SC/F16/JR/15

# Updated estimation of prey consumption by common minke, Brydes and sei whales in the western North Pacific

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INTERNATIONAL WHALING COMMISSION

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ABSTRACT

The stomach contents of common minke (*Balaenoptera acutorostrata*), Bryde's (*B. edeni*) and sei (*B borealis*) whales, sampled in the western North Pacific from May to October in 2000-2014 by the Japanese Whale Research Program under Special Permit in the western North Pacific (JARPNII) were collected and examined. The main purpose of this study was to estimate the amount of fish resources consumed by the three baleen whale species, accounting for some uncertainties. Prey species of whales were identified by examining their stomach contents, and the amount of prey consumed in the research area was estimated by using information on prey consumption *per capita* and the numbers of whales distributed. There were seasonal and geographical changes of the prey species of each whale species. The extent of differences of estimates of consumptions among several models was 2.4-3.6 times. Based on the results obtained by three equations combined and Monte Carlo simulations, the daily prey consumptions *per capita* of common minke whales were 86-94kg and 83-94kg for immature male and female; and 129-141kg and 158-166kg for mature male and female, respectively. The daily prey consumptions *per capita* of Bryde's whales were 419-434kg and 417-428kg for immature male and female; and 577-637kg and 642-707kg for mature male and female, respectively. The daily prey consumptions *per capita* of sei whales were 397-421kg and 436-468kg for immature male and female; and 524-539kg and 610-647kg for mature male and female, respectively. The CVs of the daily prey consumption consumed by whales *per capita* were in the range 0.2-0.3. The seasonal prey consumption during May-September in the two periods (2000-2007, 2008-2013) by three baleen whale species were 1.1 and 1.2 million tons, respectively. The prey consumption of Japanese anchovy, mackerels and Pacific saury by three baleen whale species in the two periods were estimated as 674-724 thousand tons, 43-70 thousand tons and 48-56 thousand tons, respectively. The CVs of the seasonal prey consumption consumed by whales were in the range 0.3-0.4. These values were equivalent to 22-48%, 5-66% and 2-7% of the biomass of each fish resources in the western North Pacific. These estimates on prey consumption will be useful as input data in ecosystem models.

KEYWORDS: COMMON MINKE WHALE; BRYDE'S WHALE, SEI WHALE, NORTH PACIFIC; SCIENTIFIC PERMIT

## INTRODUCTION

Baleen whales feed on a variety of prey from small zooplankton to fish, playing an important role in the food web in the western North Pacific because of their large biomass. The Second Phase of Japanese Whale Research Program in the Western North Pacific (JARPNII) conducted samplings of baleen whale species such as common minke (*Balaenoptera acutorostrata*), Bryde's (*B. edeni*) and sei (*B. borealis*) whales that abundantly occur off the coast of Japan, and are important components of the ecosystem in their feeding grounds.

Although these three baleen whale species occur in the JARPNII research area, their feeding habits and distribution differ. Common minke whale feed on zooplankton and large sized fish and squids such as Pacific saury (*Cololabis saira*), mackerels (*Scomber japonicus*, *S. australasicus*), walleye pollock (*Gadus chalcogrammus*) and Japanese common squid (*Todarodes pacificus*) involving a wide range of prey size (Kasamatsu and Hata, 1985; Kasamatsu and Tanaka, 1992). The information on feeding habitat in the Bryde's whales was available from the commercial whaling period, and showed that krill, Japanese anchovy (*Engraulis japonicus*), Chub mackerel (*Scomber japonicus*), Japanese sardine (*Sardinops melanostictus*), and horse mackerel (*Trachurus japonicus*) were preys of this whale species in the western North Pacific (Nemoto, 1959). The sei whale is known to feed on a wide spectrum of marine animals such as krill, Japanese anchovy, chub mackerel, Pacific saury and Japanese common squid. According to Nemoto (1962), sei whales feed mainly copepods in the northern part of the North Pacific, but they likely feed on fishes and squids off the Pacific coast of northern Japan. In the southern Aleutian waters, Pacific saury was also reported as important prey for sei whales (Nemoto, 1959; Kawamura, 1982).

It should be noted that for previous studies based on commercial whaling, only qualitative information of stomach contents was available, and the quantitative information was very limited. This was due to the fact that the stomachs were usually cut in breaking the abdominal cavity to keep meat fresh.

The Japanese Whale Research Program under Special Permit in the western North Pacific (JARPN) was conducted between 1994 and 1999. JARPN had two main objectives: a) population structure and b) feeding ecology of common minke whales in the western North Pacific. During JARPN surveys, qualitative and quantitative data on prey consumption of common minke whales in the western North Pacific were obtained. Results of some feeding ecology studies on common minke whales based on JARPN are available (Tamura, 1998; Tamura *et al.*, 1998; Tamura and Fujise, 2002; Lindstrom *et al.*, 1998).

Based on results of JARPN review, it was proposed that JARPN be continued and developed to a second phase: JARPNII (Government of Japan, 2000, 2002). The first objective of JARPNII is feeding ecology issues. The overall goal of the JARPNII was to contribute to the conservation and sustainable use of marine living resources including whales in the western North Pacific, especially within Japan's EEZ.

In 2009, the JARPNII review workshop was conducted by IWC/SC (IWC, 2010). Results on prey consumption by common minke, Bryde's and sei whales were presented (Tamura *et al*, 2009a, b). Regarding the prey consumption rate estimates presented (Tamura *et al*., 2009a, b, c), one of the major concern of the workshop was related to the lack of full treatment of uncertainty. As part of the treatment of uncertainty the workshop recommended that the analyses of the JARPNII data should: (a) incorporate the use of several reasonable models and include the range of possible results in reporting the work; (b) use that range in subsequent analyses (including any ecosystem modelling) that employ these daily/annual consumption estimates and (c) undertake sensitivity analyses for the range of parameter values used in the consumption equations (IWC, 2010).

The purpose of this study was to update the estimates of prey consumption by common minke, Bryde's and sei whales by taking into consideration the recommendations from the 2009 JARPNII review workshop, accounting for some uncertainties.

## MATERIALS AND METHODS

### Research area, year and sample size

The research area of the JARPNII comprised part of sub-areas 7, 8 and 9 (IWC, 1994) (Figure 1). A total of 1,480 minke whales, 680 Bryde's, and 1,195 sei whales were examined in this study (Table 1). After sampling, whales were brought to the research base vessel where the animals were examined by a biologist on board. All whales were sampled during daylight hours, between 06:00 and 19:00h (ship time).

### Sampling and treatment of stomach contents from whales

Baleen whales have four chambered stomach systems (Hosokawa and Kamiya, 1971; Olsen *et al*., 1994). The stomach contents remain in the forestomach (1st. stomach) and fundus (2nd. stomach).

The stomach contents were removed from each compartments and weighed to the nearest 0.1kg on the ship's flensing deck after capture. The analysis of prey consumption in this study was based on data collected from the first compartment (forestomach) and second compartment (fundus). A sub-sample (1-5kg) of stomach contents was removed and frozen and/or fixed with 10% formalin water for later analyses. The stomach contents were transferred to a system consisting of three sieves (20mm, 5mm and 1mm), which were applied in the Norwegian scientific research to filter off liquid from the rest of the material (Haug *et al.* 1995).

To examine the daily feeding rhythms of the whales, the freshness of prey in the forestomach was categorized into four digestion levels:

F = fresh (prey not affected by digestion),

fff = lightly digested (prey slightly affected by digestion),

ff = moderately digested (prey moderately to highly fragmented), and

f = heavily digested (unidentifiable remains or indigestible parts only).

### Data analyses

*Biological data*

An estimate of the daily prey consumption requires the use of some additional biological and morphometric data. Body length of the whales was measured to the nearest 1cm from the tip of the upper jaw to the deepest part of the fluke notch in a straight line. Body weight was measured using large weighing machine to the nearest 50kg. Energy requirements are different for sexual maturity classes; therefore, estimations of the daily prey consumption in this study took into consideration information on sexual maturity. Sexual maturity of each whale was defined by testis weight and ovaries observation.

*Prey species identification and stomach contents weight*

In the laboratory prey species in the sub-samples were identified to the lowest taxonomic level as possible. Undigested preys were identified using morphological characteristic, based on different sources: copepods (Brodskii, 1950), euphausiacea (Baker *et al*., 1990), squids (Kubodera and Furuhashi, 1987) and fish (Masuda *et al*., 1988; Chihara and Murano, 1997). The otoliths and jaw plate were used to identify the fish with advanced stage of digestion (Morrow, 1979; Ohe, 1984; Kubodera and Furuhashi, 1987; Arai, 1993).

