

PROGRESS REPORT ON THE AGE STRUCTURE, GROWTH  
AND AGE AT SEXUAL MATURITY OF DALL'S PORPOISE

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## ABSTRACT

Teeth from Dall's porpoise (Phocoenoides dalli) collected during fishing operations in the western North Pacific Ocean and Bering Sea from 1981 to 1984 were analyzed to determine the age structure of the catch, growth rates, and age at sexual maturity in females. Age was determined by counting growth layers in the tooth cementum.

The modal age class in the western North Pacific was 1-year-olds (18%) and in the Bering Sea was 1- and 2-year-olds which comprised over 50% of the sample.

During the first year, both males and females increase their body length by half the length at birth. After 3 years, the growth rate of females begins to decline, and ceases at about 7-8 years. Males continue growth to some time after 9 years in the western North Pacific. In the Bering Sea both males and females appear to cease growth at about 7-8 years but the maximum length is greater in the females in the Bering Sea compared to those in the western Pacific.

Age at sexual maturity in females is about 3.5 years in both populations. Mean length of females with one corpus is larger in Bering Sea females. Females tend to produce one ovarian corpus per year until age 7, after which there is increased variation in the mean number of corpora per age group.

## INTRODUCTION

Dall's porpoise (Phocoenoides dalli) have been caught incidentally to salmon fishing operations in the western North Pacific and Bering Sea since 1952. Information on the age structure of the catch is available from relatively small samples collected from 1964 to 1966 (Mizue and Yoshida 1965; Mizue, Yoshida and Takemura 1966; Kasuya 1978) and from a sample collected in the fishery from 1978 to 1980 (Newby 1982). Growth rates and age at sexual maturity were also estimated for these samples. This report provides

information on these parameters for samples collected from 1981 to 1984 by the Japanese salmon mothership fishery in the western North Pacific and Bering Sea.

In the previous studies, data were unavailable on the exact location of the catch (Mizue and Yoshida 1965; Mizue et al. 1966; Kasuya 1978) or the samples from the Bering Sea were small and combined with data from the Pacific (Newby 1982). Although our sample from the Bering Sea is still comparatively small, it is sufficient to analyze separately for comparison with the western North Pacific sample.

Recent studies have demonstrated that separate populations of Dall's porpoise occur in the western North Pacific (south of 53°N latitude) and Bering Sea (north of 53°N latitude) (Jones et al. 1987; Walker 1987; Winans and Jones 1986). The catch history of these populations is poorly known; however since 1978, fishing effort in the Bering Sea has been low ( a maximum of 53 fleet days or 2,279 gillnet operations per year) compared to effort in the western North Pacific (from about 12,500 to 16,500 operations per year). If age structure and age or length at sexual maturity are affected by harvest levels then the two populations of Dall's porpoise could show differences in these parameters.

## METHODS

Teeth samples were collected from Dall's porpoise incidentally taken during fishing operations in the western North Pacific Ocean and Bering Sea. Animals were caught in gillnets during June and July during the period 1978 to 1984.

Teeth collected from 1981 to 1984 were processed and read by both a commercial biological processing company and at the National Marine Mammal Laboratory (NMML). All teeth were stained with hematoxylin, mounted on glass slides and read by one of us (MEG). Teeth processed by the commercial biological company were decalcified in 5% nitric acid, embedded in paraffin and sliced on a rotary microtome (n=710). Teeth processed at the NMML were decalcified with RDO ( a commercial bone decalcifying solution) and sectioned at 15 microns with a freezing microtome (n=1474).

The age of each animal was determined by counting the number of layers in the cementum of the tooth. It is assumed that one growth layer (light and dark) is generated each year in the cementum. Age at sexual maturity for females was determined by presence of a single corpus in the ovaries.

A second reader is also counting growth layers of teeth from this sample. Comparisons of these readings as well as with the readings of Newby (1982) are in progress. Therefore, the results presented here are preliminary.

## RESULTS

### Age Structure

The ages of 1,758 Dall's porpoise from the western North Pacific (south of 53°N latitude) and Bering Sea (north of 53°N) were determined. Neonates (animals less than a few months old) were included in the aged sample but are probably under represented. Neonates have been taken only in the western North Pacific (4% of the total sample), not in the Bering Sea due to differences in the time of calving in the two areas (Jones et al 1987).

The age structures in the two areas are different although the maximum ages are similar (16-17 years). In the western North Pacific sample, the modal age class (18%) is 1-year-olds (Figure 1). Percentages per year class then gradually decline although there is a second small peak at age 6. In the Bering Sea, the modal age class (29%) is 2-year-olds, and over 50% of the sample is one- and two-year-olds (Figure 1).

Among males in the western North Pacific, one- and two-year-olds were the dominant age groups, comprising 40% of the aged sample (Figure 2). Females in the western North Pacific were more evenly distributed among the younger age groups (Figure 2). In the Bering Sea, the male sample was again dominated by one- and two-year-olds which comprised

61% of the aged sample (Figure 2). One- and two-year-olds also dominated the female sample in the Bering Sea (49% of the females).

Male Dall's porpoise in the western North Pacific exhibited a wide variation in age structure from year to year (Table 1). However, one- and two-year-old males each usually comprised about 20% of the sample each year. Three-year-old males varied between 9% and 20% of the sample. In 1982, there was also an unusually high number of males aged as eight-year-olds. The reason for this is unknown. The mean age of males varied considerably between years, from 2.8 to 4.8 years, showing no trend over the time period.

The age structure of female Dall's porpoise in the western North Pacific exhibited less annual variation than did the males. Females in age groups 1 to 6 usually comprised 10% to 20% of the sample in each year (Table 1). The annual mean age ranged from 3.5 to 5.0 years.

The age structure of males in the Bering Sea varied considerably from 1981 to 1984 (Table 1). One-year-old males showed the greatest variation between years, ranging from 5% (1981) to 37% (1984) of the sample. The mean age of the male sample in the Bering Sea dropped from 4.4 years in 1981 to 2.6 years in 1984, however the sample sizes are small and this may not reflect a trend.

