM	4	Injured	Serious	S7b	Entangled in mainline around head and through mouth, but animal eventually freed itself; presumed prolonged interaction time and slow swimming post-interaction indicate interaction likely to have caused capture myopathy
DS	Hawaii (P)	2008	07/05/08	UC	BF	14	Injured	Serious	S2 or S5a, S6	Hooked in head area (possibly mouth or ingested); cut free with hook, 0.5-m leader, 45- g weight, and 7-m branchline attached
DS	Hawaii (P)	2008	07/06/08	PC	PC	16	Injured	Serious	S2 or S5a, S6	Hooked in head area (possibly mouth or ingested); cut free with hook, 0.5-m leader, 45- g weight, and 5-m branchline attached
DS	Outside	2008	06/25/08	GM	GM	15	Injured	Non-serious	S5c	Hooked in either mouth or pectoral fin, but pulled free of hook; observed interaction was presumably brief (unlikely to have caused capture myopathy) and no evidence of additional injuries
DS	Outside	2008	06/25/08	GM	GM	7-8	Injured	Non-serious	S5c	Hooked in either mouth or pectoral fin, but pulled free of hook; observed interaction was presumably brief (unlikely to have caused capture myopathy) and no evidence of additional injuries
SS	Hawaii (P)	2008	06/12/08	PC	PC	7	Injured	Non-serious	S5d	Hooked in fluke and initially entangled around base of tail; cut free with hook and 6 in branchline attached (but no longer wrapped); observed interaction was presumably brief (unlikely to have caused capture myopathy) and no evidence of additional injuries
SS	Outside	2008	08/20/08	UC	BF	15	Injured	Serious	S6	Hooked and/or entangled in unknown body location(s); broke free with hook, 80-g weight, and 9-m branchline presumably attached
DS	Hawaii (P)	2008	10/24/08	PC	PC	11	Injured	Serious	S2 or S5a, S6	Hooked in mouth (possibly ingested); cut free with hook, 0.5-m wire leader, 45-g weight, and 6-8-m branchline attached
SS	Outside	2008	11/10/08	GG	GG	6.8	Dead	Dead	n/a	Hooked in fluke
SS	Outside	2009	12/20/08	UC	BB, BE, BM, BP	40	Injured	Prorate 0.75 Serious	L10	Hooked and possibly entangled in unknown body location, most likely fluke or posterior portion of body; broke free with hook, 60-g weight, and 8-m mono leader attached
SS	Outside	2009	12/13/08	GG	GG	In Error	Injured	Serious	S2 or S5a	Hooked inside mouth; broke free with hook and 0.1-m mono line attached
DS	Hawaii (P)	2009	02/13/09	PC	PC	8	Injured	Serious	S5a, S6	Hooked in mouth; cut free with hook, 0.5-m wire leader, 45-g weight, and 3-ft branchline attached

Table 2 (continued).

