PROGRESS REPORT ON 1981 RESEARCH ON DALL'S PORPOISE INCIDENTALLY TAKEN IN JAPANESE SALMON GILLNET FISHERY

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by

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A permit under the Marine Mammal Protection Act to take incidentally up to 5,500 Dall's porpoise (Phocoenoides dalli), 450 northern fur seals (Callorhinus ursinus) and 25 northern sea lions (Eumetopias jubatus) was issued to the Federation of Japan Salmon Fisheries Cooperative Association. The three-year permit is valid through June 9, 1984, subject to review by the Assistant Administrator of Fisheries, NOAA. The permit is contingent upon a signed Memorandum of Understanding between the Governments of Japan and the United States for continued research on incidental take of marine mammals.

The permit requires that each certificate holder will return dead marine mammals incidentally taken to the motherships for biological sampling, maintain a log of all marine mammal incidental take, accept observers onboard the catcherboats to monitor incidental take, and assist in and provide funds for monitoring and research.

This report describes research undertaken in 1981 and the progress of research on Dall's porpoise under the cooperative Japan-U.S. program.

A. Research Aboard the Japanese Salmon Research Vessels

U.S. biologists boarded three Japanese salmon research vessels to conduct marine mammal sighting surveys and to obtain data on gillnet operations and entanglements. The cruises were:

Vessel	Dates	Area
Oshoro Maru	5 June-17 August	North Pacific, Bering Sea and Gulf of Alaska
Kumamoto Maru	15 June-31 July	Western North Pacific
Hokusei Maru	11 July-12 August	Western North Pacific

The Dall's porpoise was the most frequently sighted and abundant species on all the cruises.

During 71 gillnet operations, a total of 17 marine mammals were incidentally taken. Entanglements included 3 Lissodelphis borealis (northern right whale dolphin), 6 Callorhinus ursinus (northern fur seal) including two released alive, and 8 Phocoenoides dalli (Dall's porpoise), including two neonates. Aboard the Oshoro Maru an additional 12 gillnet sets of 15 tans each were conducted in which one northern fur seal entangled and was released alive. The catch rate for Dall's porpoise was 0.29 per 330 tans (length of commercial nets). This is higher than the rate reported by the salmon mothership fishery (0.18 porpoise per set) but is similar to the rates observed by U.S. observers onboard the salmon catcherboats.

B. Research Aboard the Dedicated Vessel

The studies begun in 1980 onboard the vessel dedicated to marine mammal research were continued in 1981 aboard the Hoyo Maru No. 67. Gillnet operations using commercial gear and methods were conducted in the salmon mothership fishing area either alone (six gillnet sets) or in association with one of the mothership fleets (12 gillnet sets). The gillnet consisted of 180 tans of 130 mm stretch mesh size, 120 tans of 121 mm mesh size and 30 tans of research net (mesh sizes were 48 to 157 mm). The gillnet was set in three sections of 110 tans each, whereas the commercial gillnets are set in one piece. For each gillnet operation data were recorded on the environmental conditions, presence of marine mammals, incidental take and salmon catch.

The location of gillnet operations, with and without the mothership fleet, are shown in Figure 1 for 1980 and 1981. The locations varied between the two years, with 1981 operations occurring south of most of the 1980 locations.

Two Dall's porpoise became entanqled during the 18 gillnet operations, a take rate of 0.11 porpoise per set. Because of the small incidental take, comparisons beteen areas and between operations with and without the mothership fleet could not be made. The observed rate is substantially lower than the rate of 2.6 porpoise per set observed aboard the Hoyo Maru No. 81 during the 1980 dedicated vessel cruise. Examination of environmental data shows slight differences in conditions in the two years with surface water temperature and Beaufort state ranges being slightly higher and lower, respectively in 1981. In addition, although conditions for sighting marine mammals were more favorable in 1981, there were fewer Dall's porpoise sighted during set operations (one sighting during 14 sets in 1981 compared to 9 sightings in 14 set operations in 1980). Whether these or other factors had a significant affect on the biological community and the incidental take of Dall's porpoise is unknown but the data will be examined further.

Biological data and samples were collected from the incidentally taken Dall's porpoise and other entangled marine organisms. Entangled sea birds were collected by Dr. Haruo Ogi, Hokkaido University, for ongoing studies of the ecology of these species. Marine mammal sighting surveys were conducted and the data, with that collected by U.S. observers onboard the Japanese salmon research vessels, will be used for abundance estimates.

