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Progress Report on
Research Conducted in 1982 on Dall's Porpoise Taken
Incidentally in the Japanese Salmon Mothership Fishery

by

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At the 1982 annual meeting of the International North Pacific Fisheries Commission, the research undertaken in 1982 by U.S. scientists as part of the Japan-U.S. Cooperative Research Program on Marine Mammal Incidental Take was reviewed (Jones and Actor 1982). The report included discussion of research onboard Japanese salmon research vessels to collect data on marine mammal distribution, abundance, and incidental take, onboard salmon motherships to collect biological data and specimens, and onboard salmon catcherboats to monitor incidental take in commercial gillnet operations. A feasibility study on the attraction of Dall's porpoise to vessels was also discussed. This report describes further analyses of data on incidental take, entanglements and progress on biological studies.

Incidental Take of Dall's Porpoise

The incidental take of Dall's porpoise in 1982 was significantly higher than that recorded in 1981 (Chi Square Goodness of Fit Test, $p < .05$). In 1982, an estimated 4,187 Dall's porpoise were incidentally taken in the Japanese salmon mothership fishery inside the U.S. Fishery Conservation Zone (FCZ), compared to an estimated 2,039 porpoise in 1981 (Jones and Actor 1982). Some factors that may account for an increased catch are increased number of porpoises in the areas fished, change in the areas of fishing operations, or differences in the environmental conditions that increase the likelihood of entanglement. We compared the data collected by the marine mammal observers to obtain some indication of which factors may have effected variation between years in the number of porpoises entangled.

Table 1 shows the distribution of observed gillnet operations in each year and the associated incidental take. The most obvious

difference between the two years is the lack of observed sets north of 52°N. Therefore, we stratified the fishing area of 1982 into two areas (49° to 52°59'N, and 53° to 55°N) and compared their take rates. The take rate in the northern area was 1.29 porpoise per set (18 porpoise in 14 sets) compared to 0.69 per set (176 porpoise in 257 sets) in the southern portion of the U.S. FCZ in 1982. There is a significantly higher take rate (t-test, $p < 0.05$) in the northern area, in which no observations were made in 1981. Since the observer effort reflects the fishing effort, the areal difference in the fishing effort may have contributed to a higher take rate in 1982.

We also compared the take rates in the southern area of the U.S. FCZ between years (Table 1). The take rate in 1981 was 0.29 porpoise per set (119 porpoise in 402 sets). This is significantly lower than the 1982 rate of 0.69 (t-test, $p < 0.05$). Examination of Table 1 shows that in some areas (e.g., 49°N and 172°E) there was no difference in the take rate between years. In other areas (e.g., 51°N and 173°E) there was a substantial increase in the rate in 1982. There are no cases where the take rate was substantially higher in 1981 than in 1982. This implies that either conditions or porpoise behavior changed such that the probability of entanglement increased in 1982 or that more animals were present in the fishery area. More detailed analyses of take by 1° x 1° areas will be done when data on the fleet fishing effort are available.

The frequency distribution of the number of porpoise entangled per set was also compared for the two years (Table 2). There was a significant difference in the incidental take between years

(Chi Square Goodness of Fit Test, $p < 0.05$). In 1982 there were fewer sets with no porpoise entangled and a number of sets in which higher numbers of porpoise entangled than in 1981.

We examined the 1982 U.S. observer data to determine whether there was an association between entanglements of Dall's porpoise and sightings during set or retrieval operations. If so, then differences between years in the number of sets with sightings could indicate differences in the abundance of porpoise in the fishery area and would help explain differences in take rates between years.

Table 3 lists the number of gillnet sets observed by U.S. marine mammal observers in each mothership fleet, the number of sets in which one or more Dall's porpoise entangled, the number of sets in which Dall's porpoise were sighted during the set or retrieval operations, and the number of sets in which there was an entanglement and a sighting during set or retrieval. Although observer effort is limited by visibility and amount of sighting time available during the operation, the number of sets in which there was a sighting during the gillnet operations was low and does not appear to be useful as an indicator of abundance or entanglements.