The age structure of females in the Bering Sea also showed considerable variation over the sampling period (Table 1). In 1981, there were no one-year-old females in the sample, while in 1983 they comprised 40% of the sample. The percentage of two-year-old females ranged from 14% in 1981 to 31% in 1984. The mean age of females ranged from 2.7 to 4.4 years however there was no trend in the mean age over the sampling period.

#### Growth Rates

In the western North Pacific, the mean length of males for each age group is apparently greater than that of females for all ages, except ages 3 and 12 where females are about 1 cm larger (Table 2). The length difference increases between ages 5 to 8 with males 6-8 cm larger than females. At 9-years and older, the trend becomes less clear as small sample sizes reduce the reliability of the estimated mean lengths. Further analyses of these differences will be conducted.

In the Bering Sea, the length differences between males and females are similar in trend to those in the western North Pacific (Table 2). However, age 5 is anomalous with females larger than males, perhaps because of the low numbers of males sampled (n=6).

Age groups above 4 years of age were pooled (Table 3) to alleviate small sample size problems. Mean length for the age group was used to calculate the growth increments.



The growth rates of males and females in the western North Pacific are similar up to age three (Figure 3). Growth is most rapid between birth and one year. During this period, both males and females increase in length by about 48 cm, or by half their length at birth (about 100 cm) (Table 3). The growth rates of both sexes then decrease. After three years, the growth rate of females drops, and they appear to stop growing at a mean length of 186 cm, at around 7-8 years of age. Males however appear to continue growth up to a mean length of 199 cm, some time after 9 years of age.

Comparisons of male and female growth rates in the Bering Sea are difficult because of the small sample sizes, particularly for male age groups. In the Bering Sea, both males and females appear to stop growing at around 7 to 8 years of age. The mean length for males is then about 200 cm, which is similar to the maximum male length in the western North Pacific sample. Females in the Bering Sea appear to cease growth at a mean length of about 192 to 195 cm, compared to 186 cm for females in the western North Pacific.

#### Age at Sexual Maturity

Sexual maturity in females was determined by the presence of a single ovarian corpus. In the western North Pacific, the mean age of females with a single corpus was 4.5 years (Table 4). Since the majority (more than 90%) of these females were pregnant with a near-term fetus or were

lactating from recent calving, the mean age at sexual maturity is actually about 3.5 years, assuming a calving interval of one year. There was variation in the mean age of females with one corpus over the sampling period, but there was no trend in the age (Table 4).

The mean length of females with a single corpus was 177 cm (n=219) (Table 4). The range in the mean length over the sampling period was 175 to 180 cm. Again, there was no trend in the mean length over the period of sampling.

In the Bering Sea, the calculated mean age of females with a corpus was 4.4 years (n=21) (Table 4) and the actual age at sexual maturity is 3.4. The calculated mean length of females with one corpus is 182 cm (n=40). For the period 1978 to 1981, the mean length was 179 cm, while from 1982 to 1984 the mean was 183 cm. Whether this change in the mean length of females with a corpus is significant or a reflection of the small sample size is unknown.

There is little difference between Bering Sea and western Pacific females in the mean age at sexual maturity. The youngest animal with one corpus is 2 in the western North Pacific and 3 in the Bering Sea. The smallest animal with one corpus is 151 and 154 cm, respectively.

The mean age per number of ovarian corpora for females in the western North Pacific is given in Table 5. Beyond 8 corpora, the sample sizes are too small to interpret trends.

The greatest number of corpora was 18 in an 11 year-old female (Table 5).

The modal number of corpora for each age group increases by one for ages 4 to 7 (Table 6). After that, the pattern becomes erratic. Whether this is due to small sample sizes for older individuals, corpora resorption as suggested by Newby (1982), or an increasing probability that individuals will miss an ovulation is unclear.

Females can form more than one corpora per year. For example, at age 7, the mean number of corpora is 5.1 (Table 6). If the average female matures at age 4 and forms one scar per year, the expected number of corpora would be 4. Two females out of 64 of age 7 had 14 corpora (Table 6).

#### DISCUSSION

Newby (1982) analyzed samples collected primarily from the western North Pacific, from 1978 to 1980. The male sample was dominated by one-year-olds (30%) and, to a lesser extent, by two-year-olds (15%), totalling 45 % of the male sample. In the 1981-1984 sample of males, one- and two-year-olds comprised 40%, but the proportions were about 20% each. It is unknown whether this difference represents a change in the male age structure or is related to a differences in estimating ages by different readers.

The age structure of females from 1978 to 1980 (Newby 1982) was similar to that for the later sample. Females were evenly distributed among the age classes from one to six and these classes accounted for about 80% of the females.

Kasuya and Shiraga (1985) compared the age structure of porpoise collected south of the U.S. Exclusive Economic Zone (EEZ) in 1982 and 1983 with that of the gillnet catch in the U.S. EEZ from 1978 to 1980 (Newby 1982). In the south area the dominant age classes were 2- to 4-year-olds while 1-year-olds were dominant in the EEZ sample. Kasuya and Shiraga (1985) concluded that the samples from the two areas of the western North Pacific were different components of the population.

In the sample collected from the EEZ from 1981 to 1984, the age structure differs from that presented by Newby (1982) for the same area. Further analyses are needed to determine whether the differences in the age structure between the two samples are due to difference in counting the growth layers or to changes in the age structure of the samples.

The von Bertalanffy growth curve for males in the western North Pacific collected from 1978 to 1980 was calculated to be (Newby 1982):

$$l_t = 204.3 \text{ cm } (1 - e^{-.22(t+5.0625)})$$

and for females  $l_t = 187.3 \text{ cm } (1 - e^{-.5045(t+2.1075)})$

where  $l_t =$  length at time  $t$ .

The calculated lengths for the 1978-80 sample and the mean lengths of age groups from the 1981-84 samples are similar, usually within 3 cm of each other.

