# Marine Mammals Reported under Catch Lost to Predators on Fishermen's Commercial Catch Reports to the State of Hawaii, 2003-2014<sup>1</sup>

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#### Introduction

This report provides preliminary summaries of data on marine mammals named by fishers as predators responsible for reported losses of fish catch. The data were derived from a variety of Commercial Fish Catch Reports submitted by fishers to the State of Hawaii on forms in use after 2002. There is no assurance that the data are comprehensive, or that the types of mammals named by the fishers are always accurately identified. Further, in many cases only a broad category is specified, such as "dolphin" or "porpoise". These are not observer data, but rather commercial fishermen's self-reports, as required by State of Hawaii regulations. These data were requested by the Scientific Review Group (SRG) for Pacific Marine Mammals and by the Take Reduction Team for False Killer Whales. The treatment of the data here is cursory, and the authors and collaborators intend to complete a more comprehensive analysis for publication.

#### Methods

predators from at least 3 Commercial Marine License (CML) holder reports are considered by the State of Hawaii to be non-confidential. No summary information is provided here that does not meet this criterion. To illustrate trends over time it was necessary to aggregate data over three-year periods for less common species to get a sufficient count of CMLs (here the term "CML" means a CML-holding fisher who filed reports). For summaries by season, gear, and area, data from 2003-2014 were combined. For seasonal summaries, too few CMLs reported by month for several taxa, which had to be summarized bimonthly (over all years combined) to achieve non-confidential results.

Only summaries that are an aggregation of data on a particular taxon of marine mammal

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<sup>&</sup>lt;sup>1</sup> PIFSC Data Report DR-15-006. Issued 8 April 2015. Do not cite without permission of authors.

For area summaries, individual areas of the State of Hawaii Fisheries Statistical Chart had to be aggregated into composite areas for less-frequently reported species. The logic for creating composite areas was, if possible, to segregate information on reports for areas within 2-3 nautical miles of the islands, referred to here as "inshore areas". Each island is also surrounded by areas defined by radial extent from the outer boundaries of the coastal areas to 20 nautical miles from shore. These areas are referred to as "offshore areas" in this report. Where possible, aggregations of inshore and offshore areas were separated for the more windward North and East (combined) sides of the islands versus the South and West (combined) sides. In one case the inshore and offshore areas of an island had to be combined to preserve confidentiality. When aggregating areas, county structuring by Hawaii County, Maui County (including Molokai, Lanai, and Kahoolawe), Oahu, and Kauai County (including Niihau and Kaula) was retained if possible. And for all areas beyond the 20-nautical mile zone combined, there were a few species where there was data from at least 3 CMLs.

Data summaries (Tables 1-3) include the number of CMLs that reported particular taxa of marine mammals, as well as the number of records (reports) involved and the number of "days in records" (reported number of days fishing). The number of records was larger than the number of CMLs when there were multiple reports for some CMLs. And the number of days in records was larger than the number of records when reports included several days of fishing.

After 2002 revised report forms included a requirement to list on a daily basis catch lost to predators, along with area fished and method used, and to identify the predators and total number of fish lost in a summary line at the end of each report. For example, Figure 1 shows the form for the "Fishery Report" with summary line at the bottom; other catch report forms are similar. In many cases fishers listed multiple predators in the summary line. So reports frequently included separate data for many days of fishing, but had one line of data on the predators responsible for the losses. A typical summary line for predators appears as follows (with fictitious data):

Number Lost to Predators: Sharks 3 Unknown 25 Other Dolphin, Yellowfin / 34

Number Number Predator Name Number

Thus the number of days in each record that apply to each named predator could not be estimated unambiguously from the data available for this paper. Still, the amounts of loss given for the predators were typically more than listed on any given day, and in many cases the recorded predation must involve more than one day of fishing. All of the days when losses occurred in a report (days in records) were summarized along with the number of records (reports) in this paper, to give an upper limit to the number of days fishing that could have involved depredation by each predator. These numbers of days in records are probably an overestimate of the days when the predator was involved, just as the number of records is an underestimate for each predator's involvement. The best estimate would be somewhere in between. In future, an analysis could provide estimates for reports that include only one predator. However, any estimates based only on a subset of the data for infrequent predators will run into difficulties with the number of CMLs needed to produce non-confidential summaries. There may be more information to link which days of fishing each recorded predator was responsible for the loss, but these data, or the procedures to better link them, were not accessible for this report.

