

# A note on cephalopods from the stomachs of Dall's porpoises (*Phocoenoides dalli*) from the Northwestern Pacific and Bering Sea, 1978-1982

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## ABSTRACT

Cephalopod prey were identified from the stomachs of 100 Dall's porpoise (*Phocoenoides dalli*) incidentally taken by commercial salmon gillnets and research vessels from 1978 to 1982 in the western North Pacific Ocean and Bering Sea. Eighty-four porpoise were collected in June and July during the salmon fishing season; the remainder were collected in August-September. Seven cephalopod families (Enoploteuthidae, Onychoteuthidae, Gonatidae, Histioteuthidae, Chiroteuthidae, Cranchiidae and Bolitaenidae) were identified in the stomachs. Gonatids were the most abundant, comprising 98% of the beaks. *Gonatopsis borealis* was the most abundant species, occurring in 85 stomachs. The gonatids occur in meso- and epipelagic waters and many approach the surface at night when the porpoise are feeding.

KEYWORDS: DALL'S PORPOISE; SQUID; FOOD/PREY; FEEDING; NORTHERN HEMISPHERE; PACIFIC OCEAN

## INTRODUCTION

A cooperative programme between the United States and Japan on the incidental take of Dall's porpoises (*Phocoenoides dalli*) in the Japanese High Seas Salmon fishery was initiated in 1978. As part of this, a study of the feeding habits of the Dall's porpoise was carried out. This paper presents information on the cephalopod portion of stomach contents of Dall's porpoises collected from 1978 through 1982. Crawford (1982) reported on fish remains from the 1978-79 collection ( $n=472$ ). He noted that cephalopods comprised some 90% of stomach contents by volume.

The salmon mothership fishery area is located in the northwestern North Pacific Ocean from 46-56°N and 168-175°E, and between 56-59°N and about 173°E-175°W north of 56-59°N in the Bering Sea. Surface water temperatures in this sub-Arctic water mass, in June and July, range from 6-9°C in the Pacific and 4-7°C in the Bering Sea (Oceanographic Monthly Summary, 1982). A small number of Dall's porpoises were collected to the southwest of these areas in August and September 1982, between 42-50°N and 158-170°E. Surface water temperatures here were noticeably higher, mostly 14° and 15°C, but the range was between 10° and 17°C (Oceanographic Monthly Summary, 1982).

The oceanography of the region is described by Favorite *et al.* (1976). Jefferts (1988) describes the distribution of the North Pacific epi- and meso-pelagic cephalopods related to water masses.

## MATERIALS AND METHODS

When the salmon gillnets were hauled, the dead porpoises were brought aboard and, after being weighed and measured, the stomachs were removed and usually preserved by freezing for later examination (28 taken in 1978 were preserved in formalin). Most stomachs were frozen upon

removal and transported to the National Marine Mammal Laboratory (NMML), Northwest and Alaska Fisheries Center, NMFS, Seattle, Washington.

For a complete description of the methods used for examining Dall's porpoise stomachs, see Crawford<sup>2</sup> (1982). Stomachs were thawed and the contents removed, then weighed and the volume determined by water displacement. Through a process of water flushing and sieving through graduated screens, the material was cleaned and sorted, then stored in 50% isopropyl alcohol (Treacy and Crawford, 1981; Crawford, 1982). Fish and cephalopod remains were separated at this time. Otoliths and statoliths were stored dry.

Cephalopod remains were initially sorted into fleshy parts (bodies and crowns), buccal masses and upper and lower beaks. Beaks were then sorted into recognisable categories preliminary to final designation. Most identifications were based on the examination of lower beaks, as the bodies and crowns in most instances lacked the tentacle and arm components necessary for identification.