<u>AGE,yrs</u>	LENGTH OF MALES		LENGTH OF FEMALES	
	Calculated	Mean	Calculated	Mean
	<u>1978-80</u>	<u>1981-84</u>	<u>1978-80</u>	<u>1981-84</u>
1	150.5	153.5	148.2	150.8
2	161.1	160.3	163.7	159.1
3	169.6	170.2	173.1	171.1
4	176.5	178.9	178.7	175.8
5.5	184.3	188.9	183.3	182.0
7.5	191.4	193.4	185.8	186.1

In our sample, growth leveled off at about 199 cm for males and 186 cm for females. The asymptotic length calculated by Newby (1982) was 204 cm for males and 187 cm for females.

Our estimates of sexual maturity for females for the western North Pacific population based on the presence of one corpus is 177 cm or less and 3-4 years. In the Bering Sea our estimates are 178 cm or less and 4 years, although there may be an increase in length ( to 183 cm or less) since 1982.

Kasuya (1978) studied the coastal truei color type Dall's porpoise and a small sample from the western North Pacific/Bering Sea collected from gillnets of the Japanese salmon mothership fleets. He estimated the length at sexual

maturity for females to be 186.5 cm for the coastal population and 177.9 cm for the high seas population. Age at sexual maturity using the least squares regression technique was estimated as 6.8 and 4-5 years respectively (Kasuya 1978). He considered the values for the North Pacific/Bering Sea animals to be underestimates due to sampling bias. In his Figure 28, all females with a single corpus are larger than 180 cm, however his estimate of mean age and length includes data from Mizue et al (1966) in which females with a single corpus were as small as 170 cm.

Newby (1982) gives 179 cm and 5 years for the mean length and age of females with a single corpus. For the period 1978-1980, there were only 11 females collected from the Bering Sea, therefore his estimates are mainly for western North Pacific females taken in the salmon mothership fishery. Since these females were pregnant or lactating, sexual maturity was attained the previous year (e.g., at less than 179 cm and at 4 years).

In general, the estimates of mean length at sexual maturity in females are similar, ranging from 177 to 179 cm. These values are overestimates since they are all based on females that are close to calving or have recently calved. Estimates of the age at sexual maturity are also similar and differences may be due in part to differences in counting growth layers.

The estimates of the age and length at sexual maturity for females do not appear to have changed during our sampling period nor from the values calculated in 1964-65 by Kasuya (1978) after 10 years of high levels of fishing effort (25,000 to 36,000 gillnet sets per year). However his method of calculation was different and he considered the estimates to be low due to sampling bias. Therefore, the question remains concerning possible change in the onset of sexual maturity and further analyses are necessary.

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Table 1: Age frequency and percent of total sample by year of female and male Dall's porpoise from the western North Pacific (south of 53°N) and Bering Sea, 1981-1984.

A. Females from western North Pacific.

	AGE	0	1	2	3	4	5	6	7	8	9	10	11	12	13	Other	Total	Mean Age	95% C.I.
1981	No.	2	45	36	30	27	33	26	16	13	7	2	2	2	1	-	242	4.11	(3.78-4.44)
	%	0.8	18.6	14.9	12.4	11.2	13.6	10.7	6.6	5.4	2.9	0.8	0.8	0.8	0.4	-	100		
1982	No.	6	8	21	21	29	23	30	20	8	9	5	2	1	1	<u>16GIG</u> 1	185	4.98	(4.59-5.38)
	%	3.2	4.3	11.4	11.4	15.7	12.4	16.2	10.8	4.3	4.9	2.7	1.1	0.5	0.5	0.5	100		
1983	No.	6	58	21	30	18	10	23	12	9	4	2	1	1	-	-	195	3.51	(3.14-3.89)
	%	3.1	29.7	10.8	15.4	9.2	5.1	11.8	6.2	4.6	2.1	1.0	0.5	0.5	-	-	100		
1984	No.	8	33	23	27	33	30	29	18	6	12	2	2	3	-	-	226	4.32	(3.97-4.67)
	%	3.5	14.6	10.2	11.9	14.6	13.3	12.8	8.0	2.7	5.3	0.9	0.9	1.3	-	-	100		
Total	No.	22	144	101	108	107	96	108	66	36	32	11	7	7	2	<u>16GIG</u> 1	848	4.22	(4.03-4.40)
	%	2.6	17.0	11.9	12.7	12.6	11.3	12.7	7.8	4.2	3.8	1.3	0.8	0.8	0.2	0.1	100		

Table 1: continued.

B. Males from western North Pacific

	AGE	0	1	2	3	4	5	6	7	8	9	10	11	12	13	Other	Total	Mean Age	95% C.I.
1981	No.	2	29	37	17	16	12	5	8	5	2	1	1	-	-	-	135	3.28	(2.89-3.67)
	%	1.5	21.5	27.4	12.6	11.9	8.9	3.7	5.9	3.7	1.5	0.7	0.7	-	-	-	100		
1982	No.	9	5	17	8	4	6	6	6	15	2	2	4	1	1	-	86	4.81	(4.08-5.55)
	%	10.5	5.8	19.8	9.3	4.7	7.0	7.0	7.0	17.4	2.3	2.3	4.7	1.2	1.2	-	100		
1983	No.	9	22	18	18	4	2	7	6	-	-	2	-	-	-	-	88	2.75	(2.27-3.24)
	%	10.2	25.0	20.5	20.5	4.5	2.3	8.0	6.8	-	-	2.3	-	-	-	-	100		
1984	No.	6	26	15	11	9	9	13	10	5	5	-	-	1	-	<u>15GIG</u> 1	111	3.87	(3.32-4.43)
	%	5.4	23.4	13.5	9.9	8.1	8.1	11.7	9.0	4.5	4.5	-	-	0.9	-	0.9	100		
Total	No.	26	82	87	54	33	29	31	30	25	9	5	5	2	1	<u>15GIG</u> 1	420	3.64	(3.37-3.91)
	%	6.2	19.5	20.7	12.9	7.9	6.9	7.4	7.1	6.0	2.1	1.2	1.2	0.5	0.2	0.2	100		

Table 1: Continued.