The numbers of records (reports) pertinent to each predator were less ambiguous than the number of days. Records for monthly reports were enumerated as unique CML and day fished combinations for the last day in the month in which catch was reported lost, which was accurate at the monthly resolution used for this report. In other words no two dates in the same month were counted as a record for any given predator. Records more frequent than one per month (Trip Reports) were identified by trip begin and end dates and enumerated as unique CML and day fished combinations for the last day in the report in which catch was reported lost. Other days with losses in each report were summarized for the count of "days in record."

Even when several predators were listed together in a report, that represented one record for each predator. Most often only one marine mammal was listed in records that included multiple predators, with the others most often being fish. In the cases when several mammals were included in a report, the report was counted as a record only for the least common predator as a shortcut around analytical complications, and in only one case were two infrequent mammal predators named in a single report. That report was counted as a record for both of the rare predators. However, when a report included more than one fishing method or area fished, it could not be assumed with assurance that either of the two methods or areas was pertinent to the mammal predator. So to be conservative, such reports were not counted as CMLs or records for the purposes of making non-confidential summaries, unless, in the case of areas, both areas were part of a larger, composite area for summary purposes.

#### Results

Six marine mammal predator taxa were named by at least 4 CMLs. From least to most common these were: pigmy killer whale, false killer whale, pilot whale, monk seal, dolphin, and porpoise. No further information can be revealed about the least common species, but data and illustrations are provided on the other five taxa with respect to trends in numbers of records over time, seasonality of records, fishing methods, and areas of occurrence. Interestingly, no particular species of dolphin or porpoise was named. Porpoises and Dolphins were reported with enough frequency that non-confidential summaries could be provided at the annual and monthly (all years combined) resolution (Figure 2) and maps for these taxa do not resort to use of composite areas to achieve non-confidential summaries. They provide the full resolution possible from the State of Hawaii Statistical Fisheries Chart except that some areas show no data due to confidentiality (Figures 3-7). For the other species three-year and bimonthly summaries, as well as composite areas, were required to achieve a non-confidential degree of aggregation. For all taxa, the number of records by fishing method could be provided for all years combined (Figure 8). Nonconfidential classification at lower levels of detail, for example area by month or area by gear, was not attempted and is not possible for the infrequent species.

#### Discussion

The patterns revealed are based on occurrence, and the influence of the frequency of the different methods of fishing remains to be shown by further analysis, which would provide the ratio of records with mammals to all records for a given time, gear, or area.

## Caveat

The apparent distribution, time trends, seasonality, and prevalence of gears reflected in these summaries are nominal. The patterns observed have not been evaluated with respect to several important factors, such as: (1) the total number of reports or amount of fishing effort that depredation reports are a subset of (the total sample size); (2) the reliability of the marine mammal taxa named by fishermen in the reports; (3) the fraction of reporting fishermen who ever report depredation; (4) or other sources of bias in the data summaries. As such, the information in this report should be treated cautiously and should not be cited without permission of the authors.

(Please Print) Fishing Report											FOR OFFICE USE				
Licens	ee Nan	ne						Marine License N	io.	I	R/L K/D				
		CG No.		TT	TT										
Vessel	Name					Н	A No		or USC	ÇG No.			<u> </u>		
Month	& Yea	r Fished		Mont	h		_	2 0 Year							
101.0			FISH	NG E	FOR	T			SPECIES	CA	тсн -		IR		
	Charter Trips "X"	Buoy or Area Fished	Fishing Method (See Methods List)	Hours Fished Per Method/ Area	Number of Net Sets	Number of Fishing Lines, Traps or Net Length in Feet	No Catch "X"	Port of Landing	Species Name	Number Landed	Pounds Landed	and Re	r of Lost eleased sh it eased R		
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Figure 1. State of Hawaii "Fishing Report" form for use by fishers to report catch, effort, and number of fish lost to predators; other catch reports are similar.