The major identification problem encountered during this study was the lack of suckers and hooks on arms and tentacles, and in most instances absence of tentacles other than stubs. The major cause of this is probably related to length of time (12-24 hours) between entanglement and dissection of the porpoise. However, another factor which may have contributed to the lack of hooks and suckers on remnants of arms and tentacles is the method used to separate stomach contents. Although washing stomach contents through a sieve may not be a problem with fish remains and otoliths/statoliths, it may contribute to the absence (i.e. destruction) of features needed to identify cephalopod specimens. For future studies, therefore, we recommend that cephalopod bodies and crowns be carefully removed and cleaned prior to or as the stomach contents undergo the initial flushing, to preserve any remaining suckers and hooks on the arms and tentacles.

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<sup>2</sup> T.W. Crawford made the original examination of the Dall's porpoise stomachs collected in 1978-79 and, with the assistance of L. Tsunoda, those collected through 1982.

The identification of beaks was made through comparison with identified specimens in the NMML voucher collection and through the use of keys and descriptive material (Akimuskina, 1963; Panina, 1966; Iverson and Pinkas, 1971; Clarke, 1980; 1986).

The size of the squid portion of the stomach contents collection precluded examination of the entire collection and a sub-sample was selected. We asked the investigators who did the initial separation of squid from the fish samples, to set aside the few relatively intact squid for us, otherwise the sub-sample was randomly selected making sure samples came from each area.

Distribution of samples examined from the fishery by year was: 1978 (26), 1979 (11), 1980 (1), 1981 (19), and 1982 (17). In addition, the stomachs of 25 *dalli*-type and 1 *truei*-type of Dall's porpoise collected by T. Kasuya during an August/September 1982 Japanese research cruise were examined. In all, the cephalopod portion of the contents of 100 stomachs were examined and are reported on in this paper.

## RESULTS

The samples examined were from four localities (Fig. 1; Table 1). The Western North Pacific (WNP) sample was taken from 21 August to 10 September 1982. The cephalopod stomach contents of the one *truei*-type porpoise taken in the WNP did not differ significantly from the contents of the 25 *dalli*-type porpoises and is not treated

separately. Two of the remaining localities were located within the US Fisheries Conservation Zone (US FCZ) and sampling dates are based on when each locality opened for fishing. The Southern North Pacific (SNP) opened on 1 June and the Central Western Aleutians (CWA) on 10 June. Little fishing effort occurs in the SNP area after the main fishing area (CWA) opens. The remaining location is the southern Bering Sea (SBS) which opened on 25 June. Samples from these three localities were all taken in June and July, 1978-1982.

The cephalopod fauna of the region is well documented (Kodolov, 1970; Nesis, 1973; 1987; Ogi, 1980; Bublitz, 1981; Kubodera and Okutani, 1981a, b; Fiscus and Mercer, 1982; Kubodera and Jefferts, 1984a; b; Jefferts, 1988; Okutani *et al.*, 1988 and Okutani and Nemoto, 1964).

In addition to the cited publications, we were fortunate to have specimens collected in or adjacent to the fishery area by Roger Mercer (Resource Assessment and Conservation Engineering Division, Northwest and Alaska Fisheries Center, National Marine Fisheries Service, Seattle, Washington) in July 1982. Mercer fished six deep midwater trawl stations. The specimens were identified by Drs. K. Jefferts and T. Kubodera, and the first author. Of particular importance to the present project was the acquisition of seven species of gonatids (three new to the NMML collection) from these stations.

The family Gonatidae dominates the cephalopod fauna of epi- and meso-pelagic waters in the subArctic Pacific and Bering Sea (Okutani *et al.*, 1988).