Fishery type	EEZ area	Vessel return year	Take date	Species code	Probable species code	Estimated size (ft)	Recorded condition	Injury determination	Injury categories	Interaction details and case-specific factors
DS	Hawaii (P)	2009	02/18/09	PC	PC	9	Injured	Serious	S6	Hooked and entangled in tail stock; cut free with two hooks, two 0.7-m wire leaders, two 45-g weights, and 2-4-ft branchlines attached
SS	Outside	2009	04/12/09	GG	GG	4-5	Injured	Non-serious	S5c	Hooked in mouth, but pulled free of hook; observed interaction was presumably brief (unlikely to have caused capture myopathy) and no evidence of additional injuries
DS	Outside	2009	04/14/09	PC	PC	7	Injured	Serious	S5a, S6	Hooked in mouth; broke free with hook, 0.3-m wire leader, 45-g weight, and 5-m branchline attached
DS	Hawaii (P)	2009	04/19/09	PC	PC	9	Injured	Serious	S6	Hooked in unknown body location (possibly mouth); cut free with hook, 0.3-m wire leader, 45-g weight, and 15-m branchline attached
DS	Outside	2009	05/04/09	UC	UC	18	Injured	CBD	Possibilities: one or more of S5a, S5d, S6, S7b, S8a, or S8b	Unknown if hooked or entangled, but mainline came under tension when animal surfaced; animal broke free, but unknown how much or if any gear attached (retrieved gear was in a tangle)
DS	Outside	2009	05/04/09	UC	UC	15	Injured	Non-serious	S7b	Appeared to drag mainline, but freed itself with no stress or breakage of gear; observed interaction was brief (unlikely to have caused capture myopathy) and no evidence of associated injury
DS	Outside	2009	04/22/09	PC	PC	12	Dead	Dead	n/a	Entangled in branchline, with two wraps around caudal peduncle
SS	Hawaii (P)	2009	06/04/09	PC	PC	9	Injured	Serious	S5a, S6	Hooked in mouth; cut free with hook, 9.3-m mono leader, 80-g weight, and 6-m branchline attached
DS	Outside	2009	06/29/09	TT	TT	9.8	Injured	Serious	S5a	Hooked in mouth; cut free with hook and < 10-cm mono leader attached
DS	Outside	2009	06/27/09	PC	PC	20	Injured	Serious	S2 or S5a, S6	Hooked in mouth (possibly ingested); broke free with hook, 0.5-m wire leader, and 45-g or 60-g weight attached
DS	Outside	2009	07/31/09	PC	PC	10	Injured	Serious	S2 or S5a, S6	Hooked in mouth (possibly ingested); cut free with hook, 0.5-m wire leader, 60-g weight, and 10.5-m branchline attached
DS	Outside	2009	07/31/09	PC	PC	7	Injured	Serious	S6	Hooked in unknown body location; cut free with hook, 0.5-m wire leader, 60-g weight, and 11.9-m branchline attached
DS	Outside	2009	08/30/09	UC	BF, TT	6.6-9.8	Injured	Non-serious	S5c	Hooked in unknown body location, but pulled free of hook; observed interaction was presumably brief (unlikely to have caused capture myopathy) and no evidence of additional injuries
DS	Outside	2009	10/22/09	PC	PC	6-7	Injured	Serious	S5a, S6	Hooked in mouth; cut free with hook, 0.5-m wire leader, 45-g weight, and 4-ft branchline attached
SS	Outside	2009	12/04/09	GG	GG	12	Injured	Serious	Possibilities: one or more of S5a, S5d, S6, S8a, or S8b	Hooked and entangled in unknown body location(s); one line cut and animal broke free of others, but gear retrieved indicates several hooks and portions of branchline attached; multiple tangled and broken branchlines indicate animal struggled extensively and likely suffered capture myopathy
SS	Outside	2010	12/02/09	GG	GG	4.5-5	Dead	Dead	n/a	Hooked in mouth and entangled around pectoral fin
DS	Outside	2009	12/23/09	PC	PC	8	Injured	Serious	S5a, S6	Hooked in mouth; cut free with hook, 0.5-m wire leader, 60-g weight, and 0.3-m branchline attached
SS	Outside	2010	01/16/10	GG	GG	13.1	Injured	Serious	S2 or S5a, S6	Hooked in mouth or head (possibly ingested); broke free with hook and 4.8-m mono leader attached
SS	Outside	2010	02/21/10	TT	TT	8-10	Injured	Serious	S2 or S5a, S6	Hooked in mouth (possibly ingested); broke free with hook and 1-3 m branchline attached
SS	Outside	2010	02/23/10	SC	SC	5	Injured	Serious	S5a	Hooked in mouth (with line wrapped through mouth); cut free with hook and 2-in line attached

Table 2 (continued).