Table 1. Depredation over time, by year or three-year intervals, where at least three State of Hawaii Commercial Marine Licensees (CML's) reported loss of catch to marine mammals. Records are commercial monthly or trip catch reports to the Hawaii Division of Aquatic Resources. Multiple days with loss to predators may be included without dayly specification of the responsible predator, resulting in possible over-estimation of days.

197 201 118	CML's 47 39	Records 16	Days in Records 56	CML's	Three Year Period	No. of	Days in		No. of	Days in	No. of	No. of	Days in	No. of
Records 197 201 118	CML's 47 39	Records 16	Records	CML's			-		No. of	Days in	No. of	No. of	Days in	No. of
197 201 118	47 39	16			Period	Records								1
201 118	39		56	۰ .		rtcooras	Records	CML's	Records	Records	CML's	Records	Records	CML's
118		6		0	2003									
_			15	4	to							5	22	3
	35	7	19	5	2005									
153	36	5	15	4	2006									
92	35	12	31	12	to	7	8	6				6	11	6
156	51	13	37	7	2008									
126	34	8	26	6	2009									
117	40	16	28	12	to	10	13	10	14	26	11	20	35	15
156	52	41	81	31	2011									
135	49	59	79	45	2012									
97	38	48	65	37	to	15	19	14	13	20	11	43	71	27
88	35	73	95	47	2014									
	126 117 156 135 97	126 34 117 40 156 52 135 49 97 38	126 34 8 117 40 16 156 52 41 135 49 59 97 38 48	126     34     8     26       117     40     16     28       156     52     41     81       135     49     59     79       97     38     48     65	126     34     8     26     6       117     40     16     28     12       156     52     41     81     31       135     49     59     79     45       97     38     48     65     37	126     34     8     26     6     2009       117     40     16     28     12     to       156     52     41     81     31     2011       135     49     59     79     45     2012       97     38     48     65     37     to	126     34     8     26     6     2009       117     40     16     28     12     to     10       156     52     41     81     31     2011       135     49     59     79     45     2012       97     38     48     65     37     to     15	126     34     8     26     6     2009       117     40     16     28     12     to     10     13       156     52     41     81     31     2011       135     49     59     79     45     2012       97     38     48     65     37     to     15     19	126     34     8     26     6     2009       117     40     16     28     12     to     10     13     10       156     52     41     81     31     2011     2012     2012     2012     37     10     15     19     14	126     34     8     26     6     2009       117     40     16     28     12     to     10     13     10     14       156     52     41     81     31     2011     2012	126     34     8     26     6     2009       117     40     16     28     12     to     10     13     10     14     26       156     52     41     81     31     2011     2012     31     31     2012     32     33     34     36     37     10     15     19     14     13     20	126     34     8     26     6     2009       117     40     16     28     12     to     10     13     10     14     26     11       156     52     41     81     31     2011     2012 <td>126     34     8     26     6     2009       117     40     16     28     12     to     10     13     10     14     26     11     20       156     52     41     81     31     2011     2012</td> <td>126     34     8     26     6     2009       117     40     16     28     12     to     10     13     10     14     26     11     20     35       156     52     41     81     31     2011     2012</td>	126     34     8     26     6     2009       117     40     16     28     12     to     10     13     10     14     26     11     20       156     52     41     81     31     2011     2012	126     34     8     26     6     2009       117     40     16     28     12     to     10     13     10     14     26     11     20     35       156     52     41     81     31     2011     2012

Table 2. Depredation over annual cycle, by month or bimonth, where during 2003-2014 (combined), at least three State of Hawaii Commercial Marine Licensees (CML's) reported loss of catch to marine mammals. Records are commercial monthly or trip catch reports to the Hawaii Division of Aquatic Resources. Multiple days with loss to predators may be included without dayly specification of the responsible predator, resulting in possible over-estimation of days.