## C. Females from Bering Sea.

	AGE	0	1	2	3	4	5	6	7	8	9	10	11	12	13	Other	Total	Mean Age	95% C.I.
1981	No.	-	-	4	8	9	2	4	-	-	1	1	-	-	-	-	29	4.17	(3.45-4.90)
	%	-	-	13.8	27.6	31.0	6.9	13.8	-	-	3.4	3.4	-	-	-	-	100		
1982	No.	-	8	19	15	7	8	7	6	5	4	2	-	1	1	-	83	4.39	(3.77-5.00)
	%	-	9.6	22.9	18.1	8.4	9.6	8.4	7.2	6.0	4.8	2.4	-	1.2	1.2	-	100		
1983	No.	-	45	28	9	12	6	3	2	3	3	-	1	-	-	-	112	2.68	(2.26-3.10)
	%	-	40.2	25.0	8.0	10.7	5.4	2.7	1.8	2.7	2.7	-	0.9	-	-	-	100		
1984	No.	-	21	26	5	9	8	6	3	3	2	-	-	1	-	-	84	3.27	(2.75-3.80)
	%	-	25.0	31.0	6.0	10.7	9.5	7.1	3.6	3.6	2.4	-	-	1.2	-	-	100		
Total	No.	-	74	77	37	37	24	20	11	11	10	3	1	2	1	-	308	3.44	(3.16-3.73)
	%	-	24.0	25.0	12.0	12.0	7.8	6.5	3.6	3.6	3.2	1.0	0.3	0.6	0.3	-	100		

Table 1: continued.

D. Males from Bering Sea.

	AGE	0	1	2	3	4	5	6	7	8	9	10	11	12	13	Other	Total	Mean	95% C.I.
																	Age		
1981	No.	-	1	2	5	6	3	1	2	-	-	-	-	-	1		21	4.38	(3.24-5.52)
	%	-	4.8	9.5	23.8	28.6	14.3	4.8	9.5	-	-	-	-	-	4.8		100		
1982	No.	-	15	23	9	3	1	4	3	2	1	2	-	1		<u>17GLG</u> 1	65	3.45	(2.67-4.22)
	%	-	23.1	35.4	13.8	4.6	1.5	6.2	4.6	3.1	1.5	3.1	-	1.5	-	1.5	100		
1983	No.	-	20	19	4	2	1	3	1	3	2	-	-	-	-	-	55	2.73	(2.10-3.35)
	%	-	36.4	34.5	7.3	3.6	1.8	5.5	1.8	5.5	3.6	-	-	-	-	-	100		
1984	No.	-	15	16	2	1	1	2	3	-	-	1	-	-	-	-	41	2.56	(1.88-3.24)
	%	-	36.6	39.0	4.9	2.4	2.4	4.9	7.3	-	-	2.4	-	-	-	-	100		
Total	No.	-	51	60	20	12	6	10	9	5	3	3	-	1	1	<u>17GLG</u> 1	182	3.14	(2.74-3.53)
	%	-	28.0	33.0	11.0	6.6	3.3	5.5	4.9	2.7	1.6	1.6	-	0.5	0.5	0.5	100		

TABLE 2.--Mean length of males and females for each age group. Data for the period 1981-1984.

A. WESTERN NORTH PACIFIC POPULATION											
MALES						FEMALES					
Age Group	n	Mean length, cm	95% C.I.	Range of lengths		Age Group	n	Mean length, cm	95% C.I.	Range of lengths	
				Min.	Max.					Min.	Max.
0	26	105.3	102.1-108.6	91	125	0	22	102.1	99.5-104.7	95	119
1	81	153.0	151.3-154.7	120	169	1	143	150.3	149.2-151.4	116	167
2	85	160.1	158.6-161.6	137	179	2	99	159.0	157.3-160.8	130	192
3	53	170.4	168.7-172.0	154	184	3	108	171.3	170.0-172.5	154	187
4	33	178.8	176.5-181.1	159	192	4	107	175.6	174.3-177.0	161	196
5	29	189.9	185.9-193.9	169	206	5	94	181.6	180.1-183.1	158	200
6	31	188.0	185.1-190.9	166	207	6	107	182.4	181.0-183.9	149	200
7	29	192.2	189.4-195.0	177	209	7	63	185.4	183.4-187.5	168	209
8	25	194.8	192.2-197.4	184	207	8	36	187.3	185.0-189.6	174	199
9	9	202.1	196.6-207.6	186	211	9	32	185.0	183.0-187.2	174	205
10	5	203.6	195.3-211.9	199	215	10	11	187.6	182.9-192.3	175	195
11	5	199.0	190.8-207.2	188	205	11	7	188.3	183.2-193.4	179	201
12	2	(184)		175	193	12	7	185.6	180.0-191.2	176	195
13	1	(188)				13	2	(183.5)	-	181	186
15	1	(197)				16	1	(192)	-	-	-
	415						849				
B. BERING SEA POPULATION											
1	50	155.6	153.9-157.4	140	175	1	74	152.4	150.8-154.1	125	165
2	60	159.8	157.9-161.4	141	172	2	77	157.8	156.2-159.3	140	181
3	20	168.2	163.1-173.1	141	179	3	37	167.6	164.6-170.7	144	197
4	12	179.2	171.2-187.1	157	210	4	37	177.4	173.5-181.2	149	205
5	6	178.7	165.6-191.8	152	205	5	24	184.9	181.5-188.4	154	198
6	10	196.1	189.3-202.9	175	210	6	20	185.2	181.8-188.7	165	200
7	9	197.2	192.6-201.8	189	208	7	11	188.6	184.0-193.3	167	199
8	5	204.6	196.1-213.1	193	210	8	11	195.4	189.7-201.1	174	210
9	3	194.0	-	182	210	9	10	191.5	187.4-195.6	177	201
10	3	197.0	-	192	205	10	3	(199.3)	-	189	206
12	1	206.0	-	-	-	11	1	(185.0)	-	-	-
13	1	191.0	-	-	-	12	1	(195.0)	-	-	-
17	1	214.0	-	-	-	13	1	(235.0)	-	-	-
	181						307				

TABLE 3.—Growth increments of Dall's porpoise in the Western North Pacific and Bering Sea, 1981-84.