Characteristics of Entanglements

In 1982, we continued collecting data on the location of entanglements in the gillnet. Table 4 shows the location of porpoise horizontally in the net for both 1981 and 1982. Out of 140 entanglements for which there are data in 1982, 46 (33%) occurred within 500 m of the start or end of a net section. This is similar to the 1981 data (33 out of 84 entanglements or 39% (INPFC Document 2505)). The entanglement rate in 1982 for these end sections is 0.77 porpoise per tan compared to 0.35 per tan in the remainder of the net. In 1981, these rates were 0.56 and 0.18 respectively. Apparently there is a tendency for entanglement to occur near the ends of the net sections. The explanation for this tendency is unknown.

It has been suggested that the porpoise are attracted to the radio or radar buoys on the gillnets and tend to entangle near these. Since these are usually located at or near the ends of the net sections, this could explain the tendency for entanglements near the ends. Although observers did not consistently note information on buoy proximity, there were several cases (6) in 1982 in which the observer noted a buoy in the vicinity of an entangled porpoise, at distances varying from 5 to 500 m from the porpoise. In 1983, we will attempt to obtain additional information on the buoy position with respect to entanglements.

The vertical location of entanglements was also recorded by the observers (Table 5). As in 1981, the majority of the entanglements appeared to be in the upper half of the net. Since the observers are unable to closely examine each entanglement, it is difficult to determine with accuracy the location of initial contact with the net by the porpoise, but it appears that the porpoise tend to entangle nearer the surface.

Catch Composition

Table 6 lists the composition of the incidental catch of Dall's porpoise returned to the motherships in 1982. Maturity is not based upon examination of the reproductive organs, but upon body length (mature, ≥ 180 cm), and in females also upon presence of a fetus or lactation. Therefore these results are preliminary and will change when the laboratory analyses on reproductive specimens are completed.

As in previous years, although pregnant females were collected in the Bering Sea outside the U.S. FCZ, no newborn animals were collected in this area in 1982. Newborn animals were taken inside the U.S. FCZ during the time when one or more fleets were operating in this Bering Sea area (Table 7). It is unknown whether the lack of newborn animals is a result of a later calving date in the northern area, lack of return to the motherships of newborn animals, or some other factor.

Biological Studies

Reproductive Analyses.--Reproductive specimens collected aboard the motherships in 1981 have been examined and measured in the laboratory. Histological slides produced under contract are currently being examined. Laboratory analysis of the 1982 specimens is to be completed by Fall 1983.

Food habits.--Stomachs collected aboard the salmon motherships in the Bering Sea in 1981 and 1982, in the U.S. FCZ in 1982, and during the 1982 cruise of the Hoyo Maru No. 12 have been examined and processed under contract (T.W. Crawford, private contractor). The fish prey are being identified to species using the otoliths. These results will be compared with those from specimens collected onboard the salmon motherships in 1978 and 1979. The analysis is scheduled to be completed in March 1983.

Stock Identity Studies--A preliminary study on geographic variation in Dall's porpoise based on skeletal morphometrics and parasite data was begun in 1982 (W. A. Walker, private contractor). The final report will be submitted on 15 March 1983.

A total of 93 Dall's porpoise skulls were measured: 58 from the U.S. FCZ (30 female, 28 male) and 35 from the eastern North Pacific, south of 35°N (12 female, 23 male). Preliminary analyses indicate the possibility of differences in the general shape of the porpoise rostra in the two geographic areas.

Parasite data on the larval cestodes Phyllobothrium sp. and Monorygma sp. collected in 1981 were inadequate for comparison between the two geographic areas. Data collected in 1982 are presently being analyzed.

Total vertebral counts were made and compared from fourteen animals from the Southern California Bight, 48 specimens from central California and 121 specimens collected in the U.S. FCZ, in 1981. No significant differences were found (Table 8). Therefore this method does not appear to be useful for determining stock differences between geographic areas.

Thoracic vertebral epiphyses are being examined to determine size and/or age at onset of physical maturity. This may provide information on potential size or growth rate differences between the two areas.