		Porpoise			Dolphin			ı	Pilot Whale	Э	Fals	e Killer W	hale		Monk Seal				
	No. of	Days in	No. of	No. of	Days in	No. of		No. of	Days in	No. of	No. of	Days in	No. of	No. of	Days in	No. of			
Month	Records	Records	CML's	Records	Records	CML's	Bi-Month	Records	Records	CML's	Records	Records	CML's	Records					
Jan	80	180	57	22	36	19	Jan-⊦eb							16	30	14			
Feb	52	124	39	17	28	14								10	30				
Mar	68	161	54	17	32	15	Mar-Apr	3	6	3	10	15	7	10	18	9			
Apr	70	153	60	36	58	35	Wai Api	3											
May	72	174	63	34	70	32	1 10/20-3011	11	15	10	12	16	12	8	28	7			
Jun	74	157	60	30	48	28				10	\ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \		12						
Jul	70	131	63	40	75	37	Jul-Aug	14	17	14	6	13	6	7	8	7			
Aug	52	93	48	28	44	26	Jui Aug		17	14				, '					
Sep	55	122	48	25	43	22	Sep-Oct	5	5	5				14	22	12			
Oct	40	89	36	18	38	15	Sep-Oct	3	3	3					22	12			
Nov	59	110	48	14	20	14	Nov-Dec							19	29	14			
Dec	58	142	40	23	55	20	NOV-DEC							13	23	'-			

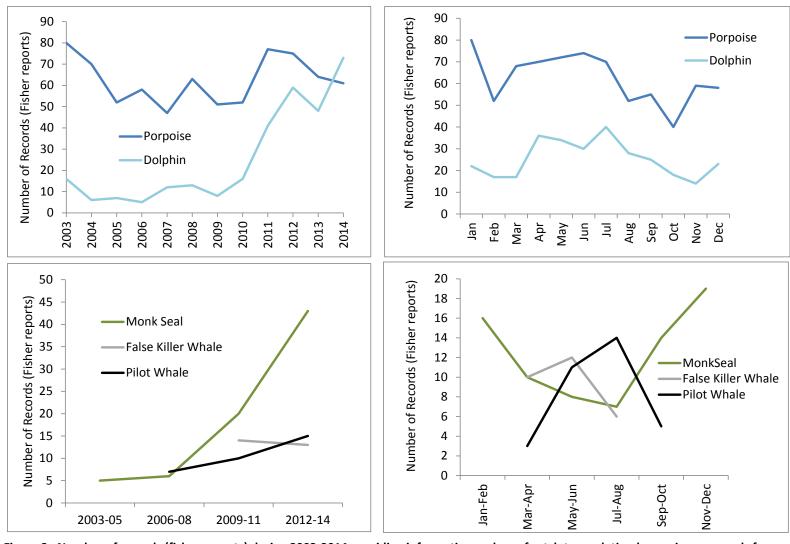


Figure 2. Number of records (fisher reports) during 2003-2014 providing information on loss of catch to predation by marine mammals for fisher-identified categories of marine mammals, all fishing methods combined. In each case, the number of records represents information from at least 3 CML holders.

Table 3. Depredation by fishing method, where, during 2003-2014 (combined), at least three State of Hawaii Commercial Marine Licensees (CML's) reported loss of catch to marine mammals. Records are commercial monthly or trip catch reports to the Hawaii Division of Aquatic Resources. Multiple days with loss to predators may be included without dayly specification of the responsible predator, resulting in possible over-estimation of days. And if several methods were included in a report, then that report and the CML were not counted due to uncertainy about which method applied to a given predator in that report.