Fishery type	EEZ area	Vessel return year	Take date	Species code	Probable species code	Estimated size (ft)	Recorded condition	Injury determination	Injury categories	Interaction details and case-specific factors
SS	Outside	2010	03/02/10	GG	GG	7	Injured	Serious	S2 or S5a, S6	Hooked in mouth (possibly ingested); cut free with hook and 8-m branchline attached
SS	Outside	2010	03/08/10	GG	GG	6	Injured	Serious	S2 or S5a, S6	Hooked in mouth (possibly ingested); cut free with hook and 5-m branchline attached
SS	Outside	2010	03/01/10	UC	SC, TT	9	Injured	Non-serious	S5c	Hooked in mouth, but pulled free of hook; observed interaction was presumably brief (unlikely to have caused capture myopathy) and no evidence of additional injuries
SS	Outside	2010	03/16/10	GG	GG	6.6-9.8	Injured	Serious	S5a, S6	Hooked in mouth; broke free with hook and 7-m branchline attached
SS	Outside	2010	04/13/10	GG	GG	5	Injured	Non-serious	S5c	Hooked in mouth, but pulled free of hook; observed interaction was brief (unlikely to have caused capture myopathy) and no evidence of additional injuries
DS	Hawaii (P)	2010	07/11/10	PC	PC	13	Injured	Serious	S2, S6	Hooked in mouth (presumably ingested); cut free with hook, 0-5 m wire leader, 45-g weight, and 3-m branchline attached
DS	Hawaii (P)	2010	07/03/10	PC	PC	8	Injured	Serious	S2 or S5a, S6	Hooked in mouth (possibly ingested); broke free with hook, 0.5 m wire leader, 45-g weight, and 1.2-m branchline attached
DS	Outside	2010	08/01/10	TT	TT	10	Injured	Serious	S2 or S5a, S6	Hooked in mouth (possibly ingested); cut free with hook, 0.5-m wire leader, 60-g weight, and 10.1-m branchline attached
SS	Outside	2010	09/19/10	TT	TT	6	Injured	Serious	S5a	Hooked in mouth and entangled around body; cut free with hook and 6-in branchline attached
DS	Hawaii (P)	2010	10/11/10	UC	BF	12	Injured	Serious	S5a, S6	Hooked in mouth; broke free with hook, 0.6-m wire leader, 45-g weight, and a few feet of branchline attached
DS*	Hawaii (P)	2010	10/22/10	PC	PC	14	Injured	Non-serious	S5c	Hooked in head area (possibly mouth or ingested), but straightened hook and was freed; observed interaction was brief (unlikely to have caused capture myopathy) and no evidence of additional injuries
DS	Hawaii	2010	11/07/10	GG	GG	8	Injured	Serious	S2 or S5a, S6	Hooked in mouth (possibly ingested); cut free with hook, 0.5-m wire leader, 45-g weight, and 3-m branchline attached
SS	Outside	2010	11/05/10	SC	SC	4.7	Dead	Dead	n/a	Entangled around body behind pectoral fins by a single loop of branchline that was hooked onto itself
SS	Outside	2010	11/18/10	GG	GG	Not specified	Injured	Serious	S6	Hooked in unknown body location; broke free with hook and 3-m branchline attached
DS	Outside	2010	12/01/10	UC	BF, SB, TT	4.5-5.5	Injured	Serious	S2 or S5a, S6	Hooked in head area (possibly mouth or ingested); broke free with hook, swivel, 0.7-m wire leader, 45-g weight, and 18-in branchline attached
DS	Outside	2010	12/02/10	PC	PC	7	Injured	Serious	S2 or S5a, S6	Hooked in mouth (possibly ingested); cut free with hook, swivel, 0.7-m wire leader, 45-g weight, and 3-6-in branchline attached
DS	Outside	2010	12/21/10	UC	BF, SB, TT	Not specified	Injured	CBD	Possibilities: one or more of S5a, S5d, S6, S8a, or S8b	Hooked and/or entangled in unknown body location(s); animal broke free, but unknown how much gear attached (some branchlines missing hooks and one 0.4-m wire leader had snapped); this interaction shared similarities with that from 4-Dec-09, except had less information to make inference about capture myopathy and presumably less gear remained on animal

* This take occurred as part of the experimental fishery designed to evaluate the effectiveness of "weak" circle hooks (Bigelow et al., 2012) and will be considered separately during the estimation of mortality and serious injury.

Table 2 (continued).

Fishery type	EEZ area	Vessel return year	Take date	Species code	Probable species code	Estimated size (ft)	Recorded condition	Injury determination	Injury categories	Interaction details and case-specific factors
SS	Outside	2011	12/12/10	GG	GG	6	Injured	Non-serious	S5c	Hooked in mouth, but pulled free of hook; observed interaction was presumably brief (unlikely to have caused capture myopathy) and no evidence of additional injuries
SS	Outside	2011	12/19/10	TT	TT	6	Injured	Non-serious	S5c	Hooked in head area (possibly mouth), but pulled free of hook; observed interaction was brief (unlikely to have caused capture myopathy) and no evidence of additional injuries
SS	Outside	2011	12/24/10	UC	BF	Not specified	Injured	Serious	S2 or S5a, S6	Hooked in head area (possibly mouth or ingested); broke free with hook, 1 m mono leader, and likely 45-g weight and part of branchline attached
SS	Outside	2011	02/03/11	GG	GG	6	Injured	Serious	S5a, S6	Hooked in mouth; cut free with hook and 3-m mono line attached
SS	Outside	2011	02/03/11	GG	GG	10	Injured	Serious	S5a, S6	Hooked in mouth; broke free with hook and 2-3-ft mono leader attached
SS	Outside	2011	02/08/11	GG	GG	6	Injured	Serious	S6	Hooked in unknown body location; released with hook, 1-m mono leader, 60-g weight, and 14 m branchline attached
SS	Outside	2011	02/18/11	UM	UM	15	Injured	Serious	S5a, S6	Hooked in mouth; cut free with hook and 5-m mono leader attached
SS	Outside	2011	03/05/11	TT	TT	7	Injured	Serious	S5a, S6	Hooked in mouth; cut free with hook and 1-ft mono leader attached
DS	Hawaii (P)	2011	02/18/11	PC	PC	12	Injured	Serious	S2 or S5a, S6	Hooked in mouth (possibly ingested); released with hook, 0.5-m wire leader, 45-g weight, and 13.7-m branchline attached
DS	Hawaii (P)	2011	02/18/11	PC	PC	12	Injured	CBD	Possibilities: one or more of S5a, S5d, S6, S8a, or S8b	Unknown if hooked or entangled, but mainline came under tension when animal surfaced; animal broke free and one of the next branchlines came up broken; presumably hook, 0.5-m wire leader, 45-g weight, and an unspecified amount of branchline attached
SS	Outside	2011	03/22/11	MD	MD	16.4	Injured	Non-serious	S7b	Appeared to get stuck on mainline, but freed itself and all gear retrieved; observed interaction was presumably brief (unlikely to have caused capture myopathy) and no evidence of associated injury
SS	Outside	2011	04/11/11	UC	ZU	32.8	Injured	Serious	S6	Entangled in mainline, which was wrapped twice around the body anterior to dorsal fin; cut free with 50-m mainline attached
SS	Hawaii (P)	2011	05/15/11	PC	PC	10	Injured	Non-serious	S5c	Hooked in mouth, but pulled free of hook; observed interaction was brief (unlikely to have caused capture myopathy) and no evidence of additional injuries
DS	Hawaii	2011	05/27/11	PM	PM	25-30	Injured	Prorate 0.75 Serious	L10	Unknown if hooked or entangled, but mainline came under tension when animal surfaced; cut free with hook, 0.5-m wire leader, 45 g weight, 12-m branchline, and 25-30-ft mainline possibly attached
DS	Outside	2011	06/19/11	SC	SC	6.8	Dead	Dead	n/a	Entangled in wire leader, which was wrapped 3-4 times around caudal peduncle with the hook caught on branchline
DS	Hawaii (P)	2011	09/30/11	PC	PC	12	Injured	Serious	S2 or S5a, S6	Hooked in head area (possibly mouth or ingested); broke free with hook, 0.5-m wire leader, 45-g weight, and 10-m branchline attached
DS	Hawaii (I)	2011	10/12/11	UC	BF	14	Injured	Serious	S6	Hooked in unknown body location (possibly mouth); broke free with hook, 0.5-m wire leader, 45-g weight, and 9 m branchline attached