A contract was implemented in December 1982 for a more complete analysis of possible stock differences based on skeletal morphology (W. A. Walker, Santa Barbara Museum of Natural History). The contractor will examine and measure skulls, and other skeletal materials as necessary, available in museums and collections throughout the U.S. Specimens from the western and eastern North Pacific Ocean and Bering Sea will be included. The study is to be completed in early 1984.

A study of possible stock differences based on electrophoretic techniques is scheduled to begin in March 1983 (Dr. F. Utter, Northwest and Alaska Fisheries Center). This project will analyze tissues collected in 1981 and 1982. The study is to be completed in summer 1983.

Behavior of Dall's Porpoise

In 1980, a cooperative U.S.-Japan research cruise was conducted onboard the Hoyo Maru No. 81 in the western North Pacific Ocean to study the distribution, movements and entanglement of Dall's porpoise. During the period 16 May to 7 June, the objective was to emplace modified spaghetti tags in Dall's porpoise as they rode the bow wave of the vessel. Analysis of the sighting and tagging data collected during this segment of the cruise shows areal differences in the response of Dall's porpoise to the survey vessel (Table 9).

The data were grouped by time of day (morning and afternoon) and area (south of 50°N and north of 50°N). The number of sightings was similar in the two areas and within time periods, however there were more sightings in the afternoon (Table 9A). The number of groups in which there were one or more successful taggings was similar for each case, with the lowest number of taggings occurring in the afternoon in the southern area (Table 9B). The total number of animals tagged was highest in the northern area (35 animals versus 9) (Table 9C).

Comparison of the number of animals tagged per sighting (Table 9D) shows more animals tagged per sighting in the northern area. Group size was not significantly different in the four categories (ANOVA, $p \geq 0.05$) but varied from 3.9 porpoise per sighting in south area in the afternoon to 6.0 for the northern area in the afternoon. Since not all animals in a group necessarily came to the bow of the vessel where they could be tagged, the increased success in tagging in the northern area suggests that more animals in a group approached the bow in this area. This implies some behavioral difference of animals between areas.

References

Jones, L.L. and L. Actor. 1982. Progress Report on 1982 Field Research on Dall's Porpoise Incidentally Taken in the Japanese Salmon Gillnet Fishery. (Annual Report to The International North Pacific Fisheries Commission, October 1982).

TABLE 1.-- Comparisons of number of Dall's porpoise and observed gillnet sets and of take ratio by 1° area in 1981 and 1982 in the U.S. Fishery Conservation Zone.

	Longitude									
	170°		171°		172°		173°		174°	
	1981	1982	1981	1982	1981	1982	1981	1982	1981	1982
<u>55°N</u>										
No. of porpoise	-	-	-	-	-	-	-	1	-	2
No. of observed sets	-	-	-	-	-	-	-	3	-	3
Take rate	-	-	-	-	-	-	-	0.33	-	0.67
<u>54°N</u>										
No. of porpoise	-	-	-	-	-	-	-	2	-	-
No. of observed sets	0	0	0	0	0	0	0	3	0	0
Take rate	-	-	-	-	-	-	-	0.67	-	-
<u>53°N</u>										
No. of porpoise	-	-	-	10	-	0	-	3	-	-
No. of observed sets	0	0	0	2	0	1	0	2	0	0
Take rate	-	-	-	5.0	-	0	-	1.5	-	-
<u>52°N</u>										
No. of porpoise	-	-	-	0	1	-	0	-	5	-
No. of observed sets	0	0	0	1	2	0	1	0	8	0
Take rate	-	-	-	0	0.5	-	0	-	0.63	-
<u>51°N</u>										
No. of porpoise	0	-	1	1	15	1	11	15	9	9
No. of observed sets	1	0	3	4	32	2	45	14	39	20
Take rate	0	-	0.33	0.25	0.47	0.5	0.24	1.1	0.23	0.45

TABLE 1.-- Comparisons of number of Dall's porpoise and observed gillnet sets and of take ratio by 1° area in 1981 and 1982 in the U.S. Fishery Conservation Zone-- (continued).