	Monk Seal			Fals	e Killer W	hale	F	ilot Whale		Dolphin			Porpoise		
	No. of	Days in	No. of	No. of	Days in	No. of	No. of	Days in	No. of	No. of	Days in	No. of	No. of	Days in	No. of
Fishing Method	Records	Records	CML's	Records	Records	CML's	Records	Records	CML's	Records	Records	CML's	Records	Records	CML's
Trolling - Lures	3	6	3	15	18	15	27	33	27	119	164	78	230	363	146
Deep-Sea Handline, Bottom Handline	39	63	28							41	85	22	206	392	62
Palu Ahi, Drop Stone, Make Dog				6	6	6				55	78	26	96	150	66
Inshore Handline	12	27	8							21	68	11	57	218	20
Casting. Light Tackle, Spinner, Whipp.										16	18	10	24	38	19
Trolling - Bait										9	10	9	20	54	14
Ika-Shibi										9	10	4	8	14	8
Trolling (Misc.)													3	3	3
Kona Crab Net, Loops	3	5	3												
All Trolling, Summed	3	6		15	18		27	33		128	174		253	420	
All Handlining, Summed	51	90		6	6		0	0		126	241		367	774	

# Records of Porpoise Depredation in Hawaii State Fishery Data

by Individual State Statistical Areas where there were at least 3 Commercial Marine Licenses (CMLs) reporting depredation by porpoise from 2013-2014. When reports were from <3 CML's, no data are shown.

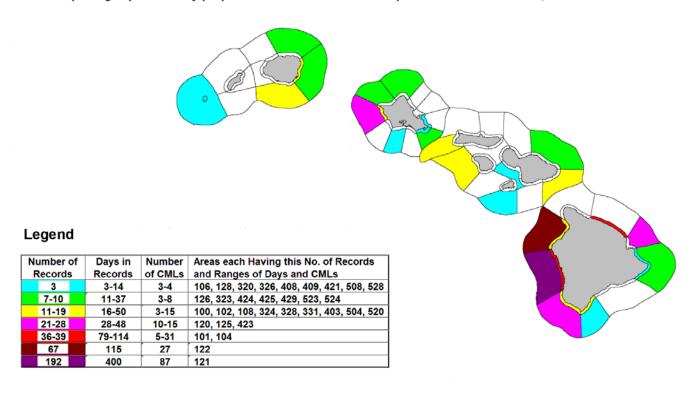


Figure 3

# Records of Dolphin Depredation in Hawaii State Fishery Data

by Individual State Statistical Areas where there were at least 3 Commercial Marine Licenses (CMLs) reporting depredation by dolphin from 2003-2014. When reports were from <3 CML's no data are shown.

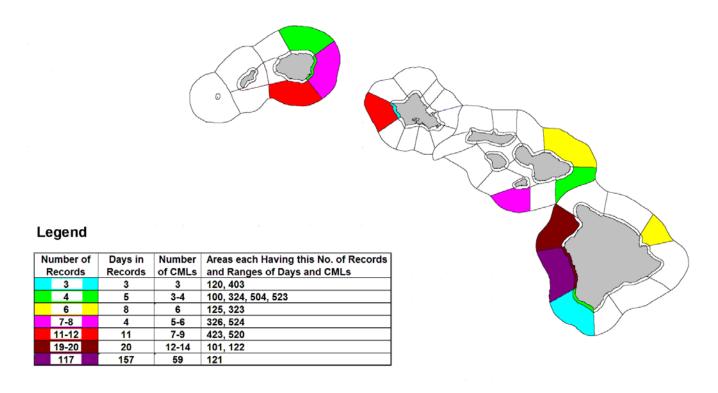


Figure 4

## Records of False Killer Whale Depredation in Hawaii State Fishery Data

by County and by Inshore Areas (~2 nautical miles from shore) or Offshore Areas (~2 to ~20 nautical miles from shore). When reports of killer whales were from <3 Commercial Marine Licencees, no data are shown.

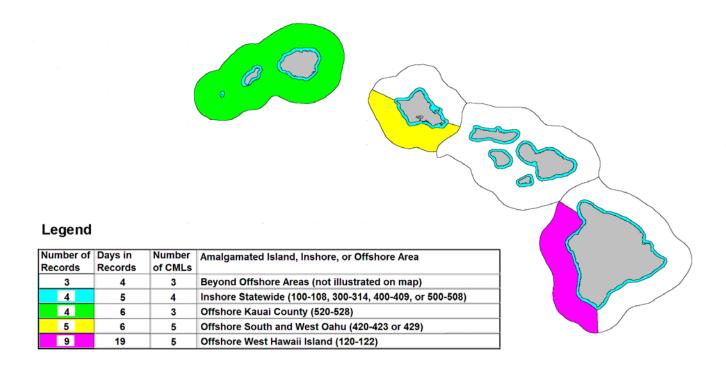


Figure 5

# Records of Pilot Whale Depredation in Hawaii State Fishery Data

by County and by Inshore Areas (~2 nautical miles from shore) or Offshore Areas (~2 to ~20 nautical miles from shore). When reports of whales were from <3 Commercial Marine Licencees, no data are shown.