When undigested fish and squid were found, fork length, mantle length and the weights were measured to the nearest 1mm and 1g, respectively. This data were used for restoring their stomach contents with advanced stage of digestion.

The total number of each fish and squid species in the sub-sample were calculated by adding to the number of undigested fish or squid, undigested skulls and half the total number of free otoliths. The total weight of each prey species in the sub-sample was estimated by multiplying the average weight of fresh specimens by the number of individuals. The total number and weight of each prey species in the stomach contents were estimated by using the figures obtained from the sub-sample and the total weight of stomach contents.

*Prey composition (W %) in each season and period*

In order to simplify the comparison of feeding indices, prey species were divided as follow: copepods (*Neocalanus cristatus*, *N. plumchrus*, *Calanus* sp.), krill (*Euphausia pacifica*, *E. similes*, *E. gibboides*, *Thysanoessa gregaria*, *Nematoscelis difficilis*), Japanese anchovy, Japanese sardine (*Sardinops melanostictus*), Pacific saury, walleye pollock, Mackerels, oceanic lightfishes (*Vinciguerria nimbaria; Maurolicus japonicus*), other squids (Japanese common squid, minimal armhook squid (*Berryteuthis anonychus*), and others) and other fishes (Japanese pomfret (*Brama japonica*), Atka mackerel (*Pleurogrammus monopterygius*), Salmonidae).

The relative prey composition (*%*) in weight of each prey species (*RW*) in each season and period was calculated as follows:

$RW = (W_i / W_{all}) \times 100$

$W_i$ = the weight of contents containing prey group *i*

$W_{all}$ = the total weight of contents analyzed.

*Estimation of daily and seasonal prey consumption in each whale species*

Daily prey consumption

The amount of prey consumption consumed by three baleen whale species is estimated using theoretical energy requirement calculations. The uncertainties associated to the relevant parameters were treated by Monte Carlo simulations.

The daily prey consumption ($D_{kg}$) in each sexual maturity class was estimated from the standard metabolic rate ($SMR_{kJ}$) and energy deposit according to the following equations:

$D_{kg} = SMR_{kJ} / (E_{KJ} * AE)$ (1)

Where $D_{kg}$ is daily prey consumption (kg day$^{-1}$), $SMR_{kJ}$ is the standard metabolic rate (kJ day$^{-1}$), $E_{kJ}$ is the caloric value of prey species (kJ kg$^{-1}$), and *AE* is Assimilation efficiency (%).The details of these items are described as follows:

*SMR* (STANDARD METABOLIC RATE, ALLOMETRIC RELATIONSHIPS)

The uncertainty in several components involved in estimating the amounts and types of prey consumed by whales was assisted by a recent review by Leaper and Lavigne (2007) and Tamura *et al.* (2009c). They considered that the appropriate consumption estimates is between the high end of Equation 1 and the low end of Equation 2. The estimate of consumption by Equation 3 was considered by the authors at the upper range of these reasonable values. Equation 4 is used by PICES for estimating prey consumption of marine mammals (Hunt *et al*., 2000).

Equation 1: $BMR = 0.42\ M^{0.67}$ (Innes *et al*., 1986) (2)

Equation 2: $SMR = 2{,}529.2\ M^{0.524}$ (Boyd, 2002) (3)

Equation 3: $SMR = 863.6M^{0.783}$ (Sigurjónsson and Víkingsson, 1997) (4)

Equation 3-1: $SMR = 690.36M^{0.783}$ (Revised from Sigurjónsson and Víkingsson, 1997) (5)

Equation 4: $SMR = 803.71M^{0.75}$ (Perez *et al*, 1990) (6)

*SMR* is the daily prey consumption (expressed by KJ day$^{-1}$) and *M* is body mass in kg. It should be noted here that the estimates from Equation 1 depend only on the body weight data (expressed in kg). The estimates from Equations 2, 3 and 4 require body weight data (expressed in kg) and energy content of prey (expressed in KJ kg$^{-1}$). Equation 3.1 excluded an *AE* value of 80% from Equation 3. In this study, three equations (Equations 2, 3-1 and 4) were used in the sensitivity analysis with 10,000 Monte Carlo simulations using the electronic software package (Oracle ® Crystal Ball: Release 11.1.2.3.). The details of these parameters are described as follows:

The mean, minimum and maximum body weight were calculated for each sexual maturity stage. These weights were obtained from JARPN and JARPNII survey. Body weight of each whale species sampled in each season was shown in Table 2. The body weight distribution in each sexual maturity assumed a triangular distribution with minimum, maximum and average values.

The mean caloric value of copepod (*Neocalanus cristatus, N. plumchrus*), krill (*Eupahusia pacifica*), Japanese sand lance, Japanese anchovy, Japanese sardine, Pacific saury, Chub mackerel, walleye pollock, oceanic lightfishes and Japanese common squid, mesopelagic squids (*Taningia danae, Histioteuthis dofleini*, *Belonella pacifica borealis*) were measured using bomb caloric meter (Table 3). These samples were obtained from the stomach contents of whales. Prey composition (Weight of %) of whales sampled were calculated in each period and season (Table 4).

The energy contents consumed by whales were calculated based on their prey composition in research area based on Tables 3 and 4 (Table 5). The distribution assumed a triangular distribution with minimum, maximum and average values.

Although an Assimilation Efficiency (*AE*) of 0.8 (80%) is commonly assumed, this value clearly vary with prey condition, size and species. The range of assimilation efficiency was assumed between 0.75 (75%) and 0.85 (85%) and used randomly in the sensitivity analysis. The distribution assumed a uniform distribution between 0.75 and 0.85.

Many baleen whales are generally known to migrate between the feeding ground in high latitudinal waters in summer and the breeding ground in low latitudinal waters in winter. There are some uncertainties, because the ratio of high feeding season and low feeding season (*r*) and the proportion (*P*) of the energy intake per year during high feeding season are assumed without actual data. For example, Lockyer (1981a) indicated that around 83% of the annual energy intake in Southern Hemisphere balaenopterid species is ingested during the summer season. If the days of high feeding season (*HD*) was 120 days and the rest days were low feeding season (*LD*), *r* becomes 0.10. Leaper and Lavigne (2007) was estimated the *r* to be from 0.34 (Antarctic minke whales) to 0.62 (North Atlantic minke whales) based on other literatures.

The *r* was calculated as following:

$$r = (365(1-P)) / (365-HD))/ (365P/HD) \quad (7)$$

*P* is the proportion of amount during high feeding season per annual energy intake assumed.

The daily prey consumption of high feeding season was assumed to be the feeding index of high feeding season (*H index*). If the *HD* was 150days and the proportion of amount during high feeding season per annual energy intake assumed 80% (0.8), *H index* was 1.95. *HF* is the feeding index as a multiplicative factor greater than one. The *H index* was calculated as following:

$$H\ index = 365P / HD \quad (8)$$

The range of *H* index was assumed between 1.42 and 2.74 and used randomly in the sensitivity analysis (Table 6). The distribution assumed a triangular distribution with minimum, maximum and average values (1.95).

Based on this assumption, the daily and seasonal prey consumption of high feeding season was calculated using Equations 2, 3-1, 4 and *H index*.

$$SMR \text{ of high feeding season} = H\ index * SMR \quad (9)$$

THE BODY MASS (*M*) OF EACH SEX AND REPRODUCTIVE STATUS OF WHALES

The composition of maturity stages of whales sampled is shown in Table 7. Males of minke, Bryde's and sei whales were defined as sexually mature by testis weight (larger side) of more than 290g, 560g and 1,090g, respectively (Bando *et al*., unpublished data). Female were defined as sexually mature by the occurrence of at least one corpus luteum or albicans in their ovaries. These criteria are practical ones and confirmed biologically (Bando *et al*, per com.).

The body mass data (< 22,000kg) were obtained directly by using the large electronic weighing system in JARPNII. If the body mass was over 22,000kg, we measured it separately. This method for obtaining the body mass data was evolved one compared with past methods. With regard to the measurement of body mass by sex and reproductive status, there seems to be little uncertainty.