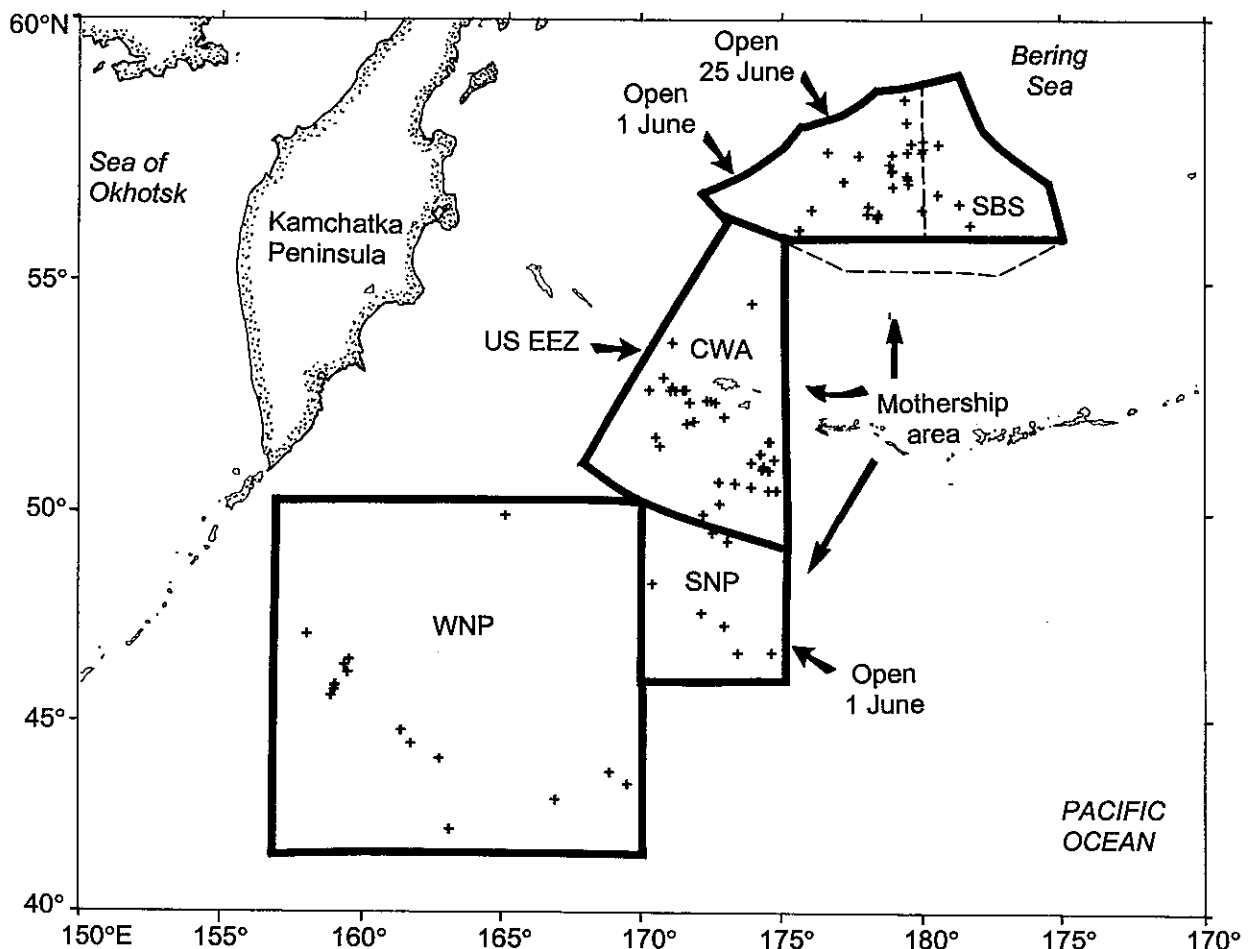


Fig. 1. Approximate locations where Dall's porpoise (*Phocoenoides dalli*) were taken in the Japanese high seas salmon gillnet fishery and by a Japanese research vessel in the North Pacific Ocean and Bering Sea 1978-1982, from which cephalopod prey were identified. The four localities are: WNP = Western North Pacific (26 stomachs); SNP = Southern North Pacific (7 stomachs); CWA = Central Western Aleutians (35 stomachs); SBS = Southern Bering Sea (32 stomachs).

Table 1

Cephalopods from the stomachs of Dall's porpoise (*Phocoenoides dalli*) taken in the Japanese high seas salmon gillnet fishery and by a Japanese research vessel in the western North Pacific Ocean.