C. Research Aboard Japanese Salmon Motherships

One marine mammal biologist was onboard each Japanese salmon mothership while the vessel operated inside the U.S. Fishery Conservation Zone (FCZ). The purpose of the studies was to continue research begun in 1978 on the characterization of the incidental take and to collect biological samples

and data from Dall's porpoise and other marine mammals incidentally taken in the salmon gillnets. The biologists were also responsible for transmitting the data on the daily incidental take of Dall's porpoise, northern fur seals and northern sea lions from the U.S. and Japanese observers and the mothership fleets to the National Marine Fisheries Service for monitoring the permit quotas for these species.

Each biologist worked aboard the mothership for 3 days and then transferred to a catcherboat for six days to work as an observer monitoring the incidental take of marine mammals. This rotation of the observers continued throughout the period the fleet operated inside the FCZ.

Table 1 lists the dates of fishing operations and observer coverage for each mothership fleet. The Jinyo Maru fleet remained in the FCZ from June 10 to the end of the fishing season on July 24. The other three fleets moved north outside the FCZ for varying periods in early July and then returned to the FCZ about mid-July. The U.S. biologists boarded Japanese fishery inspection vessels during the time their mothership fleets operated outside the FCZ. Marine mammal sighting surveys were conducted aboard the catcherboats and the fishery inspection vessels.

Table 2 lists the incidental take of porpoises for each fleet. The total number of porpoise returned to the mothership for sampling was 725 (54%) out of 1,354 reported incidentally taken in the gillnets. The total included two harbor porpoise, one black variant, and three Truei-type Dall's porpoise; the remainder were Dalli-type Dall's porpoise. Of the total, 200 (15%) were released alive. At least 429 (32%) were lost during retrieval or were not returned to the motherships by scoutboats. This loss rate is high and if certain sex or age classes are lost more often than others

a biased sample might result. Efforts must be made to obtain more information on animals that are not returned. In particular, estimates of body size and sex of the animals are needed.

D. Monitoring of the Incidental Take

A new program in 1981 was monitoring the incidental take of marine mammals in the salmon gillnets. In each mothership fleet one Japanese observer was aboard catcherboats throughout the fishing season and U.S. observers were aboard two catcherboats during operations inside the U.S. FCZ.

On the catcherboats, observers conducted marine mammal sighting surveys to obtain information on the distribution and abundance of marine mammals in the fishing area, and for each gillnet operation collected data on the environmental conditions, gear characteristics, entanglements and on the number of salmon that dropped out of the nets during retrieval.

U.S. observers conducted gillnet monitoring operations on thirteen to fifteen catcherboats per mothership fleet. Japanese observers worked aboard one to five catcherboats per fleet. In each mothership fleet approximately 38 to 54% of the catcherboats were involved in the monitoring program. Scoutboats were not included in the studies since they did not return to the mothership each day and therefore could not meet the observer schedules.

Data collected by U.S. observers on the gillnet operations have been provided to the Fleet Commander on each mothership. Data collected by the Japanese observers have been, or are to be, provided to the National Marine Mammal Laboratory.

The total number of gillnet sets monitored by U.S. observers in the FCZ was 265 (Table 1). The percentage of sets monitored by U.S. observers inside the FCZ was 4% (265 out of 6,278 sets). The total percentage of monitored sets for the fishing season was 5% (462 out of 8,987). Based on the observed variances and mean number of porpoise taken per set in 1981, the number of sets which should be monitored to assure 95% confidence in estimates of the incidental take of Dall's porpoise is between 491 (5%) and 642 (7%) out of 8,987 sets (Cochran 1977). The higher estimate is based upon the highest observed take rate.

A total of 10 northern fur seals (Callorhinus ursinus) were incidentally taken inside the FCZ. Of these two were dead, six were released alive and two were lost. No northern sea lions were reported incidentally taken.

A total of 87 entangled Dall's porpoise were observed by the U.S. observers. The observer catch rates for Dall's porpoise ranged from 0.13 to 0.44 porpoise per set with a mean of 0.33 and a range of 0 to 5 porpoise per set.