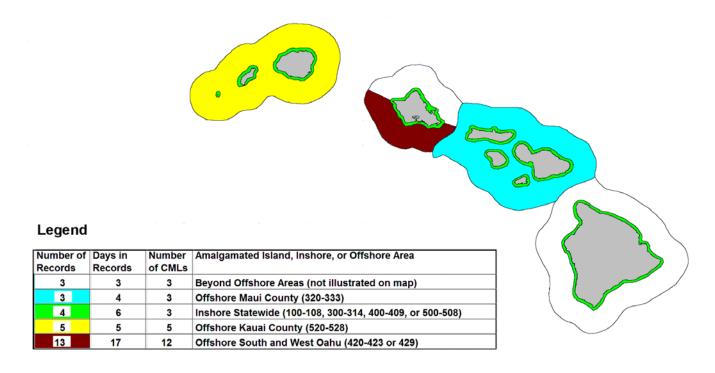


Figure 6

# Records of Monk Seal Depredation on Catch in Hawaii State Fishery Data

by County and by Inshore Areas (~2 nautical miles from shore) or Offshore Areas (~2 to ~20 nautical miles from shore). When reports of monk seals were from <3 Commercial Marine Licencees, no data are shown.

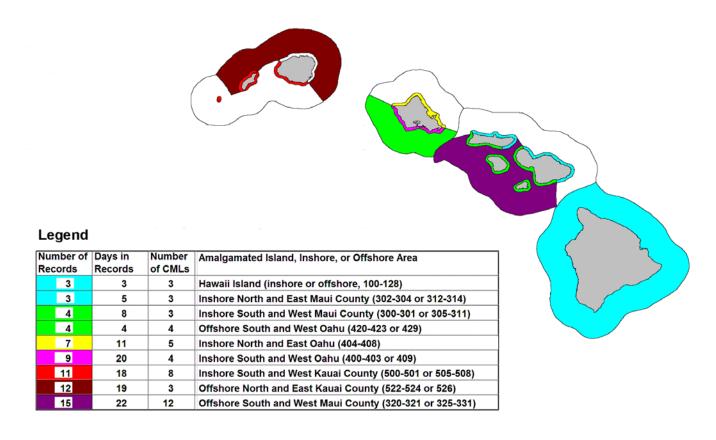


Figure 7

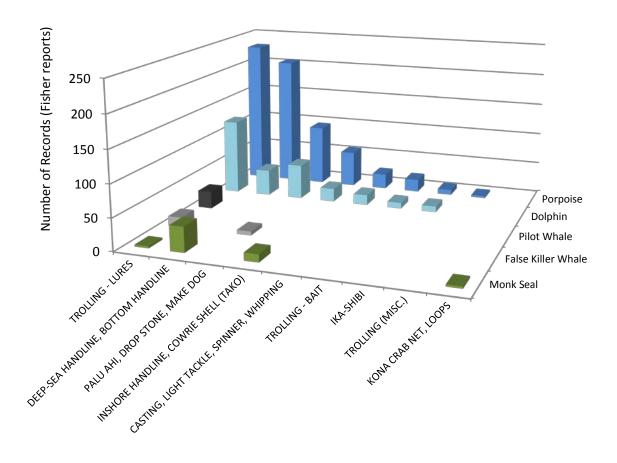


Figure 8. Number of records (fisher reports) during 2003-2014 providing information on loss of catch to predation by marine mammals for fisher-identified categories of marine mammals, by fishing method. In each case, the number of records represents information from at least 3 CML holders.