Table 2 (continued).

Fishery type	EEZ area	Vessel return year	Take date	Species code	Probable species code	Estimated size (ft)	Recorded condition	Injury determination	Injury categories	Interaction details and case-specific factors
SS	Outside	2011	11/05/11	DD	DD	5	Injured	Serious	S7b	Entangled in mainline and branchline around beak and body, but animal eventually freed when line cut; presumed prolonged interaction time, nature and extent of struggle, and a consideration of species indicate interaction likely to have caused capture myopathy
SS	Outside	2011	11/13/11	MN	MN	30	Injured	Prorate 0.75 Serious	L10	Entangled in mainline, which was wrapped tightly around caudal peduncle; cut free with potentially up to four 8.7-m branchlines, 7-m mono leaders, and 80-g weights along with unknown amount of mainline
DS	Outside	2011	12/06/11	UC	BF	15	Injured	Non-serious	S7b	Entangled in mainline around caudal peduncle, but animal freed itself of all gear; observed interaction was presumably brief (unlikely to have caused capture myopathy) and no evidence of associated injury

Table 3.--Summary of deaths (D), serious injuries (SI), non-serious injuries (NSI), and injuries with a severity that cannot be determined (CBD) observed in the Hawaii deep-set longline fisheries during 2007-2011. Species codes are defined in Table 1. Year is the vessel return year. Non-integer values for large whales indicate the use of injury categories with prorated severity (Table 1 in NMFS, 2012).

		Hawaii EEZ				Palmyra EEZ				Outside U.S. EEZ			
Species Code	Year	D	SI	NSI	CBD	D	SI	NSI	CBD	D	SI	NSI	CBD
BF	2007												
	2008		3										
	2009												
	2010		1										
	2011		1									1	
GG	2007									1			
	2008										1		
	2009												
	2010		1										
	2011												
GM	2007										1		
	2008										1	2	
	2009												
	2010												
	2011												
PC	2007		1	1			1					1	
	2008		3										
	2009		3							1	6		
	2010		2	1*							1		
	2011		2		1								
PM	2007												
	2008												
	2009												
	2010												
	2011		0.75	0.25									
SA	2007												
	2008									1			
	2009												
	2010												
	2011												
SC	2007												
	2008												
	2009												
	2010												
	2011									1			
TT	2007												
	2008												
	2009										1		
	2010										1		
	2011												
UC	2007		1									1	
	2008												1
	2009											2	1
	2010										1		1
	2011												

* This take occurred as part of the experimental fishery designed to evaluate the effectiveness of "weak" circle hooks (Bigelow et al., 2012) and will be considered separately during the estimation of mortality and serious injury.