UNCERTAINTIES ON SEASONAL PREY CONSUMPTION IN HIGH FEEDING SEASON

In the Southern Hemisphere, immature animals and mature male of Antarctic minke whale were estimated to spend 90 days in the feeding grounds, mature female spend 120 days (Lockyer, 1981a, b). Hinga (1979) assumed that baleen whales spend 120 days in the Antarctic (feeding area).

If the proportion of the energy intake per year during high feeding season was between 70-90%, the relationship between values of residence days in feeding area and percentage of annual prey consumption is as summarised in Table 6. The range of *H index* in minke, Bryde’s and sei whales were estimated to be 1.95 (Range: 1.70-2.19) during 150 days of feeding (from May to September). These indexes were applied for estimating seasonal consumption of whales in the research area.

Uncertainty of the seasonal estimated numbers distributed of whales in each period and season was treated as following. The number of whales distributed in each region and year was estimated by Hakamada *et al*. (2009) and Hakamada and Matsuoka (2016: SC/F16/JR12) (Table 8). The population of baleen whales is sometimes segregated by sex and reproductive status. For example, mature male of common minke whale distribute dominantly in the research area, especially in offshore area such as sub-areas 8 and 9. The seasonal number of whales distributed (early and late) in each sex, reproductive status in each sub area and year were calculated (Tables 7 and 8).

*Prey species abundance and fisheries catch information*

JAPANESE ANCHOVY

Japanese anchovy is widely distributed in the western North Pacific. Some researches on biomass are conducted by the National Research Institute of Fisheries Science based on surface trawl net and echo sounder (Table 9).

MACKERELS

Mackerels are widely distributed in the western North Pacific. Some researches on biomass are conducted by the National Research Institute of Fisheries Science based on surface trawl net and echo sounder (Table 9).

PACIFIC SAURY

Pacific saury is widely distributed in the western North Pacific. Some researches on biomass are conducted in June and July since 2003 by the Tohoku National Fisheries Research Institute based on surface trawl net (Table 9).

## RESULTS

### Diet of whales in the study area

*Common minke whales*

A total of fourteen preys, including one species of copepod, two of euphausiids, two of squids and nine of fishes were identified in 1,480 stomachs of minke whales (Table 10).

*Bryde's whales*

A total of eighteen preys, including five species of euphausiids, one of squid and twelve of fishes were identified in 680 stomachs of Bryde's whales (Table 10).

*Sei whales*

A total of twelve preys, including three species of copepods, three of euphausiids, one of squid and five of fishes were identified in 1,195 stomachs of sei whales (Table 10).

### Diurnal changes in feeding activity

The composition of freshness categories is shown in Figure 2. This figure shows that the proportion of fresh and lightly digested categories was high (> 37%), and there was no trend throughout the day.

### Stomach contents weight and RSC

The average and maximum weight and the ratio of stomach contents weight to body weight, expressed as a percentage (RSC) of fresh or lightly digested stomach contents (freshness category F and fff) by different reproductive classes are shown in Table 11 by whale species.

*Common minke whales*

The average weights were 27.1kg and 34.9kg for immature males and females, respectively and 48.8kg and 62.1kg for mature males and females, respectively. The average and maximum of RSC in each sexual maturity of whales were around 1% and 3-4%, respectively.

*Bryde's whales*

The average weight and RSC were 106.8kg and 76.4kg for immature males and females, respectively and 118.7kgand 157.6kg for mature males and females, respectively. The average and maximum of RSC in each sexual maturity of whales were around 1% and 3-4%, respectively.

*Sei whales*

The average weight and RSC were 74.2kg and 69.2kg for immature males and females, respectively and 88.4kg and 145.3kg for mature males and females, respectively. The average and maximum of RSC in each sexual maturity of whales were around 0.5% and 3-4%, respectively.

### The size distribution of main prey species consumed by common minke, Bryde's and sei whales

*Japanese anchovy*
The size distributions of Japanese anchovy in the stomach of three baleen whales are shown in Figure 3-1. Minke whale feed on larger anchovies (fork length ranged from 54 to 155mm with a single mode at 120-130mm). Bryde's whale feed on smaller anchovies (fork length ranged from 20 to 153mm with a single mode at 50-75mm).The fork length of Japanese anchovy ingested by sei whales ranged from 24 to 143mm with a single mode at 120mm.

*Mackerels*
The size distributions of mackerels in the stomach of three baleen whales are shown in Figure 3-2. Minke whale fed on the largest mackerels (fork length ranged from 70 to 280mm with a single mode at 240mm).

*Pacific saury*
The size distributions of Pacific saury in the stomach of three baleen whales are shown in Figure 3-3. No Pacific saury was found from the stomach contents of Bryde's whale. There were two modal distributions (standard length: 200-230mm and 300mm) in Pacific saury consumed by minke and sei whales, but minke whale fed on larger Pacific saury.

**The daily prey consumption estimates *per capita* of each sex and reproductive status of each whale species in each model**

The daily prey consumption estimates *per capita* of each sex and reproductive status were shown in Table 12 and Appendix 1, by whale species. The estimates of Eq-3-1 were 2.4-3.6 times larger than the estimates of Eqn. 2. The results of the calculation based on three equations combined were as following (10,000 Monte Carlo simulations).

*Common minke whales*
In early season (May and June), the daily prey consumption *per capita* was 86kg and 83kg for immature males and females, respectively; and 141kg and 166kg for mature males and females, respectively. In late season (From July to September), it was 94kg and 94kg for immature males and females, respectively; and 129kg and 158kg for mature males and females, respectively. The CVs were in the range 0.2-0.3.

*Bryde's whales*
In early season, the daily prey consumption *per capita* was 434kg and 417kg for immature males and females, respectively; and 637kg and 707kg for mature males and females, respectively. In late season, it was 419kg and 428kg for immature males and females, respectively and 577kg and 642kg for mature males and females, respectively. The CVs were in the range 0.2-0.3.

*Sei whales*
In early season, the daily prey consumption *per capita* was 421kg and 468kg for immature males and females, respectively; and 539kg and 647kg for mature males and females, respectively. In late season, it was 397kg and 436kg for immature males and females, respectively and 524kg and 610kg for mature males and females, respectively. The CVs was around 0.2.

**The seasonal prey consumption in each research period**

The seasonal prey consumption estimates were shown in Table 13 and Appendix 1, by whale species. The estimates of Eq-3-1 were 2.4-3.6 times larger than the estimates of Eqn. 2. Estimate of seasonal prey consumption based on three equations combined (10,000 Monte Carlo simulations) during May-September in two periods (2000-2007, 2008-2013) by three baleen whale species were 1.1 and 1.2 million tons, respectively. The prey consumptions of Japanese anchovy, mackerels and Pacific saury by three baleen whale species in the two periods were estimated as 674-724 thousand tons, 43-70 thousand tons and 48-56 thousand tons per year, respectively. The results for each whale species were the following.

*Common minke whales*
The seasonal prey consumptions in the 2000-07 and 2008-2014 periods were 82 thousand tons and 70 thousand tons, respectively. The CVs were around 0.3. They fed mainly on Japanese anchovy and Pacific saury. The consumptions of Japanese anchovy in the two periods were 34 thousand tons and 15 thousand tons, respectively. The consumptions of Pacific saury in the two periods were 40 thousand ton and 25 thousand tons, respectively. The CVs were in the range 0.3-0.5.

*Bryde's whales*
The seasonal prey consumptions in the 2000-07 and 2008-2014 periods were 502 thousand tons and 714 thousand tons, respectively. The CVs were in the range 0.3-0.4. They fed mainly on Japanese anchovy and krill. The consumptions of Japanese anchovy in the two periods were 418 thousand tons and 511 thousand tons, respectively. The consumptions of krill in the two periods were 74 thousand tons and 176 thousand tons, respectively. The CVs were in the range 0.3-0.4.

*Sei whales*

The seasonal prey consumptions in the 2000-07 and 2008-2014 periods were 533 thousand tons and 442 thousand tons, respectively. The CVs were in the range 0.2-0.3. They fed mainly on Japanese anchovy, copepods and mackerels. The consumptions of Japanese anchovy in the two periods were 272 thousand tons and 148 thousand tons, respectively. The consumptions of copepods in the two periods were 78 thousand ton and 155 thousand tons, respectively. The consumptions of mackerels in the two periods were 42 thousand ton and 66 thousand tons, respectively. The CVs were in the range 0.2-0.3.

## DISCUSSION

### Diet of whales in the study area

This study showed that the prey species of three baleen whale species in the western North Pacific during May and September in the years 2000-2014, included various pelagic species of zooplankton, squid and fishes. Prey species of three baleen whale species varied both geographically and temporally. It was confirmed that three baleen whale species in the western North Pacific are euryphagous, similar to those in the Northeast Atlantic.