A. WESTERN NORTH PACIFIC POPULATION					B. BERING SEA POPULATION				
MALES					FEMALES				
Age Group	n	Mean length, cm	95% C.I.	Growth Increment, cm	Age Group	n	Mean length, cm	95% C.I.	Growth Increment, cm
0	26	105.3	102.1-108.6	47.7	0	22	102.1	99.5-104.7	48.2
1	81	153.0	151.3-154.7	7.1	1	143	150.3	149.2-151.4	8.2
2	85	160.1	158.6-161.6	10.3	2	99	159.0	157.3-160.8	12.3
3	53	170.4	168.7-172.0	8.3	3	108	171.3	170.0-172.5	4.3
4	33	178.8	176.5-181.1	10.1*	4	107	175.6	174.3-177.0	6.4*
5-6	60	188.9	186.5-191.3	4.5**	5-6	204	182.0	181.0-183.1	4.1**
7-8	55	193.4	191.4-195.4	6.0	7-8	103	186.1	184.6-187.7	(-0.1)
>8	23	199.4	195.3-203.4		>8	62	186.0	184.4-187.6	
1	50	155.6	153.9-157.4	4.2	1	74	152.4	150.8-154.1	5.4
2	60	159.8	157.9-161.4	8.4	2	77	157.8	156.2-159.3	9.8
3	20	168.2	163.1-173.1	11.0	3	37	167.6	164.6-170.7	9.8
4	12	179.2	171.2-187.1	10.4*	4	37	177.4	173.5-181.2	7.7*
5-6	16	189.6	180.9-198.2	10.3**	5-6	44	185.1	182.5-187.6	6.9**
7-8	14	199.9	195.3-204.4	(-1.7)	7-8	22	192.0	187.7-196.3	2.8
>8	9	198.2	189.9-206.5		>8	17	194.8	188.3-201.4	

\* time interval = 1.5 years.

\*\* time interval = 2 years.

TABLE 4.—Mean age (growth layer groups) and length (in cm) at sexual maturity of female Dall's porpoise. Maturity is based on the presence of a single corpus.

	Western North Pacific						Bering Sea (north of 53°N lat.)					
	Age (s.e.)	n	Length (s.e.)	n	Age (s.e.)	n	Length (s.e.)	n	Age (s.e.)	n	Length (s.e.)	n
1978 <sup>1/</sup>	4.6 (0.63)	5	180 (1.18)	18	-	0	-	0	-	-	-	0
1979 <sup>1/</sup>	5.4 (0.34)	19	176 (1.22)	33	8.0	1	175	-	1	-	-	1
1980 <sup>1/</sup>	4.1 (0.53)	14	177 (1.17)	47	4.0 (0.35)	4	179 (2.53)	10	4.0	4	179 (2.53)	10
1981	4.1 (0.25)	28	175 (1.33)	36	6.0	2	177 (4.62)	3	6.0	2	177 (4.62)	3
1982	4.6 (0.27)	20	177 (1.28)	30	4.6 (0.29)	6	184 (1.77)	8	4.6	6	184 (1.77)	8
1983	4.3 (0.23)	16	175 (1.38)	19	4.4 (0.36)	5	183 (3.48)	10	4.4	5	183 (3.48)	10
1984	4.1 (0.17)	<u>28</u>	178 (1.33)	<u>36</u>	4	<u>3</u>	182 (2.83)	<u>8</u>	4	<u>3</u>	182 (2.83)	<u>8</u>
Overall	4.5	130	176.9	219	4.4	21	182.1	40	4.4	21	182.1	40

<sup>1/</sup> Ages for 1978-1980 are from Newby (1982).

TABLE 5.— Mean age per number of ovarian corpora in Dall's porpoise from the western North Pacific, 1981-1984.

Number of Corpora	Mean Age	n
1	4.4	87
2	5.1	72
3	5.8	91
4	6.8	55
5	6.9	45
6	7.7	34
7	7.4	18
8	7.5	17
9	8.7	9
10	9.0	10
11	8.5	6
12	6	1
13	10	2
14	8.5	4
15	12	1
17	10	1
18	11	1



TABLE 6.--Age distribution per number of corpora in Dall's porpoise from the western North Pacific, 1981-1984.

Age	Number of ovarian corpora															
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
0	22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	143	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	94	1	0	1	0	0	0	1	0	0	0	0	0	0	0	0
3	85	16	5	0	0	0	0	0	0	0	0	0	0	0	0	0
4	33	43	11	9	2	3	1	1	2	0	0	0	0	0	0	0
5	14	15	31	13	9	3	4	0	4	1	1	1	0	0	0	0
6	3	9	22	37	10	12	4	5	0	1	0	1	1	0	0	0
7	0	1	3	11	22	9	5	4	2	1	3	1	0	0	2	0
8	0	2	0	3	11	11	4	1	2	1	1	0	0	0	0	0
9	0	0	0	2	2	5	11	3	4	1	2	0	0	1	1	0
10	0	0	0	0	1	2	3	1	0	0	1	1	0	0	0	0
11	0	0	0	0	0	0	1	0	2	0	0	1	0	1	1	0
12	0	0	0	0	0	0	1	2	1	0	1	1	0	0	0	1
13	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0