	Longitude									
	170°		171°		172°		173°		174°	
	1981	1982	1981	1982	1981	1982	1981	1982	1981	1982
<hr/>										
<u>50°N</u>										
No. of porpoise	0	8	5	3	13	18	28	32	7	22
No. of observed sets	1	5	12	7	36	20	57	39	62	34
Take rate	0	1.6	0.42	0.43	0.36	0.9	0.49	0.82	0.11	0.65
<hr/>										
<u>49°N</u>										
No. of porpoise	-	-	0	3	7	9	13	21	4	28
No. of observed sets	0	-	4	8	20	26	38	36	41	30
Take rate	-	-	0	0.38	0.35	0.35	0.34	0.58	0.10	0.93
<hr/>										
<u>48°N</u>										
No. of porpoise	-	-	-	-	-	-	-	2	-	4
No. of observed sets	0	-	0	-	0	-	0	3	0	5
Take rate	-	-	-	-	-	-	-	0.67	-	0.8
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TABLE 2.--The frequency of the number of Dall's porpoise entangled per gillnet set in 1981 and 1982. Data collected by marine mammal observers on salmon catcherboats.

Year	0	1	2	3	4	5	6	7	8	Total sets
1981	322	75	14	5	0	1	0	0	0	417
1982	271	114	32	14	7	3	1	0	1	443

TABLE 3.--Comparisons of number of gillnet operations with entanglements, and/or sightings of Dall's porpoise during net set and retrieval in 1982. Data collected by U.S. marine mammal observers onboard salmon catcherboats.

Mothership	No. sets observed	No. with an entanglement	No. with sighting during		No. with entanglement and sighting during	
			Set	Retrieval	Set	Retrieval
KIZAN	66	32(48%)	9	15	4	9
JINYO	64	31(48%)	4	6	0	4
MEIYO	69	25(38%)	7	9	6	4
NOJIMA	75	25(33%)	14	11	5	3
	<u>270</u>	<u>113(40%)</u>	<u>34</u>	<u>41</u>	<u>15</u>	<u>20</u>

TABLE 4.--Horizontal location of Dall's porpoise entanglements in the salmon gillnets, 1981-1982. The Start and End categories are within 500 m of a net edge.

	Sections of Net								
	1			2			3		
	Start	End	Remainder	Start	End	Remainder	Start	End	Remainder
1982	6	8	29	6	6	31	7	13	34
1981	<u>6</u>	<u>7</u>	<u>12</u>	<u>3</u>	<u>9</u>	<u>24</u>	<u>1</u>	<u>7</u>	<u>15</u>
Totals	12	15	41	9	15	55	8	20	49

TABLE 5.--Vertical distribution of Dall's porpoise entanglements in the salmon gillnets, 1981-1982.

	Net depth		
	Top (2m)	Central	Bottom (2m)
1982	41	13	4
1981	70	29	11

TABLE 6.--Composition of Dall's porpoise take in 1982. These are preliminary results because maturity is not based on examination of reproductive organs but on body length (mature \geq 180 cm) and in females, also on the presence of a fetus or lactation.

South of U.S. FCZ

Mothership	Fetus		Newborn		Females		Lact.	Preg. & Lact.	Mature, not preg. or lact.	Males	
	Female	Male	Female	Male	Imm.	Preg.				Imm.	Mat.
JINYO	2	1	0	0	3	3	0	0	0	4	0
KIZAN	5	3	0	0	2	7	1	2	1	2	1
MEIYO	5	0	0	0	3	5	0	0	1	1	1
NOJIMA	3	2	0	0	6	5	0	0	1	1	1
	<u>15</u>	<u>6</u>	<u>0</u>	<u>0</u>	<u>14</u>	<u>20</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>8</u>	<u>3</u>