Table 4.--Summary of deaths (D), serious injuries (SI), non-serious injuries (NSI), and injuries with a severity that cannot be determined (CBD) observed in the Hawaii shallow-set longline fisheries during 2007-2011. Species codes are defined in Table 1. Year is the vessel return year. Non-integer values for large whales indicate the use of injury categories with prorated severity (Table 1 in NMFS, 2012).

		Hawaii EEZ				Outside U.S. EEZ			
Species Code	Year	D	SI	NSI	CBD	D	SI	NSI	CBD
BF	2007								
	2008						1		
	2009								
	2010								
	2011						1		
DD	2007								
	2008								
	2009								
	2010								
	2011						1		
GG	2007						3		
	2008					1	3		
	2009						2	1	
	2010					1	5	1	
	2011						3	1	
MD	2007								
	2008								
	2009								
	2010								
	2011							1	
MN	2007								
	2008							1	
	2009								
	2010								
	2011						0.75	0.25	
PC	2007								
	2008			1					
	2009		1						
	2010								
	2011			1					
SC	2007								
	2008						1		
	2009								
	2010					1	1		
	2011								
TT	2007		1				3		
	2008								
	2009								
	2010						2		
	2011						1	1	
UC	2007								
	2008								
	2009						0.75	0.25	
	2010							1	
	2011								
UK	2007								
	2008							1	
	2009								
	2010								
	2011								
UM	2007								
	2008								
	2009								
	2010								
	2011						1		
ZU	2007								
	2008								
	2009								
	2010								
	2011						1		

Table 5.--Injury determinations for cetaceans observed interacting with American Samoa (AS) deep-set (DS) longline fishery during 2007-2011, using the most recent established criteria for distinguishing serious from non-serious injury of cetaceans (Tables 1-2 in NMFS, 2012). Interactions are in order of trip number (confidential data; not shown). Species codes are defined in Table 1. Animal size estimates were generally made by the observers in ft, so are reported in this unit for consistency. Gear measurement units (ft or m) are reported as made by the observers.

Fishery type	EEZ area	Vessel return year	Take date	Species code	Probable species code	Estimated size (ft)	Recorded condition	Injury determination	Injury categories	Interaction details and case-specific factors
DS	AS	2008	06/05/08	PC	PC	15	Injured	Serious	S6	Entangled in branchline (unknown if hooked), which was wrapped multiple times around caudal peduncle; broke free with hook and 2-m branchline attached
DS	AS	2008	06/06/08	PC	PC	15	Dead	Dead	n/a	Entangled in mainline, which was wrapped multiple times around caudal peduncle and head
DS	AS	2008	04/15/08	SB	SB	5	Injured	Serious	S5a, S6	Hooked in mouth; cut free with hook and 1.5- m branchline attached
DS	AS	2011	01/06/11	UC	BF	6	Injured	Serious	S6	Hooked on trailing edge of fluke and entangled in mono line around fluke blade; broke free with hook and 3-4-ft branchline attached
DS	AS	2011	11/27/10	SB	SB	7.2	Injured	Serious	S4, S5c	Hooked in fluke blade; barely moving when first observed, so brought on deck; returned to water free of gear, where animal floated motionless at surface; animal already appeared to have suffered from capture myopathy prior to prolonged handling time
DS	AS	2011	11/28/10	SB	SB	7	Injured	Non-serious	S7b	Entangled around body by multiple loose wraps of another vessel's branchline, which was hooked to branchline of current vessel; unraveled line and animal freed of gear; observed interaction was brief (unlikely to have caused capture myopathy) and no evidence of associated injury
DS	AS	2011	01/05/11	PC	PC	13.1	Injured	Serious	S2 or S5a, S6	Hooked in head area (possibly mouth or ingested); cut free with hook and 9-10-m branchline attached
DS	Cook Islands	2011	02/19/11	PC	PC	8	Injured	Serious	S6	Hooked in dorsal fin; cut free with hook and 10-ft branchline attached
DS	Cook Islands	2011	02/20/11	PC	PC	5	Injured	Serious	S2 or S5a, S6	Hooked in mouth (possibly ingested); cut free with hook and 10- ft branchline attached
DS	AS	2011	03/05/11	SB	SB	7	Injured	Serious	S6	Entangled in branchline (unknown if hooked), which was wrapped around caudal peduncle; cut free with hook and at least 2-ft branchline left tangled around caudal peduncle
DS	AS	2011	03/10/11	SB	SB	6	Injured	Serious	S2 or S5a, S6	Hooked in mouth (possibly ingested); broke free with presumably hook and unknown amount of branchline (possibly 1 m) attached
DS	AS	2011	04/27/11	SB	SB	7	Injured	Serious	S6	Hooked in trailing edge of fluke; cut free with hook and 3-ft branchline attached
DS	AS	2011	07/01/11	UC	SA, SB, SC, SL, TT	6	Injured	Serious	S5d or S6	Hooked in pectoral fin and entangled in branchline, which formed a figure 8 between the pectoral fin and mouth; noted weakened state and sinking post-interaction indicate interaction likely to have caused capture myopathy
DS	AS	2011	09/03/11	ZI	ZI	9.8	Dead	Dead	n/a	Entangled in branchline around caudal peduncle

Table 6.--Summary of deaths (D), serious injuries (SI), non-serious injuries (NSI), and injuries with a severity that cannot be determined (CBD) observed in the American Samoa deep-set longline fisheries during 2007-2011. Species codes are defined in Table 1. Year is the vessel return year.