The reported total incidental take of Dall's porpoise for the mothership fishery was 1,354 during 8,987 gillnet operations, a take rate of 0.15 porpoise per set. Inside the FCZ the reported incidental take was 1,136 Dall's porpoise is 6,278 sets, a take rate of 0.18 porpoise per set. An estimate of the total incidental take of Dall's porpoise for the salmon mothership fishery was calculated based on the observed incidental take rates for each fleet. The estimated take inside the FCZ is 2,039 Dall's porpoise. The 95% confidence limits are 1,628 and 2,450 porpoise. The reported total take inside the FCZ of 1,136 porpoise does not fall within the 95% confidence limits and therefore is significantly different than the estimated take. The total estimated take for the fishery season is 2,812. The reported total take is 1,354.

There was no difference in the incidental take rates recorded among observers in a mothership fleet but the difference in observed take rates between fleets was significant (Nested ANOVA, $p < 0.05$).

Nested ANOVA

Source	d.f.	S.S.	M.S.
Between vessels	3	0.18126	0.06042
Between Observers (within vessels)	12	0.15858	0.01322
Within Observers	16	0.68742	0.04296
	31	1.02726	

Difference between observers: $F_{12,16} = \frac{0.01322}{0.04296} = 0.308$ Not significant

Difference between vessels: $F_{3,12} = \frac{0.06042}{0.01322} = 4.572$ $p < 0.05$*

*Significant difference

There was no difference between months in the observed incidental take rates.

The take rates in 1981 were substantially lower than those observed in 1980 aboard catcherboats during 18 gillnet operations (1980: 0.94 porpoise per set; 1981: 0.13-0.44 per set). Further assessment of these differences is being made in order to explain them.

E. Abundance Estimates

Bouchet (1981) presented the results of strip and line transect analyses of sighting data collected by a U.S. observer onboard Japanese salmon research vessels and U.S. Platforms of Opportunity Program vessels during 1978 and 1979. Abundance estimates based on data collected in 1980 and a weighted mean of the combined data from 1978 to 1980 are presented here, as well as a correction for the confidence interval calculated for

the 1978 and 1979 estimates based on line transect analyses.

The formulae presented in Bouchet (1981) for the calculation of confidence intervals for the line transect analyses (p. 18, equations 11, 13 and 14) are correct. A programming error resulted in miscalculations of CV ($\overline{G}$) and this created errors in subsequent variance calculations (Var (Di), Var T) and associated confidence intervals. The corrected values are presented in Table 3 (a corrected version of Table 5, Bouchet (1981)). The result of this correction is to increase the width of the confidence intervals around the total abundance estimates. Otherwise the estimates are correct as presented in Bouchet (1981). The confidence intervals now include zero, which is statistically unacceptable. We are re-examining line transect estimators to determine if there is one which will fit the data better.

Table 4 presents the results of the strip transect analysis of the sighting data collected during 1980 by U.S. observers onboard Japanese research vessels and U.S. Platforms of Opportunity Program vessels. The analysis was performed as described in Bouchet (1981). The abundance estimates obtained using 200 meter and 400 meter strip widths are 2.1 X 10^6 and 1.3 X 10^6 porpoise, respectively.

Tables 5a and 5b are summaries of the three year's estimation results and include the weighted means of the three year's density estimates and the corresponding abundance values. The mean densities were weighted by the amount of effort (transect miles) in each area-year cell. This produced average abundance estimates of approximately 1.7 X 10^6 porpoise (200 meter strip width) and 1.0 X 10^6 porpoise (400 meter strip width).

E. Literature Cited

Bouchet, G. Christopher. 1981. Estimation of the Abundance of Dall's Porpoise (Phocoenoides dalli) in the North Pacific Ocean and Bering Sea. Northwest and Alaska Fisheries Center processed report 81-1, 25 p. Northwest and Alaska Fish. Cent., Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way NE, Seattle, WA 98115

Cochran, W. G. 1977. Sampling Techniques. 2nd edition. John Wiley and Sons, Inc. New York. 413 pp.

Figure 1: Locations of Gillnet Sets by the dedicated research vessel in 1980 (squares) and 1981 (circles) with (closed figures) and without (open figures) The Japanese Salmon Mothership Fleet.