Cephalopods	Western N. Pacific n = 26 <sup>1</sup>		Southern N. Pacific n = 7		Central western Aleutians n = 35		Southern Bering Sea n = 32		All four localities totals n = 100			
	Occ. <sup>2</sup>	Bks. <sup>3</sup>	Occ.	Bks.	Occ.	Bks.	Occ.	Bks.	Occ.	Bks.	%	
Enoploteuthidae												
<i>Abraliopsis</i> sp.	13	33							13	33	.4	
Onychoteuthidae												
<i>Onychoteuthis borealijaponicus</i>	4	13							4	13	0.2	
Gonatidae	7	166			3	54	3	44	13	264	3.5	
<i>Gonatus berryi</i>	20	177	4	7	25	506	22	299	71	929	12.3	
<i>Gonatus onyx</i>			2	6	4	74	7	41	13	121	1.6	
<i>Gonatus pyros</i>	22	660	7	52	27	388	22	349	78	1,449	19.2	
<i>Gonatus madokai</i>					4	5			4	5	0.1	
<i>Gonatus middenorffi</i>	2	4			12	28	8	11	22	43	0.5	
<i>Gonatus</i> spp.	7	34	3	23	22	472	17	128	49	657	8.7	
<i>Eogonatus tinro</i>	16	55	6	16	20	112	22	205	64	388	5.1	
<i>Gonatopsis borealis</i>	20	267	5	51	29	901	31	781	85	2,000	26.6	
<i>Gon/Berry</i>	12	184	2	6	19	681	9	444	42	1,315	17.4	
<i>Berryteuthis magister</i>					1	1	1	10	2	11	0.1	
<i>Berryteuthis anonychus</i>	1	1	2	3	6	26	10	154	19	184	2.4	
Histioteuthidae												
<i>Histioteuthis</i> sp.			1	1					1	1	<.1	
Chiroteuthidae												
<i>Chiroteuthis</i> sp.					1	1			1	1	<.1	
Chranchiidae			2	3					2	3	<.1	
<i>Galiteuthis</i> sp.							2	2	2	2	<.1	
<i>Taonius</i> sp.	1	1	1	5	12	63	6	18	20	87	1.1	
Bolitaenidae												
<i>Japetella</i> sp.					1	1			1	1	<.1	
Unidentified squids	2	8	1	2	2	2	1	1	6	13	0.2	

<sup>1</sup>n = number of stomachs examined. <sup>2</sup>Occ. = number of occurrences in stomachs. <sup>3</sup>Bks = total lower beaks found in all stomachs per locality.

Kubodera and Jefferts (1984a; b), reporting on catches of primarily larval and juvenile cephalopods in the northern North Pacific and Bering Sea, found that the family made up 93% of the catch in the western sector of the North Pacific, 50% in the eastern sector and 99% in the Bering Sea. Based on total lower beaks counted in all stomachs examined (Table 1), gonatids comprised 96% of the cephalopods from the WNP sample, 94% of the SNP, 98% of the CWA and 99% of the SBS samples. These values are in reasonable agreement with gonatid catches for the western North Pacific and Bering Sea sectors of Kubodera and Jefferts (1984a; b) where gonatids comprised 93% and 99% of the catch respectively.

The family Gonatidae contains four Genera (Clarke, 1986; Okutani *et al.*, 1988): *Gonatus* with 10 species, six of which are found in the area; *Eogonatus* with one species; *Gonatopsis* with five described species and undescribed species, at least two of which are found in the region; and *Berryteuthis* with two species, both of which are found in the region. Okutani *et al.* (1988) discuss and provide distributional maps of all species.

**Species accounts**

*Enoploteuthidae*

**ABRALIOPSIS SP.**

This species was found only in the stomachs of porpoises taken in late summer in the WNP (Table 1). Thirteen of the 26 stomachs examined contained *Abraliopsis*. No identifiable body fragments were found; the beaks most closely resembled those of *Abraliopsis felis*. Nesis (1987)

recorded *A. felis* from Baja California and Washington, in the northeastern Pacific westward to the area east of Japan and the Kurile Islands.