		American Samoa EEZ				Outside U.S. EEZ			
Species Code	Year	D	SI	NSI	CBD	D	SI	NSI	CBD
BF	2007								
	2008								
	2009								
	2010								
	2011		1						
PC	2007								
	2008	1	1						
	2009								
	2010								
	2011		1				2		
SB	2007								
	2008		1						
	2009								
	2010								
	2011		4	1					
UC	2007								
	2008								
	2009								
	2010								
	2011		1						
ZI	2007								
	2008								
	2009								
	2010								
	2011	1							

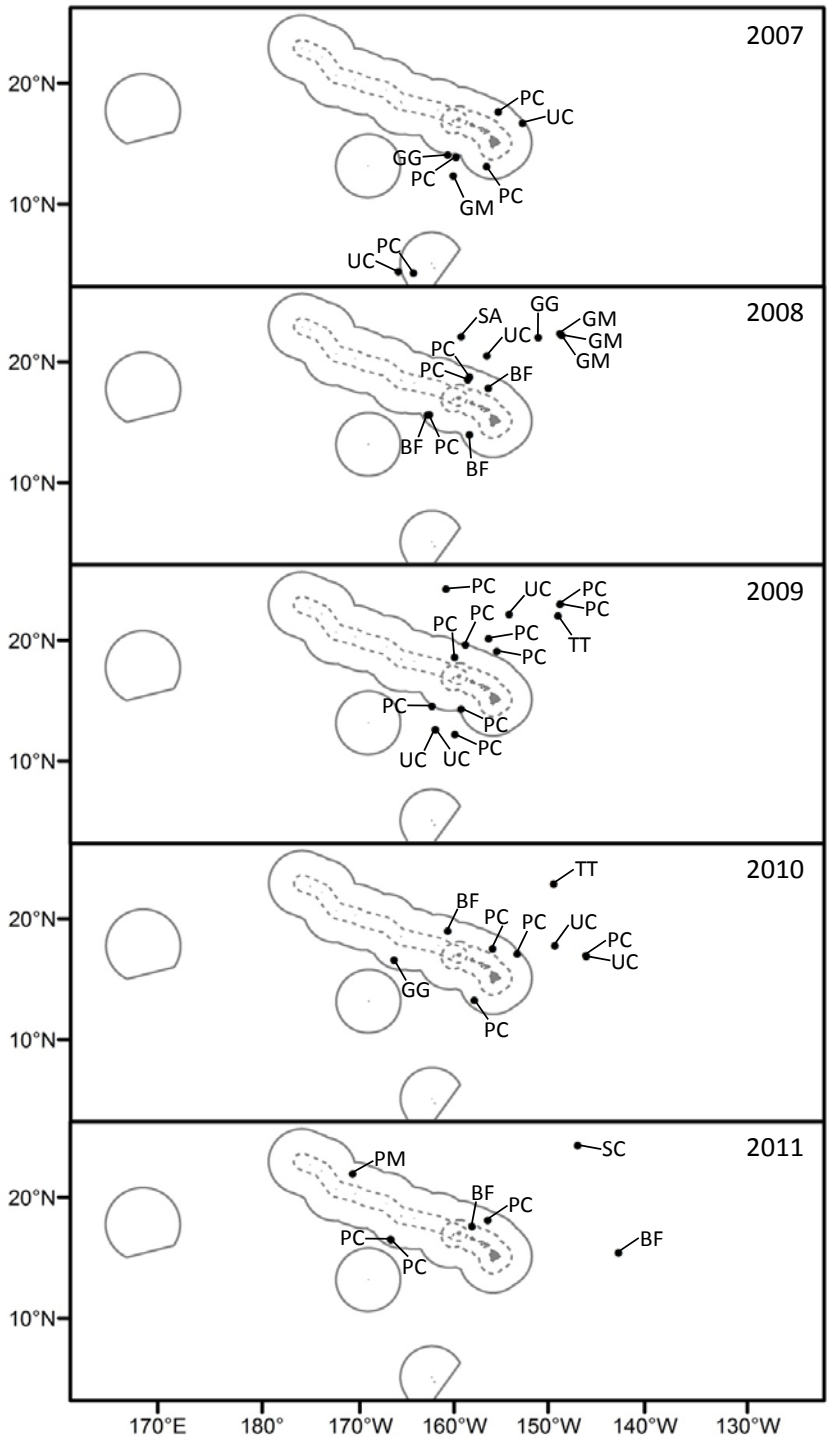

Figure 1.--Locations of observed cetacean interactions with the Hawaii deep-set longline fishery during 2007-2011. Solid gray outlines represent U.S. EEZs; dotted gray outlines are (from south to north): 1) the estimated range of the main Hawaiian Islands Insular stock of false killer whales, and 2) the estimated range of the Northwestern Hawaiian Islands stock of false killer whales. Takes are labeled by species code (defined in Table 1).