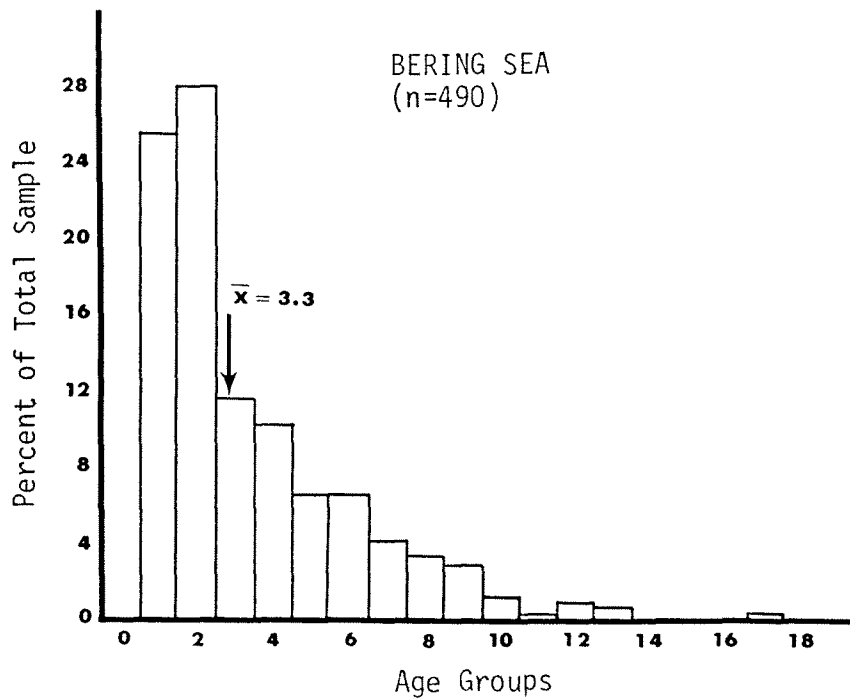
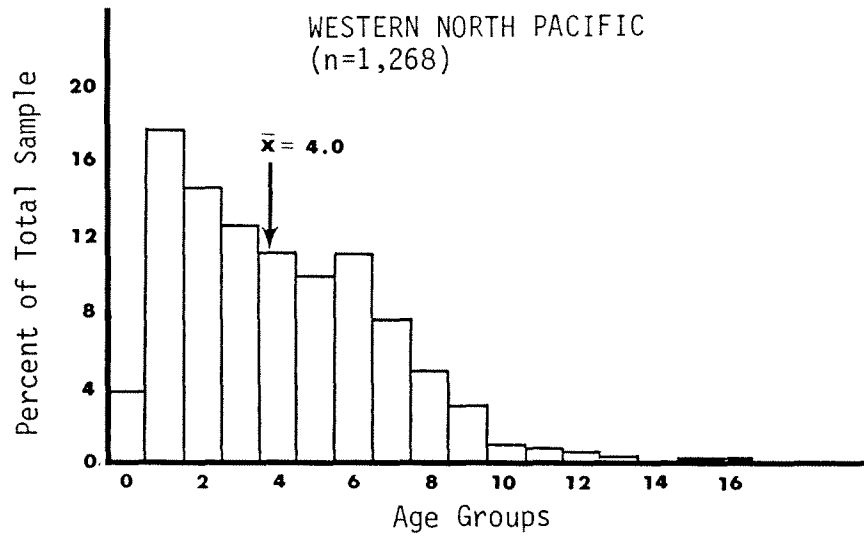


Figure 1. Age distribution of Dall's porpoise in the western North Pacific Ocean and Bering Sea for the period 1981-1984. Samples from porpoise incidentally taken by salmon mothership fishery.