### Geographical, seasonal changes of prey species

The results showed that there was geographical and seasonal change of prey species in the western North Pacific. In the offshore area, common minke whales fed on Japanese anchovy during May and June, and on Pacific saury during July to September. Minke whales feeding on Pacific saury were distributed in northern latitudes in comparison with whales feeding on Japanese anchovy, so the seasonal movement of minke whale overlap with the distribution of Pacific saury. In the north east part of sub-area 9 over the Emperor Sea Mountains, minke whale abundantly fed on minimal armhook squid in August. This result suggested that the minke whale use the feeding area near Emperor Seamounts where the minimal armhook squid occur in summer (Konishi and Tamura, 2007). Minke whale also adapted to coastal areas where large whales rarely occur. In sub-area 7, walleye pollock was one of the important prey species in addition to Pacific saury and anchovy off northern Japan. For the size of fish in the stomachs, minke whales fed on large-sized walleye pollock over the continental break and slope around 200-300m water depth.

The dominant prey species of Bryde's whale was Japanese anchovy and krill during May to September. There was no seasonal change of prey species for this whale species.

Sei whale fed on Japanese anchovy and copepods dominantly during survey season in most of the years. However they mostly fed on mackerels in the 2005 season, and this indicated that sei whale feed on most aggregated prey species near the surface. At the offshore area under the effects of Kuroshio-current extension, the prey species fed by large baleen whales depend on what the current carry in early summer.

The results showed that there was size difference of prey species. Common minke whale fed on larger Japanese anchovy, Pacific saury and mackerels than other whale species. The smaller anchovy (fork length <8cm) and mackerels (fork length <25cm) hatched in this year. These fishes distributed in the southern part of the research area. Differences in the prey size among the stomach contents of three baleen whales might reflect to geographical distribution of prey species in the research area.

### Yearly change of prey species

For three baleen whale species, the most dominant prey species was Japanese anchovy in the 2000-2007 JARPNII survey years. Japanese anchovy is distributed shallower than 30m depth, where it feeds on copepods (Kondo, 1969). The anchovy are distributed widely in temperate waters of the western North Pacific. Japanese anchovy migrate to this research area to feed copepod from June through September (Kondo, 1969). However, recently years (since 2012), the occurrence of Japanese anchovy in stomach contents was decreasing.

On the other hand, the occurrences of Japanese sardine and mackerels in stomach contents were increasing. Konishi *et al* (2016: SC/F16/JR23) also noted that the common minke, Bryde's and sei whales were highly dependent on small pelagic fish, *i.e*. Japanese anchovy, Pacific saury and mackerels in addition to copepods and euphausiids. The trend of prey compositions in the three baleen whale species differ among whale species. For example, the main prey species of sei whale showed drastic change from the Japanese anchovy in early 2000s to mackerels and Japanese sardine in late 2000s. Kasamatsu and Hata (1985) reported that Chub mackerel was the most important prey species of common minke whales in western Pacific (a northern part of sub-area 8) in August. However, in our surveys, the composition of mackerels was low. Kasamatsu and Tanaka (1992) examined annual changes of prey species based on the catch records of small type whaling in the seven whaling grounds off Japan from 1948 to 1987. In Pacific coast of Hokkaido (a part of sub-area 7W) from April to October, prey species recorded were krill, squid, Japanese sardine, Japanese anchovy, chub mackerel, walleye pollock and Pacific saury and so on. They noted that the change of prey species of minke whales from Chub mackerel to Japanese sardine in 1977, from Japanese sardine to

Pacific saury in 1996, from Pacific saury to Japanese sardine in 2012 corresponded with a change of the dominant species taken by commercial fisheries in the same area in 1976, 1996, 2012, respectively. Nemoto (1959) reported that Bryde's whales fed on krill, Japanese anchovy and Chub mackerel in the Pacific coast of Japan. According to Nemoto (1959, 1962) and Nemoto and Kawamura (1977), sei whales fed mainly copepods in the northern part of the North Pacific, but they likely feed on fishes and squids in the Sanriku and Hokkaido coastal waters of Japan.

Differences in the prey composition reflected to local and seasonal changes in the relative abundance of these prey species in the research area (Tamura *et al*., 2016 (SC/F16/JR17)). Three baleen whale species feed on prey at the surface during their seasonal migration to the feeding area. The fluctuation of prey species of baleen whales seems to reflect that these baleen whales are opportunistic feeders with a broad diet and with flexible feeding habits.

### Daily prey consumption *per capita* taking into account uncertainties

The estimates from three energetic models (Eq-2, 3-1 and 4) were compared to observed stomach contents weight. Leaper and Lavigne (2007) considered that the appropriate consumption estimates is between the high end by Eq 3-1 and the low end by Eq 2. It should be noted that these crude stomach contents data represented a quantity of one feeding. There are notable two points. First, the composition of freshness categories showed that there had no trend throughout the day. Secondly, in the results of the recent other research activity, some baleen whale species were estimate to dive many times for feeding in a day using data logger system (*e.g.* Fiedler *et al.*, 1998; Acevedo-Gutierrez *et al.*, 2002; Ishii *et al*, 2016 (SC/F16/JR25). Thirdly, for sei whales in particular, there is a possibility that the observed stomach contents are far less than total daily consumption, because they often feed on prey through skimming. They seem to feed continuously in the feeding grounds in a day. Then the consumption estimate from Eq. 2 seems to be underestimated, because consumption estimates by Eq. 2 is equal only to the intake of one or two time. If the average number of times of prey intake per day can be obtained, it might be possible to estimate narrower range of daily prey consumption using the data of observed stomach contents weight. Tagging technology of data logger and stomach contents information will provide such data in the future.

### Seasonal prey consumption by whales taking into uncertainties

The values of Eq-3-1 were 2.4-3.6 times larger than the value of Eqn. 2. This is due to differences in body mass, and the effect is larger for large whales. The uncertainty derived from the use of different energetic models seems to be appropriately captured in the Monte Carlo simulation.

### The feeding impact by whales on fisheries resources

The consumptions of Japanese anchovy, mackerels and Pacific saury by three baleen whales during May to September were estimated in 674-724 thousand tons, 43-70 thousand tons and 48-56 thousand tons, respectively. These values were equivalent to 22-48%, 5-66% and 2-7% of the each fish resources in the western North Pacific (Table 14). To evaluate the interaction between whale and fisheries, long-term information of prey composition of whales, accurate abundance of prey species and each whale, and accurate resident period of each whale are needed. Furthermore, there is a need to understand the potential for each whale to have an impact on commercial fisheries, either directly or indirectly using simulation models for specific geographical regions.

## ACKNOWLEDGEMENTS

We would like to thank all captains, crews and researchers, who were involved in offshore component of JARPNII surveys from 2000 to 2014. Our sincere thanks to Dr. Luis A. Pastene of the Institute of Cetacean Research (ICR) for the valuable suggestions and useful comments on this paper.

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**Table 1.** Numbers of whales sampled.

| Year | Minke | Bryde's | Sei |
|---|---|---|---|
| 1994 | 21 | - | - |
| 1995 | 100 | - | - |
| 1996 | 77 | - | - |
| 1997 | 100 | - | - |
| 1998 | 100 | - | - |
| 1999 | 100 | - | - |
| 2000 | 40 | 43 | - |
| 2001 | 100 | 50 | - |
| 2002 | 100 | 50 | 39 |
| 2003 | 100 | 50 | 50 |
| 2004 | 100 | 50 | 100 |
| 2005 | 100 | 50 | 100 |
| 2006 | 100 | 50 | 100 |
| 2007 | 100 | 50 | 100 |
| 2008 | 59 | 50 | 100 |
| 2009 | 43 | 50 | 100 |
| 2010 | 14 | 50 | 100 |
| 2011 | 49 | 50 | 95 |
| 2012 | 74 | 34 | 100 |
| 2013 | 3 | 28 | 100 |
| 2014 | 0 | 25 | 90 |
| Total | 1,480 | 680 | 1,174 |

