

Review of data available on the Dall's porpoise (*Phocoenoides dalli*) in Japanese waters

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Abstract

Large-scale hand harpoon hunts have targeted Dall's porpoise (*Phocoenoides dalli*) populations in Japanese waters for almost 100 years. In just 50 years (1963-2010), more than half a million (594,028) Dall's porpoise have been removed from these populations. Although 2007-2011 has seen progressive quota reductions, catch limits remain at unsustainable levels according to methods used to evaluate levels of anthropogenic mortality in other regions of the world. Recent catches have failed to fill even the reduced quotas. This report reviews historical catch and quota data and the information currently available on the status of exploited stocks. The abundance and stock structure of the exploited populations' remains poorly understood, with abundance estimates now ten years old. In the face of this uncertainty the authors make a number of recommendations towards implementation of a scientific and precautionary management system.

Distribution and abundance

Dall's porpoises are restricted in distribution to the subarctic waters of the North Pacific Ocean and adjacent seas (Bering and Okhotsk Seas, and Sea of Japan) (Hammond et al., 2008). Two geographically segregated colour morphs occur, known as the *dalli*-type and *truei*-type colour morphs, distinguished by the size of their white flank patch. Eight breeding stocks have been identified, at least three of which are targeted by Japan's harpoon hunts (IWC, 2001a). These three stocks comprise one *truei*-type stock that breeds in the Central Okhotsk Sea, a *dalli*-type stock that breeds in the Southern Okhotsk Sea and a third of unknown identity. The *truei* and *dalli*-type porpoises forming the majority of the catch are thought to originate from the Central and Southern Okhotsk sea stocks, respectively (IWC, 2001a; Fisheries Research Agency, 2012).

The hunt for *truei*-type porpoise occurs in winter off the Pacific coast of the Sanriku region, targeting a stock that migrates past the Kuril Islands and along the east coast of Hokkaido from its breeding ground in the central Okhotsk Sea to wintering grounds in the Pacific Ocean off the coast of Japan (Wade et al., 2008; Fisheries Research Agency, 2012). Summer hunts largely target a *dalli*-type porpoise stock which migrates from wintering grounds in the Sea of Japan to breed in the southern Okhotsk Sea and off the Pacific coast of Hokkaido (Wade et al., 2008; Fisheries Research Agency, 2012). A third stock from the northern Okhotsk Sea may also be hunted in the winter hunts when it migrates along the west coast of Kamchatka, past the Kuril Islands, and possibly into the offshore Pacific Ocean, where it may intermingle with *truei*-type porpoises off the coast of Hokkaido (Amano & Hayano, 2007).

In 2007 abundance estimates for the Dall's porpoise populations in Japanese waters were made available, based on 2003 survey data (IWC, 2008; Miyashita et al., 2007). The *dalli*-type was estimated at 173,638 (CV=0.21) individuals and the *truei*-type at 178,157 (CV=0.23) (Miyashita et al., 2007), a 23% and 18% decrease from previous estimates published in 1991 of 226,000 and 217,000 respectively which were based on survey data from 1989-1990 (Miyashita, 1991; IWC, 2008). Both the most recent and earlier estimates have been subject to criticism, the estimate published in 1991 for failing to take into account potential bias due to response of animals to survey vessels and the more recent 2007 estimate due to the extrapolation of density and abundance into un-surveyed areas based on survey data from 1989-1990 and other old data (Hammond et al., 2008; IWC, 2008; IWC, 2009).

Hunts

There is a long history of hand harpoon hunts in Japan and the Dall's porpoise has long formed the dominant component of small cetacean captures in Japanese waters, accounting for ~ 80% of the catches from all types of small cetacean hunts from 1979-2010 (Kasuya, 2007).

Large-scale hunting of Dall's porpoise commenced in the 1920s in Iwate Prefecture, occurring off the north-east Pacific (Sanriku) coast of Japan (Kasuya, 2007). There was a brief expansion in hunts before and after World War II when villages on the Sea of Japan and southern Okhotsk Sea coast also conducted hunts but they subsequently retracted back to the Pacific coast, operating from Iwate, Miyagi, Chiba and Wakayama prefectures (Kasuya, 2007). Catches remained below 10,000 per year until the 1980s, when the hunt's geographic range expanded for a second time, likely due to a declining whale meat supply following the cessation of Japan's commercial whaling and declining catches from the drive hunts due to over-hunting of striped dolphins (Kasuya, 2007). Hunters began to make longer excursions to the waters of other prefectures, the operating season was extended and kills peaked in 1988, with the removal of over 40,000 Dall's porpoises in a single year (Kasuya, 2007; see Appendix 1, Table 1). Vessels now operate from the northern prefectures of Hokkaido, Iwate, Miyagi and Aomori prefecture, with those from Iwate taking 90% of the total catch (see Table 1; Fisheries Research Agency, 2012). As well as providing meat for human consumption, Dall's porpoise were traditionally used for animal feed and it is unclear whether this continues (Fisheries Research Agency, 2012).