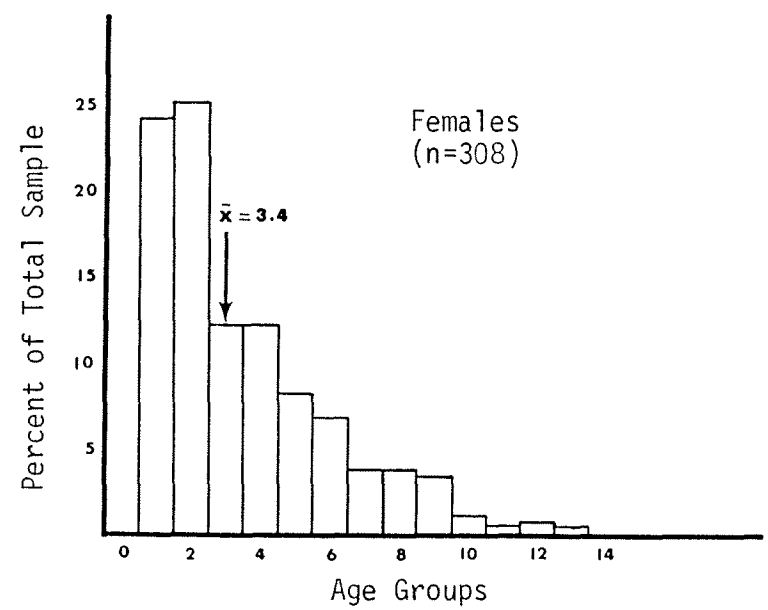
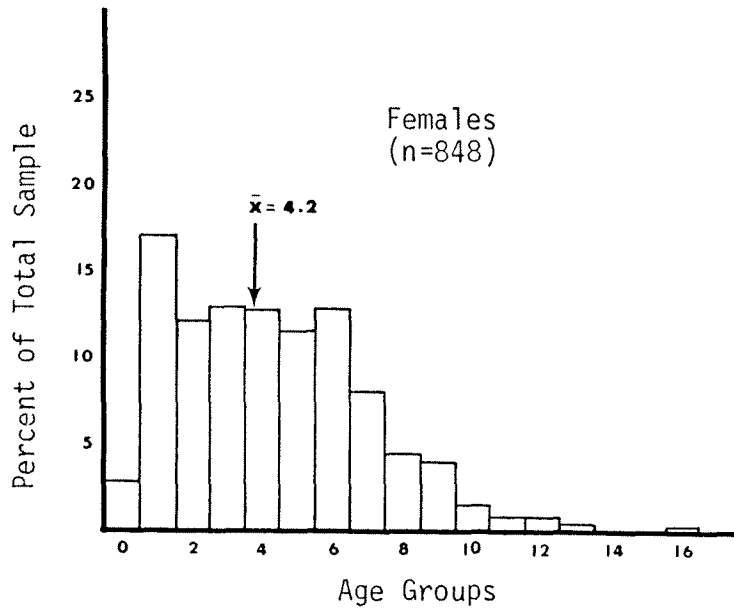
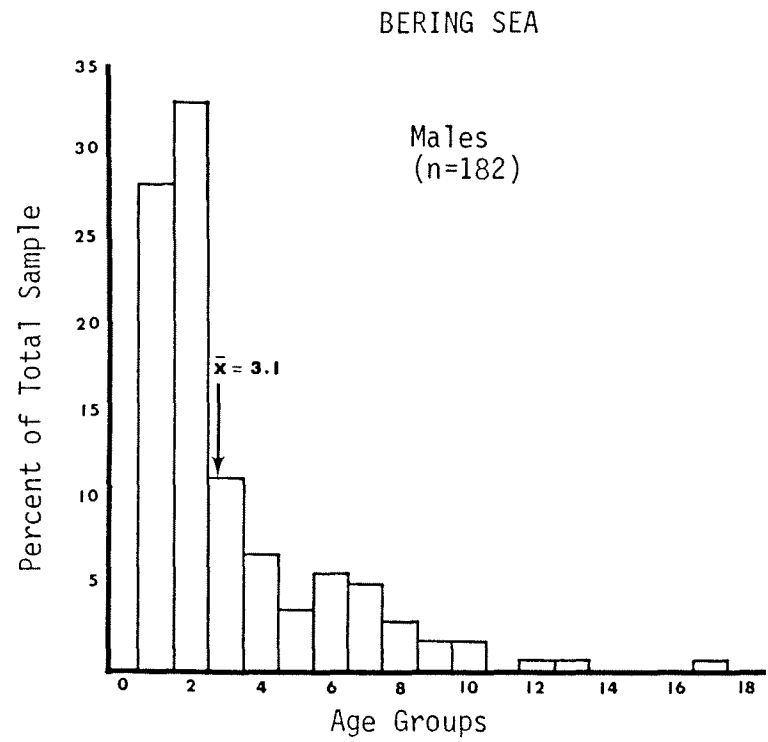
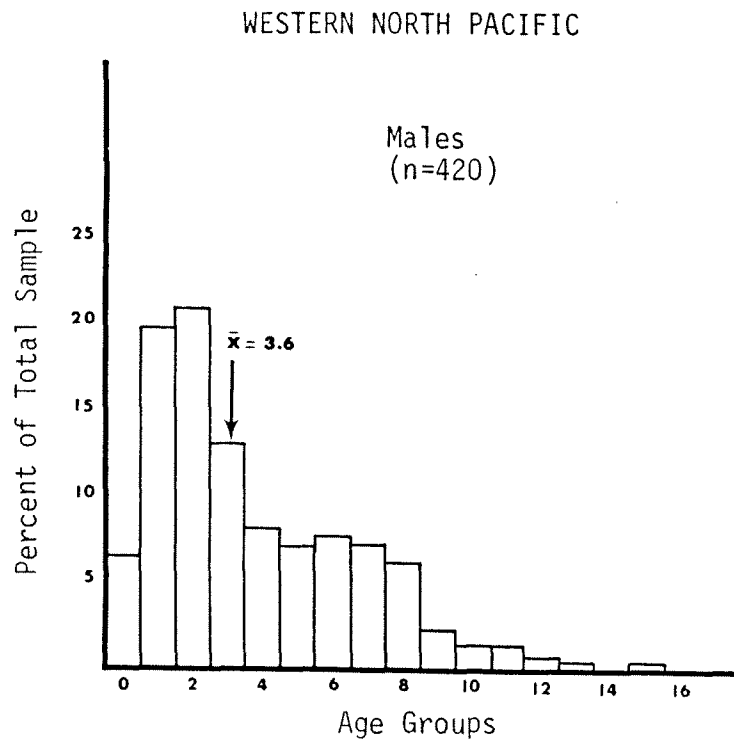


Figure 2. Age composition of males and females (1981-84) in the western North Pacific and Bering Sea salmon fishing areas.