*Onychoteuthidae*

**ONYCHOTEUTHIS BOREALIJAPONICUS (OKADA, 1927)**

This species was only found in four stomachs including that of 1 *truei*-type porpoise, from the WNP in August-September. The largest specimen, taken on 22 August 1982, had a gladius length (which approximates mantle length, ML) of 155mm, and a lower rostral length (LRL) of 4mm. Beaks of other specimens were no larger. These specimens represented immature squids. Most maturing *O. borealijaponicus* (MLs of 290mm+) were probably north of these latitudes at this season (Naito *et al.*, 1977a; Fiscus and Mercer, 1982).

*Gonatidae*

A number of beaks could be recognised only as gonatids. There were seven porpoise stomachs with Gonatid beaks in the WNP, 3 in the CWA and 3 in the SBS.

**GONATUS BERRYI (NAEF, 1923)**

*G. berryi* beaks were found in stomachs of *P. dalli* from all four localities: WNP-20; SNP-4; CWA-25; and SBS-22.

This species has been reported from the fishery area by Kubodera and Okutani (1981b), Jefferts (1983), and Kubodera and Jefferts (1984a; b). Nesis (1987) recorded *G. berryi* from the northern shelf slope in the Bering Sea to the southern Kuriles. Bublitz (1981) records this species from the eastern Bering Sea.

**GONATUS ONYX (YOUNG, 1972)**

This species was found in stomachs from three localities: SNP-2; CWA-4; and SBS-7. Kubodera and Jefferts (1984a; b) reported *G. onyx* across the northern North Pacific and into the Bering and Okhotsk Seas. Both Jefferts (1983) and Roper and Young (1975) reported it most frequently from depths less than 800m at night (it is known to approach the surface at night). *G. onyx* may have occurred more frequently in the stomachs than indicated, as the beaks at some growth stages can be confused with other species of *Gonatus*.

**GONATUS PYROS (YOUNG, 1972)**

Beaks of this species were found in stomachs from all four localities: WNP-22; SNP-7; CWA-27; and SBS-22. One relatively intact specimen was taken in the SNP. The species has been reported from the US FCZ by Jefferts (1983). Although Kubodera and Jefferts (1984a; b) reported a westernmost limit of about 174°E, our samples were from as far west as 155°E. Nesis (1987) reports *G. pyros* from the central Bering Sea to eastern Honshu, Japan, and eastward to California in mesopelagic and lower epipelagic waters.

**GONATUS MADOKAI (KUBODERA AND OKUTANI, 1977)**

*G. madokai* beaks were only found in four stomachs from the CWA. This species is reported across the northern North Pacific and into the Bering and Okhotsk Sea (Kubodera and Jefferts, 1984a; b). Kubodera and Okutani (1981a) reported a catch of only 50 (8-72mm in size) *G. madokai* in surface tows compared to 500 *G. middendorffi*. Okutani *et al.* (1988) mentioned that *G. madokai* is most abundant at depths of 150-200m at night whereas *G. middendorffi* is regularly taken in near surface tows at night. It would appear that *G. madokai* is probably mesopelagic in the adult stage whereas *G. middendorffi* is an epipelagic species.

**GONATUS MIDDENDORFFI (KUBODERA AND OKUTANI, 1981B)**

The beaks of this species were found in stomachs from three areas: WNP-2; CWA-12; and SBS-8. None were found in the seven porpoises from the SNP area in early June. Kubodera and Jefferts (1984a; b) reported the species from the western North Pacific and Bering Sea. Fiscus and Mercer (1982) reported three adult *G. middendorffi* taken in surface gillnets from the fishery area. T. Kubodera (pers. comm. March 1983) mentioned that this species is much more abundant in North Pacific waters than is *G. madokai*. Nesis (1987) lists this species as *G. kamtschaticus* (Middendorff 1849).

**GONATUS SPP**

Beaks, identifiable only as *Gonatus*, were found in stomachs from all localities: WNP-7; SNP-3; CWA-22; and SBS-17. Some of these beaks may represent different stages of beaks from species already discussed and some may represent beaks of unknown or undescribed *Gonatus* sp.