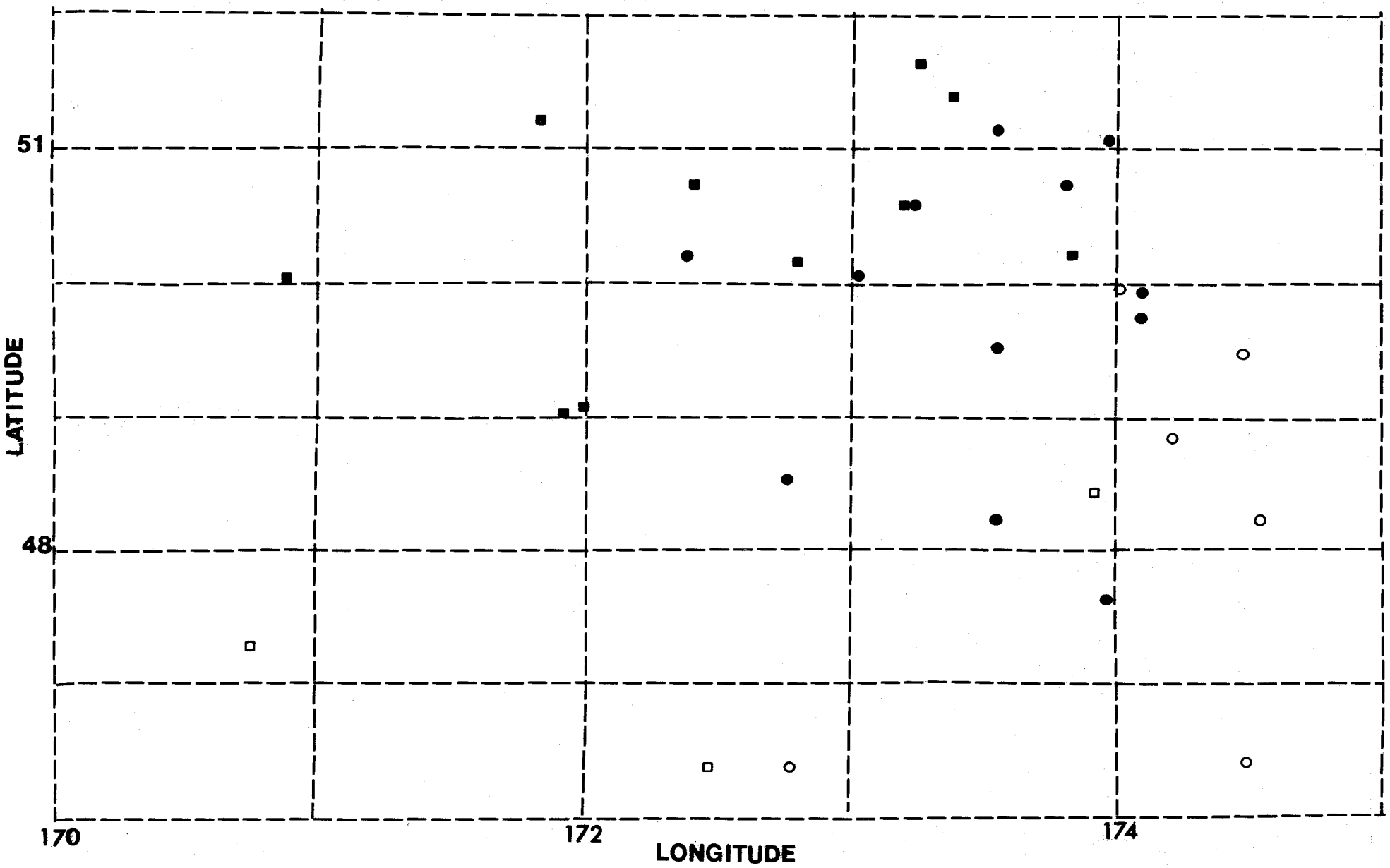

TABLE 1.--1981 Schedule of Fishing Operations of the Japanese Salmon Mothership Fleet. Dates are for gillnet set unless otherwise noted.