In response to the huge increase in the catch in 1988, the IWC passed a Resolution stating its concern (IWC, 1990), prompting the Japanese government to introduce regulations that resulted in a drop in catch to 29,048 porpoises (see Appendix 1, Table 1). Japan also stated in 1990 that it would take measures to gradually reduce the catch towards the average level of previous years (approximately 10,000 animals) (IWC, 1991a). However in 1993 when quotas for the two populations were introduced for the first time, a catch quota of more than 17,000 Dall's porpoise was set, based on the new abundance estimates.

Catch limits

The catch limits for the Dall's porpoise introduced in 1993 were based on an annual Allowable Biological Catch (ABC) of approximately 4% of the 1991 abundance estimate of 226,000 *dalli* and 217,000 *truei* type porpoises (Miyashita, 1991), permitting an annual catch of 9,000 *dalli* type and 8,700 *truei* type (Wade *et al.*, 2008; Fisheries Research Agency, 2012). They remained set at this level until 2007 when they were reduced to 8,708 and 8,168 for the *dalli* and *truei* type respectively (see Figure 1 and 2). Quotas have since been gradually reduced each year and in 2012-13 stand at 7,147 for the *dalli* type and 6,908 for the *truei* type porpoise, a reduction of 20.6% in each from their 1993 levels (see Table 1 and Figures 1 and 2).

Table 1: Quotas for Dall's porpoise for 2012-13 by prefecture (National Research Institute of Far Seas Fisheries, 2011; Elsa Nature Conservancy, 2013).

Prefecture	Number of operational months in 2010 (dates)	Number of vessels	Dall's porpoise (<i>dalli</i>)	Dall's porpoise (<i>truei</i>)
Hokkaido	4.5 (1 st May – 15 th June and 1 st Aug - 31 st Oct)	16	1,192	83
Aomori	6 (1 st Jan – 30 th April and 1 st Nov – 31 st Dec)	8	8	
Iwate		196	5,726	6,611
Miyagi		7	221	214
Total			7,147	6,908

Figure 1: Catches of *dalli*-type Dall's porpoise between 1989 and 2010, as reported in Japan's progress reports (National Research Institute of Far Seas Fisheries, 1989-2010).

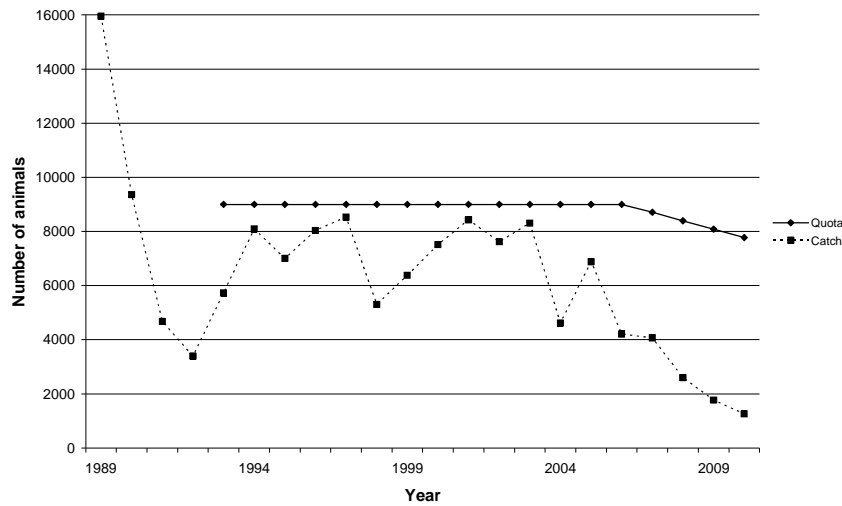
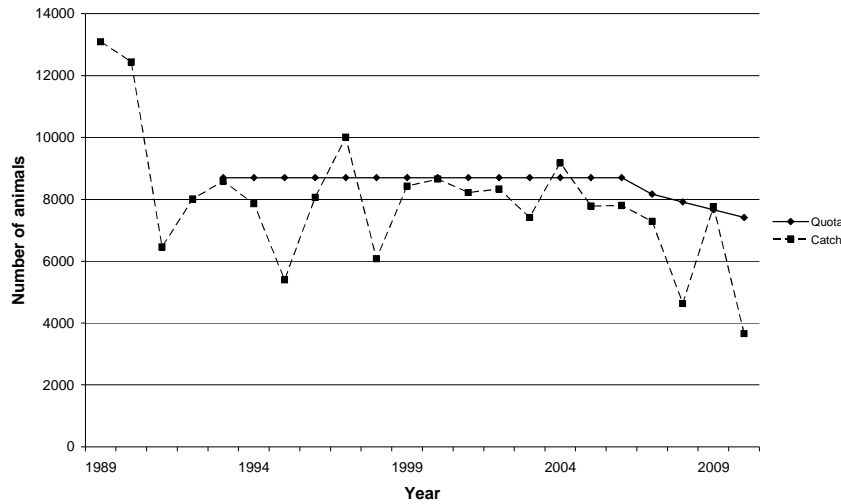