**EOGONATUS TINRO (NESIS, 1972)**

Beaks of this species were found in stomachs from all four localities: WNP-16; SNP-6; CWA-20; and SBS-22. Body and crown fragments of three were taken from one *P. dalli* stomach from the SNP. *E. tinro* has been reported from the eastern Bering Sea by Bublitz (1981). The three specimens in the NMML collection were taken by Mercer, two from the SBS and one from the northern North Pacific. Nesis (1987) lists this genus as a subgenus in the genus *Gonatus*,

distributed from the northern slope of the Bering Sea to the Okhotsk Sea and from the Kurile Islands and British Columbia.

**GONATOPSIS BOREALIS (SASAKI, 1923)**

This was the most frequently occurring species in the samples. It was identified in 85 of the 100 stomachs examined and in all four localities

The bodies and crowns (head with attached arms) of *G. borealis* apparently resist the digestive juices of marine mammal stomachs to a greater degree than other gonatids. Hence bodies, body fragments and crowns of this species persist in the stomachs long after the fragments and crowns of other gonatids have been digested.

MLs were obtained from 22 relatively intact specimens which ranged in size from 85 to 200mm. LRL measurements were taken from 27 beaks. A comparison of these measurements with beaks of *G. borealis* in the NMML collection, suggests that the squid ranged from about 140 to 265mm ML. Kubodera *et al.* (1983) reported that this species was numerically the third most abundant (20%) taken in surface gillnets in the subArctic Pacific, behind *Ommastrephes bartrami* (about 46%) and *O. borealijaponicus* (33%). They reported that the MLs of *G. borealis* taken in surface gillnets in June and July ranged in size from 130-260mm. This does not differ greatly from the measurements of specimens found in the Dall's porpoise.

**'GON/BERRY'**

Beaks in this category exhibit characteristics of *G. borealis* and the two *Berryteuthis* species and cannot be separated to species. The category was found in 42 stomachs from all four localities. Many of the beaks were very small.

**BERRYTEUTHIS MAGISTER (BERRY, 1913)**

Eleven specimens were identified during the present study. One on 20 June 1978 south of Attu Island (CWA) and ten from a single porpoise taken on 9 July 1982 from the SBS.

Larval and juvenile specimens have been taken in surface and near surface tows (Kubodera and Okutani, 1981b; Kubodera and Jefferts, 1984a; b), and from the stomachs of *Uria lomvia* (thick-billed murre) taken in the Japanese high seas salmon fishery gillnets (Ogi, 1980). Kubodera *et al.* (1983) reported that this species (mature or maturing) was rarely caught in surface gillnets, noting that it occurred in 16 stations (49 squids) from May to July in the years 1977-81. Fiscus and Mercer (1982) reported only one male taken in August 1971 (ML 152mm) in surface gillnet catches.

Naito *et al.* (1977a) reported this species as abundant around Attu Island in the western Aleutian Islands where its spawning ground is located on the slope in 200 to 500m. The spawning season occurs from June to October.

*B. magister* probably settles to the bottom at about the 55-80mm size range. Okutani *et al.* (1988) citing Naito *et al.* (1977b) used the figure < 100mm. One of us (CHF) took 42 specimens (55-363mm ML) in two bottom trawls on the eastern Bering Sea shelf on 26 June 1973 at a depth of 292m; 26 of the specimens were less than 100mm ML. Naito *et al.* (1977b) reported that commercially taken *B. magister* off Attu ranged in size as follows: males 195-265mm ML; females 235-335mm ML.

The species, because of its habit of settling to the bottom at a relatively small size, is available for only a short time to *P. dalli* which appear to be feeding in the epipelagic water layer in these localities in June and July.

**BERRYTEUTHIS ANONYCHUS (PEARCY AND VOSS, 1963)**

This species was identified from stomachs taken in all four localities, although occurrence was low except in the Bering Sea: WNP-1; SNP-2; CWA-6; and SBS-10. It probably occurred more frequently, however, as it is very difficult to separate small beaks of *G. borealis* and *B. magister* from beaks of this species. Identification of *B. anonychus* beaks is based on the size at which the beak wing darkens. Maturing specimens (ML of about 80mm) can be easily separated from similarly sized *G. borealis* and *B. magister*. If the beak wing is lost, which often happens because of its fragility, then the beak is relegated to the 'Gon/Berry' category. Mercer obtained numerous specimens of this species from a trawl station west of the SBS locality on 25 July, 1982. The species has been reported throughout the four localities sampled (Kubodera and Okutani, 1981b; Kubodera and Jefferts, 1984a; b).