**Table 2.** Body weight (kg) of each whale species sampled in each season.

Common minke whales (1994-2014) (kg)

| | IM | IF | MM | MF |
|---|---|---|---|---|
| Early (N) | 38 | 19 | 193 | 14 |
| Average | 2,317.2 | 2,178.9 | 4,557.1 | 5,736.1 |
| S.D. | 679.2 | 952.1 | 595.7 | 1,104.9 |
| Max | 4,210.0 | 4,050.0 | 7,109.8 | 7,500.0 |
| Min | 1,300.0 | 1,050.0 | 2,950.0 | 3,650.0 |
| Late (N) | 29 | 7 | 193 | 37 |
| Average | 3,154.3 | 3,171.8 | 4,904.8 | 6,522.2 |
| S.D. | 1,026.9 | 1,436.2 | 588.6 | 786.5 |
| Max | 5,154.7 | 4,500.0 | 7,050.0 | 8,054.7 |
| Min | 1,300.0 | 1,200.0 | 3,300.0 | 4,650.0 |

Bryde's whales (2000-2014) (kg)

| | IM | IF | MM | MF |
|---|---|---|---|---|
| Early (N) | 35 | 47 | 33 | 89 |
| Average | 9,051.7 | 8,567.7 | 15,282.3 | 17,618.8 |
| S.D. | 2,699.4 | 2,795.0 | 1,865.0 | 3,086.9 |
| Max | 15,200.0 | 14,559.8 | 18,959.8 | 24,874.5 |
| Min | 4,000.0 | 2,800.0 | 12,004.7 | 11,096.6 |
| Late (N) | 86 | 64 | 125 | 172 |
| Average | 9,961.3 | 10,268.2 | 15,432.1 | 17,849.1 |
| S.D. | 2,500.7 | 2,889.9 | 2,075.2 | 2,557.7 |
| Max | 15,454.7 | 16,300.0 | 21,404.0 | 24,450.0 |
| Min | 3,800.0 | 3,350.0 | 11,300.0 | 12,140.0 |

Common minke whales (Coastal) (kg)

| | IM | IF | MM | MF |
|---|---|---|---|---|
| Sanriku (N) | 151 | 233 | 52 | 47 |
| Average | 1,776.0 | 1,924.1 | 4,125.2 | 5,118.7 |
| S.D. | 664.0 | 697.0 | 576.8 | 1,207.0 |
| Max | 3,572.0 | 4,390.0 | 5,499.6 | 8,352.0 |
| Min | 600.0 | 539.4 | 2,570.0 | 1,289.2 |
| Kushiro (N) | 205 | 184 | 166 | 27 |
| Average | 2,053.2 | 1,971.1 | 4,784.1 | 6,023.3 |
| S.D. | 806.1 | 806.9 | 695.8 | 1,042.5 |
| Max | 4,440.2 | 4,879.4 | 6,302.5 | 8,225.8 |
| Min | 662.1 | 659.0 | 2,999.2 | 4,302.0 |

Sei whales (2002-2014) (kg)

| | IM | IF | MM | MF |
|---|---|---|---|---|
| Early (N) | 60 | 56 | 149 | 189 |
| Average | 13,716.2 | 15,831.4 | 19,226.7 | 24,590.8 |
| S.D. | 2,633.3 | 2,651.3 | 2,193.9 | 3,715.0 |
| Max | 18,304.7 | 21,344.2 | 24,457.0 | 35,001.1 |
| Min | 7,450.0 | 9,750.0 | 13,654.7 | 17,009.8 |
| Late (N) | 88 | 75 | 216 | 251 |
| Average | 14,095.4 | 15,984.2 | 20,531.8 | 25,249.4 |
| S.D. | 3,235.8 | 3,736.6 | 2,131.1 | 4,003.9 |
| Max | 19,954.7 | 23,918.5 | 26,234.7 | 34,564.7 |
| Min | 4,250.0 | 6,300.0 | 15,264.5 | 16,514.7 |

**Table 3.** Results of caloric value of dominant prey species in western North Pacific.

Common minke and sei whales

| Species | Season | Analyzed Number | Energy contents (KJ/kg) Avegage | S.D |
|---|---|---|---|---|
| Copepods | Early | 2 | 2,738 | 266 |
| | Late | 4 | 2,885 | 699 |
| Krill | Early | 3 | 3,929 | 1,235 |
| | Late | 4 | 3,177 | 396 |
| Japanese anchovy | Early | 3 | 7,094 | 716 |
| | Late | 3 | 6,134 | 1,748 |
| Japanese sardine | Early | 2 | 9,907 | 4,847 |
| | Late | 1 | 5,559 | - |
| Pacific saury | Early | 4 | 8,217 | 3,072 |
| | Late | 4 | 10,057 | 3,916 |
| Chub mackerel | Early | 1 | 6,479 | - |
| | Late | 3 | 8,555 | 4,613 |
| Walleye pollock | Early | 3 | 6,232 | 714 |
| | Late | 2 | 5,918 | 388 |
| Oceanic lightfish | All | - | 8,580 | - |
| Sand lance | Early | 4 | 4,663 | 2,098 |
| Squids | Early | 1 | 6,646 | - |
| | Late | 2 | 5,628 | 1,391 |

Bryde's whales

| Species | Season | Analyzed Number | Energy contents (KJ/kg) Avegage | S.D |
|---|---|---|---|---|
| Krill | Early | 1 | 3,051 | - |
| | Late | 3 | 3,429 | 616 |
| Japanese anchovy | Early | 1 | 3,389 | - |
| | Late | 5 | 4,039 | 945 |
| Japanese sardine | Early | 0 | - | - |
| | Late | 1 | 5,267 | - |
| Chub mackerel | Early | 1* | 6,479 | - |
| | Late | 2 | 4,765 | 59 |
| Oceanic lightfish | All | - | 8,580 | - |
| Squids | Early | 1 | 6,646 | - |
| | Late | 2 | 5,628 | 1,391 |

**Table 4.** Prey composition (W %) of each whale species sampled.

Common minke whales (1996-2014: excluding sub area 11)

Sub area 7

| Period | Number | Copepods | Krill | Anchovy | Sardine | Saury | Mackerel | Pollock | Squids | Others |
|---|---|---|---|---|---|---|---|---|---|---|
| Early | | | | | | | | | | |
| 2000-07 | 187 | 0.00 | 13.51 | 63.76 | 0.00 | 0.00 | 0.00 | 22.73 | 0.00 | 0.00 |
| 2008-14 | 78 | 0.00 | 11.35 | 42.81 | 0.66 | 0.00 | 0.27 | 44.92 | 0.00 | 0.00 |
| 1996-2014 | 375 | 0.00 | 12.29 | 58.25 | 0.14 | 0.00 | 0.12 | 29.09 | 0.00 | 0.10 |
| Late | | | | | | | | | | |
| 2000-07 | 125 | 0.00 | 8.83 | 31.14 | 0.00 | 24.06 | 0.84 | 19.56 | 15.57 | 0.00 |
| 2008-14 | 49 | 0.00 | 13.21 | 79.45 | 0.00 | 0.00 | 0.00 | 7.35 | 0.00 | 0.00 |
| 1996-2014 | 206 | 0.00 | 16.37 | 34.33 | 0.00 | 21.44 | 0.51 | 16.11 | 11.24 | 0.00 |

Sub areas 8 and 9

| Period | Number | Copepods | Krill | Anchovy | Sardine | Saury | Mackerel | Pollock | Squids | Others |
|---|---|---|---|---|---|---|---|---|---|---|
| Early | | | | | | | | | | |
| 2000-07 | 119 | 2.79 | 4.56 | 56.73 | 0.00 | 34.53 | 1.24 | 0.00 | 0.00 | 0.16 |
| 2008-14 | 17 | 18.90 | 51.35 | 18.03 | 0.00 | 0.00 | 11.72 | 0.00 | 0.00 | 0.00 |
| 1996-2014 | 247 | 3.28 | 4.18 | 73.68 | 0.00 | 17.77 | 1.01 | 0.00 | 0.00 | 0.08 |
| Late | | | | | | | | | | |
| 2000-07 | 281 | 0.00 | 3.31 | 16.84 | 0.00 | 69.54 | 0.00 | 0.00 | 0.00 | 10.32 |
| 2008-14 | 85 | 0.12 | 4.82 | 24.06 | 0.00 | 68.47 | 0.03 | 0.00 | 0.00 | 2.50 |
| 1996-2014 | 413 | 0.03 | 3.78 | 16.71 | 0.00 | 71.82 | 0.01 | 0.00 | 0.00 | 7.65 |