Figure 2: Catches of *truei*-type Dall's porpoise between 1989 and 2010, as reported in Japan's progress reports (National Research Institute of Far Seas Fisheries, 1989-2010).



N. B. Although catches appear to exceed the quota in two years (1997 and 2004), this is due to differences in the reporting (calendar year) and management (seasonal catch) schedules (National Research Institute of Far Sea Fisheries, 2008). In 2010 catches of the *truei* form exceeded the quota in Miyagi prefecture but this was permitted due to an inter-prefecture arrangement allowing Miyagi to use Iwate's catch allowance (Fisheries Research Agency, 2012).

In 2008 a paper submitted to the IWC Scientific Committee demonstrated that if assumptions on population growth rates are correct, allowing a catch of $>4\%$ will cause the population to decline to levels approaching zero, and will prevent future recovery (Wade et al., 2008). At this time quotas were set just below 4% of the abundance estimate published in 1991 but equated to 5% (*dalli*-type) and 4.6% (*truei*-type) of the abundance estimates published in 2007. The study demonstrated that the average catch from 2002-2006 was 1.8 (*dalli*-type) and 2.3 (*truei*-type) times higher than the largest thresholds used to manage cetacean populations in other regions of the world and more than four times higher than the 'robust' Potential Biological Removal (PBR) threshold for both forms (with a recovery factor of 0.5) (Wade et al., 2008). The PBR threshold is designed to prevent populations from declining below their maximum net productivity level (Wade et al., 2008). Despite small reductions, quotas for the 2012/13 hunting season are still 4.8 and 4.7 times higher than the PBR threshold (with a recovery factor of 0.5) for the *dalli* and *truei*-type Dall's porpoises respectively (Appendix 1, Table 2). Although recent catches have not filled these quotas, average catches (2006-2010) remain 1.9 (*dalli*) and 4.2 (*truei*) times higher than the PBR threshold. Current quotas equate to 3.9% (*truei*-type) and 4.1% (*dalli*-type) of the 2007 abundance estimates (Appendix 1, Table 2).

Unlike most modern management systems, the ABC calculation fails to take into account levels of mortality from bycatch or other incidental takes, the effects of the age and sex structure of directed catches or to calculate or report catches on a stock-by-stock basis. In the past bycatch rates have been significant - likely killing tens of thousands of Dall's porpoises in the 1970s and 1980s (Hammond *et al.*, 2008).

Japanese government scientists have fully recognised the inadequacy of their management approach. A simulation study carried out in 2008 demonstrated that "... the current management procedure, based on only the best values, could fail to manage the stocks at a **considerably high probability**" (Okamura *et al.*, 2008). According to the Fisheries Agency, since 2007 the 'concept' of the PBR has been introduced and catch limits have been gradually reduced, however the details of the calculations have not been made public and the quotas are much higher than would be calculated under a PBR threshold. In its most recent annual resource assessment report, the Fisheries Agency states that it is seeking a resource management model that takes into account the species' ecology and stock levels, as well as the special characteristics of the industry (Fisheries Research Agency, 2012).