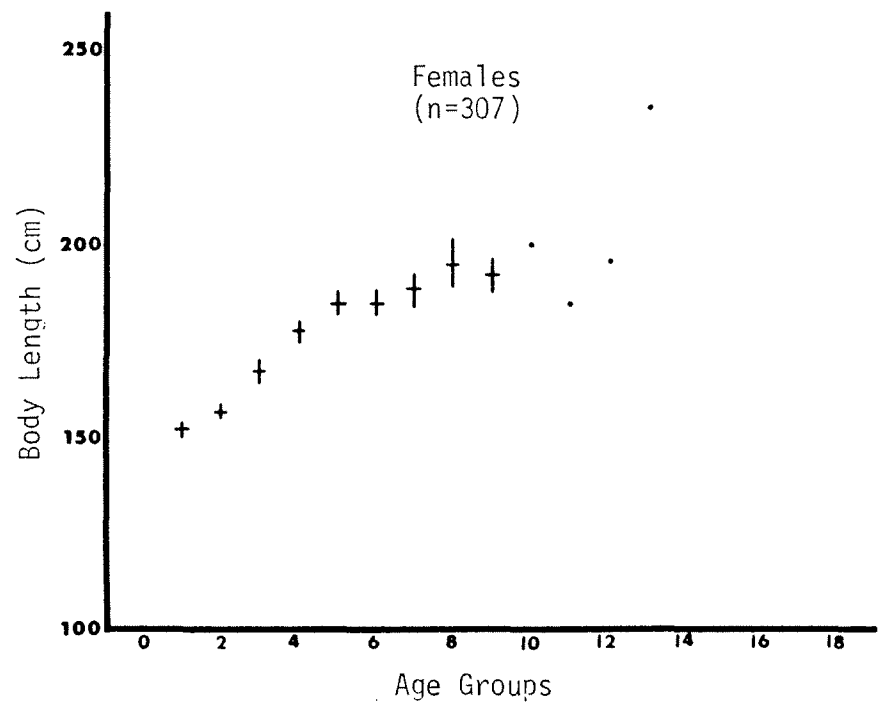
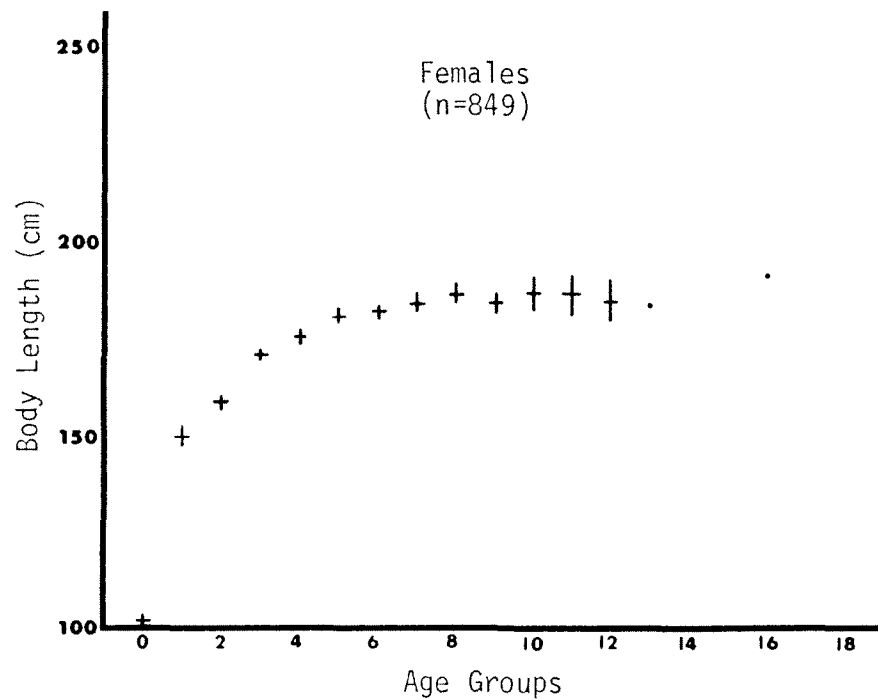
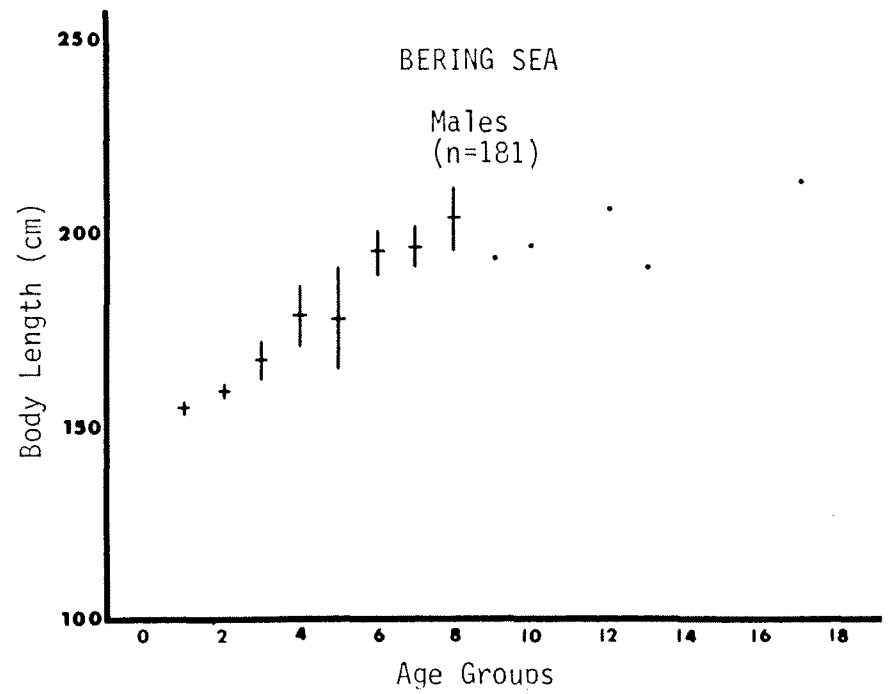
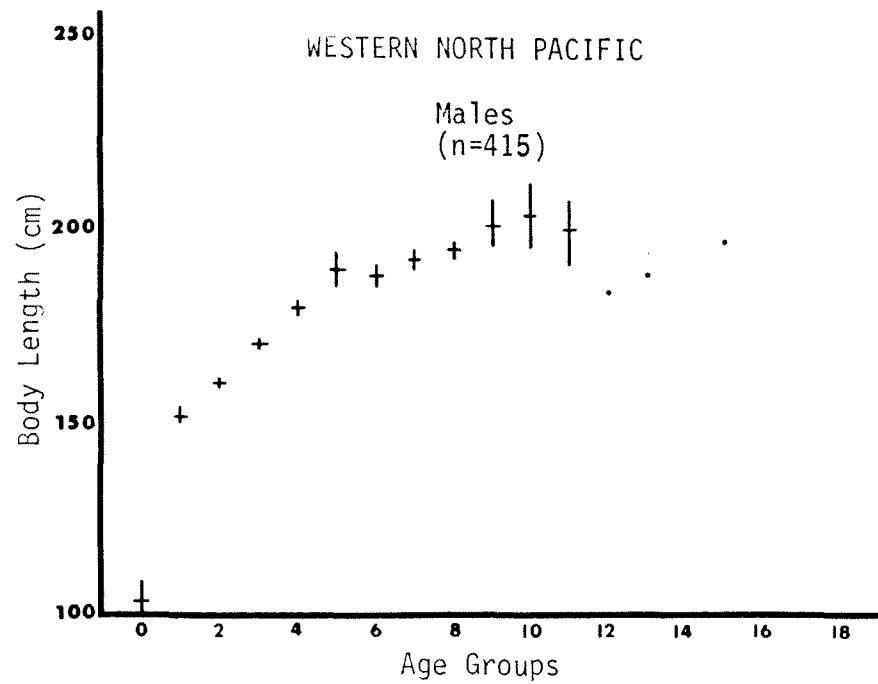


Figure 3. Growth curves of Dall's porpoise from the western North Pacific and Bering Sea, 1981-1984. Mean length, and 95% confidence limits.