Fleet	Outside FCZ	Inside FCZ	No Fishing	No. US Observers Onboard (retrieval dates)	Total No. of Sets	Total Sets Observed	
						U.S.	Japan[1/]
Jinyo Maru	June 1-8	June 10-July 23	June 15	June 10 July 24	52 da x 43 boats = 2,236	84	51
Kizan Maru	June 1-8 July 6-15	June 10-July 5 July 17-25	June 15 July 16 (in transit)	June 10 July 6,18,26 July 5, 19: 1 obs. only	53 da x 43 = 2,279	60	52
Meiyo Maru	June 1-8 July 7-16*	June 10-July 5 July 18--25	June 15 July 6,17 (in transit)	June 10 June 24-28 (1 obs.ill) July 19	52 da x 43 = 2,236	59 (2)*	50
Nojima Maru	June 1-8 July 3-11	June 10-July 1 July 12-24	June 15 July 2 (in transit)	June 10 July 13	52 da x 43 = 2,236	62	44**
					209 da x 43 = 8,987 gillnet operations	265	197 = 462

* U.S. observers onboard on 7-8 July outside FCZ
** Japanese observer ill July 10-14

1/ Includes gillnet operations inside and outside the FCZ.

TABLE 2.--1981 Incidental take by the Japanese Salmon mothership fishery of Dall's porpoises by area and category.

Mothership	Area	Category			Total Take
		Dead[1]	Released Alive	Lost	
Jinyo Maru	South of FCZ*	10	3	2	15
	FCZ*	217	47	89	353
		227	50	91	368
Kizan Maru	South of FCZ*	7	4	2	13
	FCZ*	171	44	82	297
	Bering Sea	15	14	9	38
		193	62	93	348
Meiyo Maru	South of FCZ*	10	3	5	18
	FCZ*	140	34	60	234
	Bering Sea	33	7	18	58
		183	44	83	310
Nojima Maru	South of FCZ*	14	2	11	27
	FCZ*	162	33	57	252
	Bering Sea	13	9	27	49
		189	44	95	328
	Totals (Percent)	792(58)	200(15)	362(27)	1,354

*FCZ = U.S. Fishery Conservation Zone

[1] The numbers given include 67 porpoise which were reported as "Dead" but were not returned to the motherships for sampling. These porpoise were taken mainly by the scoutboats.

TABLE 3--Abundance and density estimates for Dall's porpoise based on data collected during shipboard sighting surveys. Estimates based on line transect using exponential polynomial fall off curve. This table is a corrected version of Bouchet (1981) Table 5.

Stratum	Stratum area (NMI^2) [1]	Transect Length NMI	Dall's porpoise groups counted	Density ($\hat{D}_g$) Groups/NMI^2	Coefficient of variation CV (D_g)	Mean Group Size ($\bar{G}$)	Coefficient of variation CV ($\bar{G}$)	Density ($\hat{D}i$) Individuals/NMI^2	Variance Var Di	Abundance $\hat{T}$	Variance Var ($\hat{T}$) (millions)	95% confidence interval around $\hat{T}$
1978												
West-central North Pacific	1,029,633	7046	243	.0796	.064	4.0247	.7749	.3204	.06205	329,859	65,783.7	0 - 832,566
Bering Sea	309,874	4590	83	.0365	.243	4.0723	.62287	.1486	.009876	46,059	948.3	0 - 106,417
Gulf of Alaska	493,958	9396	121	.0405	.092	7.0413	2.9972	.2852	.7312	140,863	178,413.9	0 - 968,749
Totals:												
Surveyed area	1,833,465									516,781		
Eastern North Pacific (unsurveyed)	1,429,218			.0561 [2]		5.0275 [2]		.2818 [2]		(402,741)		
Total surveyed and unsurveyed	3,262,683									919,522		
1979												
West-central North Pacific	1,029,633	3732	115	.1465	.093	4.0696	.6652	.5962	.16036	613,863	170,002.6	0 - 1,421,988
Bering Sea	309,874	1623	112	.1532	.095	3.4911	.5831	.5348	.09984	165,732	9,587.2	0 - 357,644
Gulf of Alaska	493,958	432	19	.2263	.320	5.4211	2.0051	1.2268	6.2051	605,985	1,514,017.4	0 - 3,017,675
Totals:												
Surveyed area	1,833,465									1,385,579		
Eastern North Pacific (unsurveyed)	1,429,218			.1546 [2]		4.2612 [2]		.6588 [2]		(941,542)		
Total surveyed and unsurveyed	3,262,683									2,327,121		

[1] Stratum areas are approximated by straight line integration.