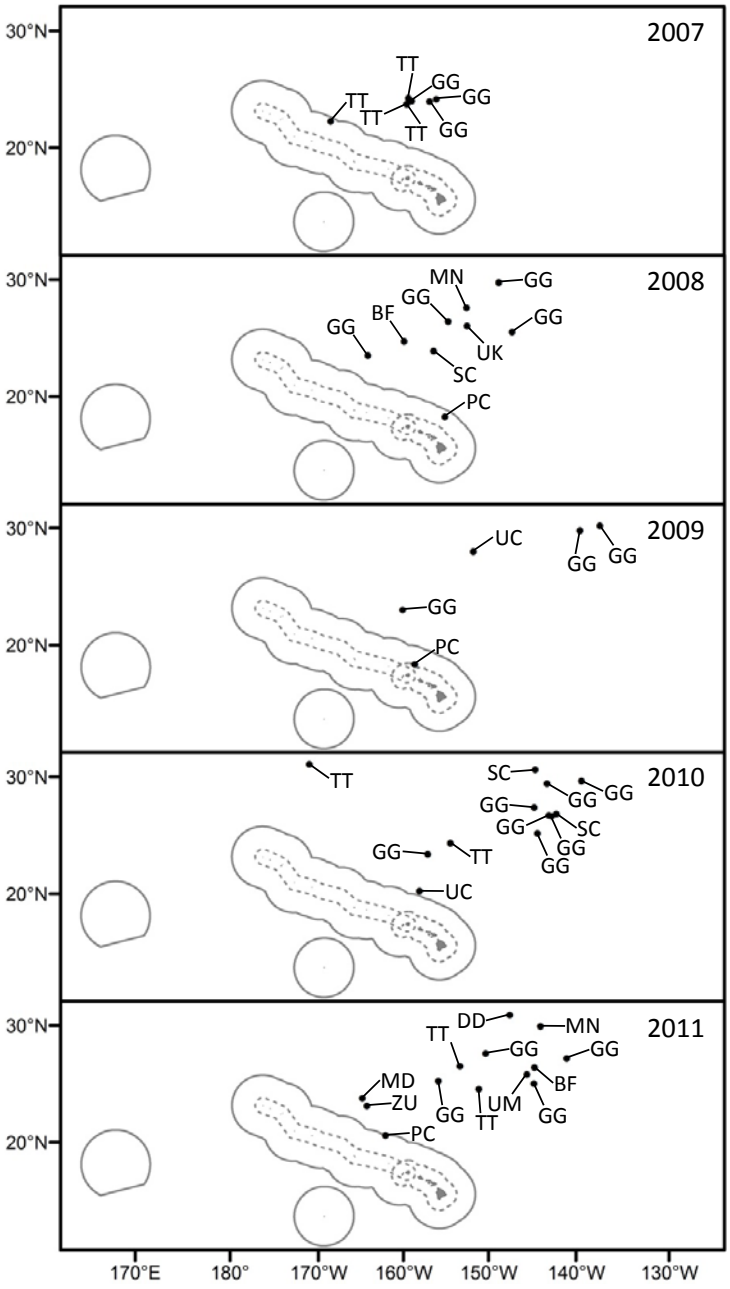

Figure 2.--Locations of observed cetacean interactions with the Hawaii shallow-set longline fishery during 2007-2011. Solid gray outlines represent U.S. EEZs; dotted gray outlines are (from south to north): 1) the estimated range of the main Hawaiian Islands Insular stock of false killer whales, and 2) the estimated range of the Northwestern Hawaiian Islands stock of false killer whales. Takes are labeled by species code (defined in Table 1).