**Histioteuthidae****HISTIOTEUTHIS SP.**

One lower beak of a ?*Histioteuthis* was identified in a stomach taken in the SNP, on 17 June 1978. Voss (1969) lists six species of the genus from the North Pacific. Akimuskina (1963) mentions that *H. (Stigmatoteuthis) dofleini* probably approaches the surface at night. Kodolov (1970) reported 2 ?*Histioteuthis* sp. taken in Aleutian waters. This beak is a good match to the immature *H. dofleini* beak illustrated in Clarke (1986, fig. 66, p.137), and compares favourably with several mature *H. dofleini* beaks in the NMML collection. It represents the first record of *Histioteuthis* from the stomach of a *P. dalli*.

**Chiroteuthidae****CHIROTEUTHIS SP.**

One lower beak (*Chiroteuthis* sp.) was identified in the stomach of a porpoise taken in the CWA on 21 June 1978. The beak, based on an LRL of 4.8mm, was from an adult or nearly adult squid. Kodolov (1970) lists *Chiroteuthis veranyi* (*veranyi* not presently used for Pacific species) from the stomachs of sperm whales taken in the vicinity of the western Aleutians. Fiscus and Mercer (1982) reported one *Chiroteuthis* sp. taken in a surface gillnet on 27 March 1968 (49° 46'N, 176° 29'W). Roper and Young (1975) reported an upward movement of this species at night. Jefferts (1988) listed *Chiroteuthis calyx* as a holo-subArctic species. The beak reported here represents the first occurrence of this species identified from the stomach of *P. dalli*.

**Cranchiidae**

Cranchiid gladii were identified in the stomachs of 2 *P. dalli* from the SNP. The largest gladius, which measured 376mm in length, was from the stomach of a porpoise taken on 17 June 1978. Two gladii (one incomplete, the other 284mm) were found in the stomach of another porpoise taken nearby on the same day, as were the beaks of 5 *Taonius* sp.

**GALITEUTHIS SP.**

One pair of *Galiteuthis* sp. beaks was found in the stomach of an animal taken in the SBS on 12 July 1981. The lower beak (LRL 6mm) represented a mature squid. A dorsal beak, *Galiteuthis* sp.?, was found in a stomach from the SBS on 17 July 1981. Both Okutani and Nemoto (1964) and Jefferts (1983) reported *Galiteuthis* from the US FCZ; the former from the stomach of a sperm whale and the latter from sampling nets. Mercer took two *G. phyllura* in a haul on 27 July 1982 just north of the western Aleutian Islands. The

*Galiteuthis* beaks found in the Dall's porpoise were probably *G. phyllura*. They represent the first record of the genus from *P. dalli* stomachs.

**TAONIUS SP.**

*Taonius* sp. beaks were identified from the stomachs of 20 animals: WNP-1; SNP-1; CWA-12; SBS-6. Okutani and Nemoto (1964) from the stomachs of sperm whales and Jefferts (1983) from sampling nets, report *T. pavo* from the vicinity of the western Aleutian Islands and in the North Pacific south of the Aleutians. Mercer caught *T. pavo* in two midwater trawl sets north of the western Aleutian Islands, in 1982. These *Taonius* beaks from the *P. dalli* stomachs are most likely *T. pavo*. Although a cranchiid is listed from the stomach of a Dall's porpoise taken off California (Kajimura *et al.*, 1980), the present beaks represent the first record of *Taonius* sp. identified from *P. dalli* stomachs.