Trends in catches

Since the 1980s catches of Dall's porpoises have declined steeply and continued to fall after the introduction of catch limits for this species (see Figures 1 and 2). In 1999, fishermen reported an increased difficulty in filling the quota for Dall's porpoise (EIA, 1999). By 2010, catches have fallen by 58% (*truei*-type) and 70% (*dalli*-type) compared to those in 2000 (Appendix 1, Table 1). The decline in the catch of the *dalli* form is particularly marked, it has not filled the quota in any year since being established and has fallen from catches of 71-94% of the quota between 1999 and 2003, to consistently less than 50% since 2006, reaching an all time low in 2010 at 16% of the allowed quota (see Figure 1). In comparison, catches of the *truei* form have remained relatively high, although these also fell to their lowest in 2010, when only 49% of the quota was taken (see Figure 2). Without data on catch per unit effort, it is not possible to determine whether the drop in catches reflects a decline in effort due to declining demand, a decline in attainable catch due to stock decline or a combination of the two.

Trends in catch composition have indicated an increase in the proportion of mature and lactating females being caught in the Sea of Japan (Perry, 1999). Whether this is due to a decline in the availability of males and non-lactating females is not clear. Alternatively it may represent a change in hunting strategy to target mother-calf pairs because of a decreased occurrence of porpoises coming to the bow (IWC, 2000). This removal of mature lactating females further reduces the recruitment potential of the population and at the same time likely results in the mortality of dependent calves. Given the evidence of female philopatry it additionally poses the risk of localised depletion (IWC, 2000).

Hunts ceased after the Great East Japan Earthquake and tsunami in 2011, recommencing at a low level in March 2012 (Perry, 2011; EIA, 2012). Catch data for 2011-2013 have not yet been reported by the National Research Institute of Far Sea Fisheries but landings for Iwate (which holds 80% of the quote for *dalli*-type and 96% of the quota for *truei*-type) are published online. According to the Iwate Prefecture's Fisheries website (accessed 28th May 2013) a total of 153,880.3kg of Dall's porpoise were landed in 2011 (prior to the 11th March tsunami), 15,651kg in 2012 and to date 95,088kg has been landed in 2013 (accessed 28th May 2013). Based on the dates of the landings, this catch likely entirely comprises *truei*-type, with no *dalli*-type landed in Iwate in 2011 or 2012. With much of the infrastructure destroyed, it remains to be seen whether the full-scale hunt will resume. Data for Iwate indicate a decline in the average value of landed meat from 1995-2013, falling from an average of 720 yen per kg in 1994 to 220 yen per kg in 2013.

Other anthropogenic mortalities and impacts

While historic catch levels have been alarmingly high and likely significantly exceeded sustainable levels (IWC, 1991b, 2001a, 2008) these published data have also historically significantly under-reported actual mortalities (Kasuya, 1992; Kasuya 2007). Incomplete collation of records, under-reporting, inaccurate calculation of catches from weight of meat landed and a failure to take into account struck and lost takes, is estimated to have led to under-reporting of mortalities by up to 11,000 animals per year (Kasuya, 1992; Kasuya 2007). As an example of the disparity between reported and actual catches, in 1991 and 1992 the number of Dall's porpoises observed landed at

only a single market in Otsuchi exceeded the total catch reported by the Government of Japan for all locations (IWC, 2002). Although under-reporting is unlikely to have continued in recent years, it is essential that actual catch levels in the past are taken into account in order to develop reliable management advice on sustainable levels of exploitation.

Struck and lost rates continue to not be published or, to our knowledge, taken into account. Based on studies from 1989-1992 struck and lost rates are relatively high, with estimated mean rates of 5.0% (in the Pacific, off Sanriku) to 10.5% (Sea of Japan) in the hand harpoon hunt (Fujise et al., 1993). Total fishing mortality would therefore be 1.1-1.14 times higher than the catches landed. However no recent studies exist, therefore current struck and lost rates, which depend chiefly upon the skill of the harpooner, are not known. What is clear is that these deaths are not included in reported catches, making mortalities appear lower than they are (Fujise et al., 1993).

In addition to hunt mortalities, incidental fisheries bycatch has, at least historically, been a major cause of mortality in Dall's porpoise populations in the North Pacific. Between the 1950s and 1990s Dall's porpoise were killed in large numbers by high-seas driftnet fisheries in the central and western North Pacific (Hammond et al., 2008). It was estimated that these fisheries killed 4,000 porpoises per year in the North Pacific until a UN moratorium banned driftnets in 1993 (Hammond et al., 2008). Although these may have removed animals from different populations to those targeted by the hand harpoon hunts, this warrants further investigation (Wade et al., 2008). Progress reports detail low levels of reported bycatch in recent years.