All areas

| Period | Number | Copepods | Krill | Anchovy | Sardine | Saury | Mackerel | Pollock | Squids | Others |
|---|---|---|---|---|---|---|---|---|---|---|
| Early | | | | | | | | | | |
| 2000-07 | 306 | 1.39 | 9.03 | 60.25 | 0.00 | 17.26 | 0.62 | 11.36 | 0.00 | 0.08 |
| 2008-14 | 95 | 9.45 | 31.35 | 30.42 | 0.33 | 0.00 | 6.00 | 22.46 | 0.00 | 0.00 |
| 1996-2014 | 622 | 1.64 | 8.23 | 65.97 | 0.07 | 8.88 | 0.56 | 14.55 | 0.00 | 0.09 |
| Late | | | | | | | | | | |
| 2000-07 | 406 | 0.00 | 6.07 | 23.99 | 0.00 | 46.80 | 0.42 | 9.78 | 7.79 | 5.16 |
| 2008-14 | 134 | 0.06 | 9.01 | 51.76 | 0.00 | 34.23 | 0.01 | 3.67 | 0.00 | 1.25 |
| 1996-2014 | 619 | 0.01 | 10.08 | 25.52 | 0.00 | 46.63 | 0.26 | 8.06 | 5.62 | 3.83 |
| Year (for EwE) | | | | | | | | | | |
| Average | 1,241 | 0.66 | 9.34 | 41.70 | 0.03 | 31.53 | 0.38 | 10.65 | 3.37 | 2.33 |

Bryde's whales (2000-2014)

| Period | Number | Krill | Anchovy | Sardine | Mackerel | oceanic lightfish | Squids |
|---|---|---|---|---|---|---|---|
| Early | | | | | | | |
| 2000-07 | 121 | 42.51 | 48.41 | 0.00 | 9.08 | 0.005 | 0.0002 |
| 2008-14 | 49 | 6.95 | 83.94 | 0.00 | 3.49 | 5.62 | 0.00 |
| 2000-14 | 170 | 33.01 | 58.13 | 0.00 | 7.35 | 1.51 | 0.0002 |
| Late | | | | | | | |
| 2000-07 | 204 | 11.31 | 87.65 | 0.00 | 0.41 | 0.63 | 0.00 |
| 2008-14 | 182 | 27.64 | 69.56 | 0.71 | 2.04 | 0.04 | 0.00 |
| 2000-14 | 386 | 14.90 | 83.47 | 0.23 | 0.95 | 0.44 | 0.00 |
| Year (for EwE) | | | | | | | |
| Average | 556 | 22.13 | 73.43 | 0.14 | 3.43 | 0.87 | 0.0001 |

Sei whales (2002-2014)

| Period | Number | Copepods | Krill | Anchovy | Sardine | Saury | Mackerel | Squids | Others |
|---|---|---|---|---|---|---|---|---|---|
| Early | | | | | | | | | |
| 2002-07 | 207 | 19.11 | 18.55 | 46.18 | 0.00 | 1.07 | 15.10 | 0.00 | 0.00 |
| 2008-14 | 322 | 53.63 | 9.60 | 14.70 | 3.52 | 3.00 | 15.39 | 0.005 | 0.15 |
| 2002-14 | 529 | 37.71 | 13.86 | 28.94 | 1.88 | 2.25 | 15.28 | 0.003 | 0.08 |
| Late | | | | | | | | | |
| 2002-07 | 282 | 10.73 | 27.59 | 55.43 | 0.00 | 4.63 | 1.62 | 0.002 | 0.00 |
| 2008-14 | 363 | 22.42 | 6.38 | 46.16 | 0.00 | 6.61 | 14.52 | 3.92 | 0.00 |
| 2002-14 | 645 | 16.47 | 17.36 | 50.96 | 0.00 | 5.60 | 7.90 | 1.71 | 0.00 |
| Year (for EwE) | | | | | | | | | |
| Average | 1,174 | 25.05 | 16.57 | 43.46 | 0.00 | 4.34 | 9.51 | 1.04 | 0.03 |

**Table 5.** Energy contents (KJ/kg) of prey consumed by each whale species based on Tables 3 and 4.

Common minke whales (1996-2014)

Early-Area 7

| Species | Krill | Anchovy | Sardine | Saury | Mackerel | Pollock | Squids | 1996-2014 | 2000-07 | 2008-14 |
|---|---|---|---|---|---|---|---|---|---|---|
| Number | N=3 | N=3 | N=2 | N=4 | N=1 | N=3 | N=1 | | | |
| Low | 2,926 | 6,276 | 6,479 | 4,849 | 6,479 | 5,518 | 6,646 | 5,637 | 5,651 | 5,558 |
| High | 5,309 | 7,608 | 13,334 | 11,548 | 6,479 | 6,945 | 6,646 | 7,131 | 7,147 | 7,085 |
| Average | 3,929 | 7,094 | 9,907 | 8,217 | 6,479 | 6,232 | 6,646 | 6,450 | 6,471 | 6,366 |

Late-Area 7

| Species | Krill | Anchovy | Sardine | Saury | Mackerel | Pollock | Squids | 1996-2014 | 2000-07 | 2008-14 |
|---|---|---|---|---|---|---|---|---|---|---|
| Number | N=4 | N=3 | N=1 | N=4 | N=3 | N=2 | N=2 | | | |
| Low | 2,720 | 4,268 | 5,559 | 5,272 | 5,309 | 5,643 | 4,644 | 4,499 | 4,696 | 4,165 |
| High | 3,678 | 7,733 | 5,559 | 13,376 | 13,836 | 6,192 | 6,611 | 7,936 | 8,289 | 7,085 |
| Average | 3,177 | 6,134 | 5,559 | 10,057 | 8,555 | 5,918 | 5,628 | 6,412 | 6,700 | 5,728 |

Early-Areas 8+9

| Species | Copepods | Krill | Anchovy | Sardine | Saury | Mackerel | Others | 1996-2014 | 2000-07 | 2008-14 |
|---|---|---|---|---|---|---|---|---|---|---|
| Number | N=2 | N=3 | N=3 | N=2 | N=4 | N=1 | N=1 | | | |
| Low | 2,550 | 2,926 | 6,276 | 6,479 | 4,849 | 6,479 | 8,580 | 5,757 | 5,533 | 3,875 |
| High | 2,926 | 5,309 | 7,608 | 13,334 | 11,548 | 6,479 | 8,580 | 8,041 | 8,721 | 5,410 |
| Average | 2,738 | 3,929 | 7,094 | 9,907 | 8,217 | 6,479 | 8,580 | 7,007 | 7,211 | 4,574 |

Late-Areas 8+9

| Species | Copepods | Krill | Anchovy | Sardine | Saury | Mackerel | Others | 1996-2014 | 2000-07 | 2008-14 |
|---|---|---|---|---|---|---|---|---|---|---|
| Number | N=4 | N=4 | N=3 | N=1 | N=4 | N=3 | N=1 | | | |
| Low | 2,174 | 2,720 | 4,268 | 5,559 | 5,272 | 5,309 | 8,580 | 5,260 | 5,360 | 4,986 |
| High | 3,849 | 3,678 | 7,733 | 5,559 | 13,376 | 13,836 | 8,580 | 11,697 | 11,611 | 11,420 |
| Average | 2,885 | 3,177 | 6,134 | 5,559 | 10,057 | 8,555 | 8,580 | 9,026 | 9,017 | 8,736 |

Bryde's whales (2000-2014)

Early

| Species | Krill | Anchovy | Sardine | Mackerel | Oceanic lightfish | Squids | 2000-14 | 2000-07 | 2008-14 |
|---|---|---|---|---|---|---|---|---|---|
| Number | N=1 | N=1 | N=0 | N=1* | N=1 | N=1* | | | |
| Low | 3,051 | 3,389 | | 6,479 | 8,580 | 6,646 | 3,583 | 3,526 | 3,765 |
| High | 3,051 | 3,389 | | 6,479 | 8,580 | 6,646 | 3,583 | 3,526 | 3,765 |
| Average | 3,051 | 3,389 | | 6,479 | 8,580 | 6,646 | 3,583 | 3,526 | 3,765 |

Late

| Species | Krill | Anchovy | Sardine | Mackerel | Oceanic lightfish | Squids | 2000-14 | 2000-07 | 2008-14 |
|---|---|---|---|---|---|---|---|---|---|
| Number | N=3 | N=5 | N=1 | N=2 | N=1 | N=0 | | | |
| Low | 2,759 | 2,884 | 5,267 | 4,723 | 8,580 | | 2,913 | 3,400 | 2,906 |
| High | 3,971 | 5,523 | 5,267 | 4,807 | 8,580 | | 5,297 | 5,850 | 5,078 |
| Average | 3,429 | 4,039 | 5,267 | 4,765 | 8,580 | | 3,977 | 4,488 | 3,895 |