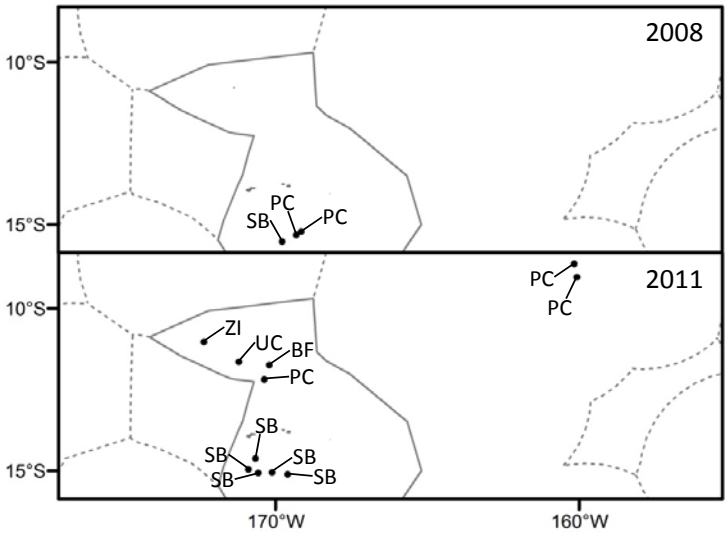

Figure 3.--Locations of observed cetacean interactions with the American Samoa deep-set longline fishery during 2007-2011. Years without observed interactions are not shown. Solid outlines represent the U.S. EEZ; dotted gray outlines are non-U.S. EEZs. The two takes outside the U.S. EEZ are within the EEZ of the Cook Islands. Takes are labeled by species code (defined in Table 1).

APPENDIX

Specific factors were considered in the application of some of the injury categories (NMFS, 2012) to cetacean interactions in the Hawaii and American Samoa longline fisheries. L = large whale category (Table 1 in NMFS, 2012); S = small cetacean category (Table 2 in NMFS, 2012).

Injury category	Factors considered
L3	This category was used to cover the case of an animal possibly freeing itself of associated gear, as there is currently not a category to cover this scenario.
S2, S5	The observers were generally able to determine when an animal was hooked in the mouth (or at least the head area), based on the presence of line coming from that region. However, it was more difficult to confirm whether the hook had been ingested. If the observer indicated that the hook was seen embedded in the mouth (or other part of the head), S5 was used. If the observer specified that the line came from the mouth, but that the hook or leader was not seen and that ingestion was presumed, S2 was applied. Otherwise, the interaction was classified as "S2 or S5" to account for the possibility of ingestion. This classification did not affect the injury determination, as both S2 and S5 represent a serious injury (NMFS, 2012).
S5c, S5d, S7b	For these categories that require "case-specific" injury determinations, a consideration of capture myopathy was included in the determination process (NMFS 2012). Specific interaction characteristics that were considered were: 1) duration of the event, 2) behavior of the animal during the interaction and upon release, and 3) known species-specific sensitivity to capture myopathy. Interactions that were prolonged, resulted in the animal actively struggling and appearing lethargic upon release, and involved a species with known sensitivity (e.g., *Stenella* spp.) were considered more likely to have caused capture myopathy. For some interactions, the interaction duration and animal behavior were specified by the observer. For others, these attributes were implied from the event description or supporting information that suggested a lengthy period of struggle (e.g., the animal was pulled to the vessel from a long distance, the gear associated with the animal was tangled).
S6	The length and body location of line remaining attached to the animal was considered relative to the length of the animal (as estimated by the observer). If the remaining line was longer than the animal, regardless of where the remaining line was attached, then S6 was used. S6 was also applied if the remaining line was shorter than the animal, but attached in a location where the line could be ingested, wrap around the goosebeak or other body parts, or become snagged on something in the environment. If the remaining line was shorter and not in a position to pose a risk, then S6 was not used.
S5d, S6	When wrapped line remained attached to an animal, these categories were consistently considered more appropriate to apply to the interaction than S8a or S8b. While the line might have been in a constricting (S8a) or loose (S8b) wrap prior to the animal breaking away or being cut free from the bulk of the gear, the observers were generally not able to assess the nature or persistence of the wrap post-release. Thus, accounting for the length and body location of the line and determining its potential (S6) or not (S5d) to wrap, be ingested, or become snagged on something in the environment was more applicable.
S15	This category was only applied in the context of a dependent animal being left with a seriously injury mother. Even though it was possible to infer dependent status for many of the injured animals (using observer size estimates, published estimates of size-at-weaning, and supporting visual information), the category description does not offer guidance as to how to determine whether a dependent animal was released alone post-interaction. Therefore, the category was not used in that way, but as described in the text, may apply to relevant interactions pending future guidance.

Availability of NOAA Technical Memorandum NMFS

Copies of this and other documents in the NOAA Technical Memorandum NMFS series issued by the Pacific Islands Fisheries Science Center are available online at the PIFSC Web site http://www.pifsc.noaa.gov in PDF format. In addition, this series and a wide range of other NOAA documents are available in various formats from the National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161, U.S.A. [Tel: (703)-605-6000]; URL: http://www.ntis.gov. A fee may be charged.

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