[2] Density and mean group size obtained as the weighted mean of western-central North Pacific and Gulf of Alaska.

TABLE 4 --Density and abundance estimates based on data collected during 1980 shipboard surveys. Estimate obtained from strip transect analysis.

Stratum	Straum area (NMI^2) 1/	Percent of area sampled	Transects in stratum =N	Dall's porpoise counted	Density (R) individuals/ NMI^2	Variance S^2_R	Abundance T	Variance Var(T) (millions)	95% confidence interval around T
200 m strip									
Western-central North Pacific	1,029,633	.107	409	739	.668	00909	687,461	9,626.5	(494,587 - 880,335)
Bering Sea	309,874	.111	100	196	.568	.03877	175,948	3,718.8	(54,946 - 296,950)
Gulf of Alaska	493,958	.307	308	943	.622	.00583	307,281	14,189.8	(233,158 - 381,404)
Total Surveyed Area	1,833,465						1,170,690		
Eastern North Pacific (unsurveyed)	1,429,218				.641 2/		916,721		
Total surveyed and unsurveyed	3,262,683						2,087,411		
400 m strip									
Western-central North Pacific	1,029,633	.215	409	896	.405	.00327	416,756	3,461.1	(301,105 - 532,406)
Bering Sea	309,874	.223	100	240	.348	.01044	107,723	9,999.2	(44,979 - 170,467)
Gulf of Alaska	493,958	.614	308	1249	.412	.00204	203,510	493.8	(159,772 - 247,220)
Total Surveyed Area	1,833,465						727,975		
Eastern North Pacific (unsurveyed)	1,429,218				.409 2/		584,615		
Total surveyed and unsurveyed	3,262,683						1,312,590		

1/ Stratum areas are approximated by straight line integration.

2/ Density was obtained from weighted mean of western-central North Pacific and Gulf of Alaska.

TABLE 5a.--Dall porpoise density and abundance estimates based on data obtained from shipboard sighting surveys. Summary of strip transect estimation results from 1978, 1979 and 1980 data and the weighted mean of all years. Results obtained using 200 m strip width

Stratum	Year	Total Survey Miles	Density	Abundance
Western-Central North Pacific	1978	7,185	.376	386,831
	1979	3,876	.432	445,230
	1980	5,125	.668	687,461
	1978-80	16,186	.482	496,146
Bering Sea	1978	3,254	.226	70,108
	1979	1,765	.462	173,995
	1980	1,598	.568	175,948
	1978-80	6,617	.398	123,396
Gulf of Alaska	1978	6,928	.514	253,865
	1979	464	1.007	497,451
	1980	7,018	.622	307,281
	1978-80	14,410	.582	287,717
Eastern North Pacific (unsurveyed)[1]	1978	-	.442	631,714
	1979	-	.493	704,604
	1980	-	.641	916,721
	1978-80		.539	770,380
Total Abundance	1978	17,367		1,342,518
	1979	6,105		1,821,280
	1980	13,741		2,087,411
	1978-80	37,213		1,677,639

[1] Density obtained from weighted mean of Western Central North Pacific and Gulf of Alaska.

TABLE 5b.--Dall propoise density and abundance estimates based on data obtained from shipboard sighting surveys. Summary of strip transect estimation results from 1978, 1979 and 1980 data and the weighted mean of all years. Results obtained using 400 m strip width.

Stratum	Year	Total Survey Miles	Density	Abundance
Western Central North Pacific	1978	7,185	.250	257,777
	1979	3,876	.259	266,277
	1980	5,125	.405	416,756
	1978-80	16,186	.301	310,159
Bering Sea	1978	3,254	.212	65,699
	1979	1,765	.398	123,179
	1980	1,598	.348	107,723
	1978-80	6,617	.294	91,244
Gulf of Alaska	1978	6,928	.277	136,671
	1979	464	.753	371,857
	1980	7,018	.412	203,510
	1978-80	14,410	.358	176,874
Eastern North Pacific (unsurveyed)[1]	1978		.264	373,313
	1979		.312	445,916
	1980		.409	584,615
	1978-80		.327	468,562
Total Abundance	1978	17,367		837,460
	1979	6,105		1,207,229
	1980	13,741		1,312,590
	1978-80	37,213		1,046,839

[1] Density obtained from weighted mean of Western Central North Pacific and Gulf of Alaska.