Overfishing may also threaten the Japanese Dall's porpoise populations. In the 1980s Japanese sardine stocks collapsed and the Dall's porpoise switched to feeding on pollock (Fisheries Research Agency, 2012). However, pollock also appear to be in decline, providing a further threat.

Management of hunts

A number of issues have been previously identified in relation to the management of hunts. These include:

1. A lack of transparency regarding methods used to set catch quotas:
 Quotas for Dall's porpoise are known to be calculated based on abundance estimates (Fisheries Research Agency, 2012c). However, the calculations currently being used remain unclear. According to the Fisheries Agency, since 2007 the 'concept' of the PBR has been introduced and catch limits have been gradually reduced, however the details of the calculations have not been made public.
2. Quotas are set considerably above likely sustainable levels when compared to a PBR threshold (see Appendix 1, Table 2).
 Average catches (2006-2010) are 1.9 (*dalli*) and 4.2 (*truei*) times higher than the PBR threshold, even assuming only moderate exploitation and no other sources of anthropogenic mortality (Wade *et al.*, 2008).
3. Abundance estimates have not been regularly updated.
 Assessments of the abundance of the targeted populations are now ten years old. Published guidelines for assessing marine mammal stocks advise that population assessments should be updated at least every 8 years and that in the absence of this, thereafter, the minimum population estimate for a stock should be decreased by 10 % per year, applied retroactively from the time of the last survey (Moore & Merrick, 2011). Particularly given the concerns raised regarding previous estimates, up to date abundance estimates and further data on stock structure of the populations exploited by Japan's hunts are urgently needed.
4. Lack of regulation and enforcement of quotas:
 Regulation of the hand harpoon is delegated to governors in each relevant prefecture. Independent observers investigating the Dall's porpoise hunt have found a lack of enforcement or oversight of the hunt. Fisheries cooperatives report catches to the prefectural authorities based on hunters' landing slips. The prefecture does not inspect the

catch and there is no monitoring of other ports (of which there are many) to ensure that porpoises are not being landed and distributed outside the official system (EIA, 2000).

5. Incomplete reporting:

Historically there have been problems with under-reporting of catches due to incomplete collation of records and use of incorrect conversion factors (Kasuya, 1992). Although such under-reporting is unlikely to have continued in recent years, reported catches still fail to take into account struck and lost animals, which in the Dall's porpoise hand harpoon hunt, have previously been estimated to result in a total mortality 1.1-1.14 times (i.e. 10-14%) higher than the number landed (Fujise *et al.*, 1993).

Conclusions

Declines in catches and changes in catch composition may signal localised depletion of exploited stocks of Dall's porpoise. However, without data on catch per unit effort, it is not possible to determine whether the drop in catches does reflect a decline in attainable catch due to population decline, a decrease in effort due to declining demand or a combination of the two. Despite long-standing concerns regarding the sustainability of catches (e.g. IWC 1984, 1991b; 1999a, 2001a, 2008), catch limits have seen only a 21% reduction from 2005 to 2011 while average catches (2006-2010) of both forms combined have fallen by 61% (*dalli*) and 24% (*truei*) respectively compared to 2000-2005 levels (see Figure 1 and 2). Quotas remain set above likely sustainable levels according to methods used to evaluate levels of anthropogenic mortality in other regions of the world (Wade *et al.*, 2008; Appendix 1, Table 2). The IWC Scientific Committee has made repeated calls for catch limits to be reduced to sustainable levels (IWC 1984, 1991b; 1999a, 2001a, 2008) and to revise the management system (IWC, 1999), but more than 20 years on this has not occurred.

Three Resolutions from the IWC have called for action on these issues, urging Japan to reduce catches to sustainable levels (IWC, 1990; IWC, 1999b) or stop the hunt altogether (IWC 2001b). To better determine the status of Japan's stocks the IWC's Scientific Committee has recommended that "a complete survey of the ranges of the populations be undertaken as soon as feasible and that sightings data on Dall's porpoises collected during whale surveys be incorporated into a new assessment" (IWC, 2008). Furthermore the Scientific Committee has recommended that "bycatch levels be quantified and that a full assessment of each of the affected populations be conducted as soon as possible" (IWC, 2008). This has yet to be undertaken.