**Bolitaenidae****JAPETELLA SP.**

A pair of *Japetella* sp. beaks were identified from the stomach of a *P. dalli* taken on 14 June 1978 in the CWA. Jefferts (1983) reported *J. heathi* as occurring across the North Pacific Ocean westward to south of the western Aleutian Islands. Fiscus and Mercer (1982) reported an adult *Japetella* taken in a surface gillnet south of the western Aleutian Islands. Akimuskina (1963) reported this species from off the Kurile Islands. Kubodera and Okutani (1981a) reported 8 larval *Japetella* from surface tows. Nesis (1987) refers to this species as *J. diaphana heathi*. This pair of *Japetella* beaks represents the first record of its occurrence in *P. dalli* stomachs.

**Unidentified beaks**

Thirteen beaks from all four localities could not be identified.

**DISCUSSION**

There is no evidence that Dall's porpoises can catch and then break up large prey before swallowing it. Therefore the size of its prey is limited to those fish and cephalopods that it can swallow whole. Kajimura *et al.* (1980) and Crawford (1982) described the size and shape of Dall's porpoise prey and list earlier records of prey consumed elsewhere in the North Pacific Ocean and Bering Sea. Fish otoliths were found in all 472 stomachs Crawford examined (average per stomach 386) and he suggested that the volume of fish consumed is underrepresented due to their rapid digestion. He also reported that the contents of the largest stomach that he examined weighed 2.5kg and had a volume of 2,542ml. The largest cephalopods found in stomachs during the present study were two cranchiids represented by gladii measuring 284 and 376mm in length. MLs of *G. borealis*, the most frequently encountered prey, ranged in size from 85-265mm in length.

Surface water temperatures in the SNP and CWA localities in June and July ranged from 6°-9°C and in the SBS from 4° to 7°C but were noticeably higher in the WNP in August and September ranging from 10° to 17°C. *Abraliopsis* and *Onychoteuthis* were identified only in stomachs of *P. dalli* taken in the warmer surface waters of the WNP.

There was no evidence of 'secondary cephalopod contamination' in the stomachs examined, i.e., of cephalopods first being the prey of fish or cephalopods which in turn were eaten by the porpoise.

Cephalopods representing 7 families (Enoploteuthidae, Onychoteuthidae, Gonatidae, Histioteuthidae, Chiroteuthidae, Cranchiidae, and Bolitaenidae) were identified from the examined stomachs. The occurrence of cephalopods, other than Gonatids in the porpoise stomachs was insignificant, comprising only 2% of the total numbers of beaks examined from the stomachs of porpoise taken in all localities.

Thus members of the family Gonatidae contributed significantly to the prey of *P. dalli* in all localities sampled. Most gonatids identified here are inhabitants of the meso- and epipelagic depth zones and many approach the surface at night. Hence they are readily available to Dall's porpoises.

The identification of species in the genus *Gonatus* was based on comparisons of beaks from known voucher specimens in the NMML collection. Differences separating some species are slight and specimens and beaks of all described *Gonatus* and several undescribed species were not available for comparison. It is entirely possible that when more specimens from other species in the genus become available for study, that some changes in species designation and percent of total sample may occur in this group.

*G. borealis* was identified in 85 of the 100 stomachs examined, ranking first in occurrence and in total count of all beaks examined. Both *B. magister* and *B. anonychus* are probably underrepresented in the samples for reasons mentioned in the results section; however, adult *B. magister*, most of which leave the epipelagic zone at a relatively early age (small size), are probably not readily available to Dall's porpoises.

*Abraliopsis* and *Onychoteuthis* were only identified in the stomachs from the WNP. These two genera do not normally occur north of the subArctic water boundary. The genera, *Histioteuthis*, *Chiroteuthis*, *Galiteuthis* and *Japetella* probably represent only opportunistic prey in the four localities. *Taonius*, which was found in 20 stomachs, from all localities, may occur in sufficient numbers in the upper mesopelagic and epipelagic zones to form a regular part of the Dall's porpoise diet.

Kuramochi *et al.* (1993) reported on the stomach contents of 32 *dalli*-type porpoises taken from the same areas in 1984-85. They report many of the same genera listed here.

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