Sei whales (2002-2014)

Early

| Species | Copepods | Krill | Anchovy | Sardine | Saury | Mackerel | Squids | Others | 2002-14 | 2002-07 | 2008-14 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Number | N=2 | N=3 | N=3 | N=2 | N=4 | N=1 | N=1 | N=1 | | | |
| Low | 2,550 | 2,926 | 6,276 | 6,479 | 4,849 | 6,479 | 6,646 | 8,580 | 4,411 | 4,912 | 4,071 |
| High | 2,926 | 5,309 | 7,608 | 13,334 | 11,548 | 6,479 | 6,646 | 8,580 | 5,549 | 6,048 | 5,139 |
| Average | 2,738 | 3,929 | 7,094 | 9,907 | 8,217 | 6,479 | 6,646 | 8,580 | 4,998 | 5,515 | 4,610 |

Late

| Species | Copepods | Krill | Anchovy | Sardine | Saury | Mackerel | Squids | Others | 2002-14 | 2002-07 | 2008-14 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Number | N=4 | N=4 | N=3 | N=1 | N=4 | N=3 | N=2 | N=1 | | | |
| Low | 2,174 | 2,720 | 4,268 | 5,559 | 5,272 | 5,309 | 4,644 | 8,580 | 3,728 | 3,680 | 3,932 |
| High | 3,849 | 3,678 | 7,733 | 5,559 | 13,376 | 13,836 | 6,611 | 8,580 | 7,067 | 6,558 | 7,819 |
| Average | 2,885 | 3,177 | 6,134 | 5,559 | 10,057 | 8,555 | 5,628 | 8,580 | 5,401 | 5,191 | 5,809 |

**Table 6.** The values of the rate of *H index* for the daily consumption.

| *H index* (Residence days) | *P* (Percentage of annual prey consumption) 70 | 80 | 90 |
|---|---|---|---|
| 120 | 2.13 | 2.43 | 2.74 |
| 150 | 1.70 | 1.95 | 2.19 |
| 180 | 1.42 | 1.62 | 1.83 |

**Table 7.** The composition of maturity stages of each whale species sampled.

(IM: Immature male, MM: Mature male, IF: Immature female, MF: Mature female, UM: Unidentified maturity)

Common minke whales

Area 7

| Period | Numbers | IM | MM | IF | MF | UM |
|---|---|---|---|---|---|---|
| Early | | | | | | |
| 2000-07 | 192 | 23.4 | 62.0 | 7.3 | 4.2 | 3.1 |
| 2008-14 | 86 | 26.7 | 46.5 | 15.1 | 4.7 | 7.0 |
| 1996-14 | 386 | 22.8 | 60.4 | 9.3 | 4.4 | 3.1 |
| Late | | | | | | |
| 2000-07 | 131 | 19.1 | 59.5 | 9.9 | 8.4 | 3.1 |
| 2008-14 | 51 | 21.6 | 56.9 | 5.9 | 13.7 | 2.0 |
| 1996-14 | 213 | 19.2 | 61.0 | 7.5 | 9.9 | 2.3 |

Bryde's whales

| Period | Numbers | IM | MM | IF | MF |
|---|---|---|---|---|---|
| Early | | | | | |
| 2000-07 | 146 | 16.4 | 16.4 | 21.9 | 45.2 |
| 2008-14 | 59 | 19.0 | 15.5 | 25.9 | 39.7 |
| 2000-14 | 205 | 17.2 | 16.2 | 23.0 | 43.6 |
| Late | | | | | |
| 2000-07 | 247 | 23.9 | 23.9 | 15.8 | 36.4 |
| 2008-14 | 228 | 12.9 | 31.1 | 13.8 | 42.2 |
| 2000-14 | 475 | 18.6 | 27.3 | 14.8 | 39.2 |

Common minke whales

Areas 8+9

| Period | Numbers | IM | MM | IF | MF | UM |
|---|---|---|---|---|---|---|
| Early | | | | | | |
| 2000-07 | 128 | 12.5 | 71.1 | 6.3 | 4.7 | 5.5 |
| 2008-14 | 20 | 20.0 | 55.0 | 10.0 | 5.0 | 10.0 |
| 1996-14 | 259 | 14.3 | 69.5 | 7.3 | 5.4 | 3.5 |
| Late | | | | | | |
| 2000-07 | 289 | 6.6 | 78.9 | 0.3 | 6.2 | 8.0 |
| 2008-14 | 85 | 5.9 | 68.2 | 2.4 | 11.8 | 11.8 |
| 1996-14 | 421 | 6.4 | 78.1 | 0.7 | 6.9 | 7.8 |

Sei whales

| Period | Numbers | IM | MM | IF | MF |
|---|---|---|---|---|---|
| Early | | | | | |
| 2002-07 | 207 | 15.5 | 30.4 | 13.0 | 41.1 |
| 2008-14 | 322 | 11.5 | 33.2 | 12.1 | 43.2 |
| 2002-14 | 529 | 13.0 | 32.1 | 12.5 | 42.3 |
| Late | | | | | |
| 2002-07 | 282 | 13.8 | 36.9 | 13.8 | 35.5 |
| 2008-14 | 363 | 13.8 | 32.8 | 10.5 | 43.0 |
| 2002-14 | 645 | 13.8 | 34.6 | 11.9 | 39.7 |

Average

| Period | Numbers | IM | MM | IF | MF | UM |
|---|---|---|---|---|---|---|
| Early | | | | | | |
| 2000-07 | 320 | 18.0 | 66.5 | 6.8 | 4.4 | 4.3 |
| 2008-14 | 106 | 23.4 | 50.8 | 12.6 | 4.8 | 8.5 |
| 1996-14 | 645 | 18.5 | 64.9 | 8.3 | 4.9 | 3.3 |
| Late | | | | | | |
| 2000-07 | 420 | 12.8 | 69.2 | 5.1 | 7.3 | 5.5 |
| 2008-14 | 136 | 13.7 | 62.5 | 4.1 | 12.7 | 6.9 |
| 1996-14 | 634 | 12.8 | 69.6 | 4.1 | 8.4 | 5.1 |

**Table 8.** Estimation numbers of whales distributed based on Hakamada *et al* (2009, 2016 (SC/F16/JR12)).

Common minke whales

| Period | Numbers | CV | 95% CI LL | 95% CI UL |
|---|---|---|---|---|
| Early | | | | |
| 2000-2007 | 6,609 | 0.691 | 1,942 | 22,488 |
| 2008-2014 | 3,629 | 0.586 | 1,252 | 10,523 |
| Late | | | | |
| 2000-2007 | 2,879 | 0.523 | 1,098 | 7,547 |
| 2008-2014 | 3,080 | 0.677 | 924 | 10,266 |

Bryde's whales

| Period | Numbers | CV | 95% CI LL | 95% CI UL |
|---|---|---|---|---|
| Early | | | | |
| 2000-2007 | 1,559 | 0.860 | 363 | 6,702 |
| 2008-2014 | 2,957 | 0.394 | 1,404 | 6,226 |
| Late | | | | |
| 2000-2007 | 9,344 | 0.316 | 5,104 | 17,106 |
| 2008-2014 | 13,306 | 0.569 | 4,712 | 37,570 |

Sei whales

| Period | Numbers | CV | 95% CI LL | 95% CI UL |
|---|---|---|---|---|
| Early | | | | |
| 2002-2007 | 7,646 | 0.272 | 4,529 | 12,908 |
| 2008-2014 | 4,734 | 0.177 | 3,355 | 6,679 |
| Late | | | | |
| 2002-2007 | 5,370 | 0.300 | 3,021 | 9,547 |
| 2008-2014 | 5,086 | 0.378 | 2,485 | 10,410 |

**Table 9.** Abundance and catch information of each prey species.

Japanese anchovy

| Year | Abundance | Catch |
|---|---|---|
| 2000 | N.D. | 213.0 |
| 2001 | N.D. | 198.0 |
| 2002 | N.D. | 334.0 |
| 2003 | N.D. | 408.0 |
| 2004 | 2,840.0 | 402.0 |
| 2005 | 1,520.0 | 238.0 |
| 2006 | 3,360.0 | 303.0 |
| 2007 | 2,760.0 | 242.0 |
| 2008 | N.D. | 209.0 |
| 2009 | N.D. | 241.0 |
| 2010 | N.D. | 248.0 |
| 2011 | N.D. | 160.0 |
| 2012 | N.D. | 155.0 |
| 2013 | N.D. | 155.0 |