An up-to-date assessment of the status of Dall's porpoise populations and the development of a scientific management approach which takes into account the multiple anthropogenic and environmental threats these populations are facing and their inherent capacity to recover is urgently required. With this in mind, the following recommendations are made with regards to reforming the management of hand harpoon hunts for Dall's porpoise in Japan:

- Respond to IWC requests and immediately suspend hunts until up-to-date population assessments have been conducted;
- Conduct an up-to-date assessment of the status of all populations targeted by the hand harpoon hunts, including studies of population and social structure and life-history characteristics;
- Verify and publish factors for converting weight of meat landed into the number of animals killed for *dalli* and *truei*-type, or require all carcasses to be landed whole;
- Reform the management strategy to bring it in line with modern international conservative management strategies that take into account other mortalities such as struck-and-lost individuals, bycatch and other environmental/anthropogenic threats, and which are based upon rigorous, up to date population assessments and knowledge of intrinsic recovery rates. Catch levels should be both sustainable and allow for population recovery;

- Introduce independent observation of landed catches and collect and publish data on struck and lost rates, catch per unit effort, stock identity and sex and age composition of catches; and
- Establish and enforce time and area restrictions on hunts in order to protect the species during sensitive breeding and calving periods.

Appendix 1

Table 1: Catch statistics for 1963-2010.

Year	Dall's porpoise	Dall's porpoise (<i>dalli</i>)	Dall's porpoise (<i>truei</i>)
1963	9,040		
1964	9,440		
1965	9,180		
1966	7,980		
1967	5,150		
1968	6,020		
1969	7,020		
1970	8,060		
1971	5,210		
1972	5,190		
1973	7,230		
1974	6,470		
1975	7,350		
1976	9,899		
1977	9,358		
1978	8,426		
1979	6,872		
1980	6,718		
1981	9,803		
1982	12,833		
1983	12,776		
1984	9,764		
1985	10,378		
1986	16,515		
1987	25,600		
1988	40,367		
1989	29,048	15,953	13,095
1990	21,802	9,360	12,442
1991	17,634	4,671	6,457
1992	11,403	3,394	8,009
1993	14,318	5,731	8,587
1994	15,947	8,093	7,854
1995	12,396	7,002	5,394
1996	16,100	8,038	8,062
1997	18,540	8,533	10,007
1998	11,385	5,303	6,082
1999	14,807	6,379	8,428
2000	16,171	7,513	8,658
2001	16,650	8,430	8,220
2002	15,949	7,614	8,335
2003	15,720	8,308	7,412
2004	13,789	4,614	9,175
2005	14,664	6,880	7,784
2006	12,014	4,212	7,802
2007	11,357	4,070	7,287
2008	7,226	2,594	4,632
2009	9,540	1,773	7,767
2010	4,919	1,256	3,663
Grand Total	594,028	139,721	175,152

Data are derived from National Research Institute of Far Sea Fisheries (1979-2010) and Kasuya (1978). Blank cells indicate years when data are not available.

Table 2: Recent quotas and catches in relation to abundance data and PBR thresholds.

Species	Estimated abundance (CV)	Survey period	Reference	Area surveyed	Catch limit (2012-2013)	Average catch (2006-2010)	PBR threshold (0.5) (Wade <i>et al.</i> , 2008)	Catch limit/PBR	Average catch (2006-2010)/PBR	Catch limit as a % of abundance	Average catch (2006-2010) as a % of abundance
<i>Phocoenoides dalli (truei)</i>	217,000 (CV=0.227)	1989-1990	Miyashita, 1991	40°N-51°N, 140°E-170°E	6,908	6,230	-	-	-	3.2%	-
	178,157 (CV=0.23)	2003	Miyashita <i>et al.</i> , 2007	Central Okhotsk Sea			1,472	4.7	4.2	3.9%	3.5%
<i>Phocoenoides dalli (dalli)</i>	226,000 (CV=0.154)	1989-1990	Miyashita, 1991	40°N-51°N, 140°E-170°E	7,147	2781	-	-	-	3.2%	-
	173,638 (CV=0.21)	2003	Miyashita <i>et al.</i> , 2007	Southern Okhotsk Sea			1,483	4.8	1.9	4.1%	1.6%

N.B. The 2012-2013 quota and average catch (2006-2010) is given as a percentage of the most recent abundance estimate for each stock (Miyashita *et al.*, 2007).

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