B. Southern U.S. FCZ

Mothership	Fetus		Newborn		Females		Lact.	Preg. & Lact.	Mature, not preg. or lact.	Males	
	Female	Male	Female	Male	Imm.	Preg.				Imm.	Mat.
JINYO	13	7	8	11	44	19	61	1	5	22	27
KIZAN	17	14	15	18	45	32	53	3	8	42	38
MEIYO	23	15	10	11	34	36	54	2	30	25	65
NOJIMA	30	22	8	5	58	46	97	6	25	29	60
	<u>83</u>	<u>58</u>	<u>41</u>	<u>45</u>	<u>181</u>	<u>133</u>	<u>265</u>	<u>12</u>	<u>68</u>	<u>118</u>	<u>190</u>

C. Northern U.S. FCZ

Mothership	Fetus		Newborn		Females		Lact.	Preg. & Lact.	Mature, not preg. or lact.	Males	
	Female	Male	Female	Male	Imm.	Preg.				Imm.	Mat.
JINYO	0	3	0	0	8	3	0	0	3	13	6
KIZAN	-	-	-	-	-	-	-	-	-	-	-
MEIYO	1	1	0	0	1	1	2	1	0	1	1
NOJIMA	1	0	0	0	1	0	0	1	1	1	2
	<u>2</u>	<u>4</u>	<u>0</u>	<u>0</u>	<u>10</u>	<u>4</u>	<u>2</u>	<u>2</u>	<u>4</u>	<u>15</u>	<u>9</u>

TABLE 6.--Composition of Dall's porpoise take in 1982 (continued).

D. Bering Sea, north of U.S. FCZ

Mothership	Fetus		Newborn		Females		Lact.	Preg. & Lact.	Mature, not preg. or lact.	Males	
	Female	Male	Female	Male	Imm.	Preg.				Imm.	Mat.
JINYO	11	1	0	0	12	12	1	0	3	14	7
KIZAN	2	2	0	0	9	4	2	0	4	12	5
MEIYO	8	8	0	0	12	16	0	0	4	11	12
NOJIMA	1	0	0	0	1	1	2	0	2	3	4
	<u>22</u>	<u>11</u>	<u>0</u>	<u>0</u>	<u>34</u>	<u>33</u>	<u>5</u>	<u>0</u>	<u>13</u>	<u>40</u>	<u>28</u>

TABLE 7.--List of dates, body length and location of the first newborn and last fetus of Dall's porpoise collected in 1982.

Mothership	First newborn				Last fetus			
	Date	Length (cm)	Latitude	Longitude	Date	Length (cm)	Latitude	Longitude
KIZAN	21 June	101	50°51'N	172°41'E	19 July	90	50°36'N	173°02'E
JINYO	15 July	103	50°25'N	174°13'E	28 July	83	50°55'N	174°50'E
MEIYO	2 July	101	49°56'N	171°18'E	10 July	98	55°55'N	174°54'E
NOJIMA	21 June	120	50°05'N	172°35'E	21 July	98	57°50'N	179°26'E
NOJIMA					19 July	98	55°35'N	174°21'E

TABLE 8.--Vertebral counts of Dall's porpoises.

	n	Mean	Range	S.D.
U.S. FCZ	121	93.7	89-98	1.61
S. California Bight	14	93.1	90-96	1.69
Central S. California	48	93.7	90-96	1.57

TABLE 9. Number of sightings and taggings of Dall's porpoise during the period 16 May to 7 June 1980 aboard the Hoyo Maru No. 12 in the western North Pacific Ocean.

A. Number of Dall's porpoise sighted

	Morning	Afternoon	Total
South of 50°E	36	40	76
North of 50°E	<u>34</u>	<u>51</u>	<u>85</u>
Totals	70	91	161

B. Number of groups successfully tagged

	Morning	Afternoon	Total
South of 50°N	6	2	8
North of 50°N	<u>7</u>	<u>9</u>	<u>16</u>
Totals	13	11	24

C. Total number of porpoise tagged

	Morning	Afternoon	Total
South of 50°N	7	2	9
North of 50°N	<u>16</u>	<u>19</u>	<u>35</u>
Totals	23	21	44

D. Number of tagged animals per sighting (C/A)

	Morning	Afternoon
South of 50°N	0.19	0.10
North of 50°N	0.47	0.37