Pacific saury

| Year | Abundance | Catch |
|---|---|---|
| 2000 | N.D. | 281.9 |
| 2001 | N.D. | 367.4 |
| 2002 | N.D. | 328.6 |
| 2003 | 2,490.5 | 440.3 |
| 2004 | 2,634.5 | 353.8 |
| 2005 | 2,355.5 | 469.1 |
| 2006 | 2,207.0 | 389.6 |
| 2007 | 1,135.5 | 519.3 |
| 2008 | 2,435.0 | 606.0 |
| 2009 | 2,097.0 | 469.7 |
| 2010 | 690.5 | 415.7 |
| 2011 | 1,248.5 | 448.7 |
| 2012 | 817.5 | 455.4 |
| 2013 | 1,008.0 | 404.0 |

Mackerels

| Year | Abundance | Catch |
|---|---|---|
| 2000 | 243.0 | 93.7 |
| 2001 | 152.0 | 55.8 |
| 2002 | 210.0 | 48.2 |
| 2003 | 230.0 | 76.7 |
| 2004 | 743.0 | 180.7 |
| 2005 | 868.0 | 226.5 |
| 2006 | 786.0 | 239.0 |
| 2007 | 614.0 | 182.1 |
| 2008 | 550.0 | 173.4 |
| 2009 | 649.0 | 127.2 |
| 2010 | 862.0 | 123.3 |
| 2011 | 106.0 | 103.0 |
| 2012 | 1030.0 | 122.0 |
| 2013 | 1360.0 | 220.0 |

**Table 10.** Prey species of each whale species sampled in JARPNII.

Common minke whale

| Species | | |
|---|---|---|
| **Main prey** | | |
| Copepods | *Calanus* sp. | |
| Krill | *Euphausia pacifica* | |
| | *Thysanoessa gregaria* | |
| Pisces | *Engraulis japonicus* | Japanese anchovy |
| | *Sardinops melanostictus* | Japanese sardine |
| | *Cololabis saira* | Pacific saury |
| | *Scomber japonicus* | Chub mackerel |
| | *Gadus chalcogrammus* | Walleye pollocke |
| | *Brama japonica* | Japanese pomfret |
| | *Oncorhynchus gorbuscha* | Pink salmon |
| | *O. keta* | Chum salmon |
| | *Pleurogrammus monopterygius* | Atka mackerel |
| | *Ammodytes personatus* | Sand lance |
| Squids | *Todarodes pacificus* | Japanese common squid |
| | *Berryteuthis anonychus* | Minimal armhook squid |
| | | |
| **Miner prey** | | |
| Pisces | *Paralepis atlantica* | Duckbill barracudina |

Sei whale

| Species | | |
|---|---|---|
| **Main prey** | | |
| Copepods | *Neocalanus cristatus* | |
| | *N. plumchrus* | |
| | *Calanus sp.* | |
| Krill | *Euphausia pacifica* | |
| | *E. similis* | |
| | *Thysanoessa gregaria* | |
| Pisces | *Engraulis japonicus* | Japanese anchovy |
| | *Sardinops melanostictus* | Japanese sardine |
| | *Cololabis saira* | Pacific saury |
| | *Scomber japonicus* | Chub mackerel |
| | *S. australasicus* | Spotted mackerel |
| **Miner prey** | | |
| Pisces | *Sardinops melanostictus* | Japanese sardine |
| Squids | *Todarodes pacificus* | Japanese common squid |

Bryde's whale

| Species | | |
|---|---|---|
| **Main prey** | | |
| Krill | *Euphausia pacifica* | |
| | *E. similis* | |
| | *E. gibboides* | |
| | *Thysanoessa gregaria* | |
| | *Nematoscelis difficilis* | |
| Pisces | *Engraulis japonicus* | Japanese anchovy |
| | *Scomber japonicus* | Chub mackerel |
| | *S. australasicus* | Spotted mackerel |
| | *Vinciguerria nimbaria* | Oceanic lightfish |
| | *Auxis rochei* | |
| Squids | *Todarodes pacificus* | Japanese common squid |
| | | |
| **Miner prey** | | |
| Pisces | *Arothron firmamentum* | Starry toado |
| | *Decapterus russelli* | Russell's scad |
| | *Diaphus theta* | Lantern fish |
| | *Tarletonbeania taylori* | Lantern fish |
| | *Starry toado* | Arothron firmamentum |
| | *Nemichthys scolopaceus* | Snipe eel |
| | *Lestidiops jayakari* | |

**Table 11.** The average and maximum weight and the ratio of stomach contents weight to body weight, expressed as a percentage (RSC) of fresh or lightly digested stomach contents (freshness category F and fff).

Common minke whale

| Sex | Maturity | Number | Average weight (kg) | S.D. | Maximum weight (kg) | 95%C.I. Lower | 95%C.I. Upper |
|---|---|---|---|---|---|---|---|
| Male | Immature | 61 | 27.11 (1.02%) | 22.30 | 97.00 (3.53%) | 21.40 (0.80%) | 32.80 (1.23%) |
| | Mature | 428 | 48.80 (1.01%) | 35.90 | 221.40 (4.09%) | 45.30 (0.94%) | 52.20 (1.07%) |
| Female | Immature | 43 | 34.90 (0.94%) | 29.40 | 115.20 (2.45%) | 25.90 (0.74%) | 44.00 (1.14%) |
| | Mature | 44 | 62.10 (1.00%) | 42.00 | 197.60 (4.03%) | 49.40 (0.77%) | 74.90 (1.23%) |

Bryde's whale

| Sex | Maturity | Number | Average weight (kg) | S.D. | Maximum weight (kg) | 95%C.I. Lower | 95%C.I. Upper |
|---|---|---|---|---|---|---|---|
| Male | Immature | 57 | 106.80 (1.10%) | 110.90 | 461.30 (4.32%) | 77.30 (0.81%) | 136.20 (1.40%) |
| | Mature | 63 | 118.70 (0.77%) | 141.40 | 448.80 (3.03%) | 83.10 (0.54%) | 154.30 (1.00%) |
| Female | Immature | 51 | 76.40 (0.80%) | 82.10 | 288.30 (3.25%) | 53.30 (0.56%) | 99.50 (1.04%) |
| | Mature | 100 | 157.60 (0.86%) | 172.50 | 715.30 (3.69%) | 123.40 (0.67%) | 191.80 (1.04%) |

Sei whale

| Sex | Maturity | Number | Average weight (kg) | S.D. | Maximum weight (kg) | 95%C.I. Lower | 95%C.I. Upper |
|---|---|---|---|---|---|---|---|
| Male | Immature | 72 | 74.20 (0.53%) | 91.50 | 395.10 (3.03%) | 52.50 (0.37%) | 95.80 (0.69%) |
| | Mature | 194 | 88.40 (0.45%) | 128.10 | 655.50 (3.45%) | 70.20 (0.35%) | 106.60 (0.54%) |
| Female | Immature | 71 | 69.20 (0.43%) | 98.70 | 595.50 (3.08%) | 45.60 (0.29%) | 92.70 (0.56%) |
| | Mature | 231 | 145.30 (0.59%) | 194.90 | 1,270.60 (4.59%) | 120.00 (0.49%) | 170.60 (0.69%) |

**Table 12.** Daily prey consumption estimates (kg) *per capita* of each sex and reproductive status of each whale species in each model.

**Eq-2**

Common minke whales

| Maturity stage | Consumption | CV | 95% CI LL | 95% CI UL |
|---|---|---|---|---|
| Early (May and June) | | | | |
| Immature male | 53 | 0.15 | 42 | 74 |
| Immature female | 52 | 0.15 | 40 | 72 |
| Mature male | 76 | 0.15 | 60 | 106 |
| Mature female | 86 | 0.15 | 67 | 119 |
| Late (July to September) | | | | |
| Immature male | 54 | 0.20 | 41 | 87 |
| Immature female | 55 | 0.20 | 41 | 87 |
| Mature male | 69 | 0.20 | 51 | 111 |
| Mature female | 80 | 0.20 | 60 | 129 |

Bryde's whales

| Maturity stage | Consumption | CV | 95% CI LL | 95% CI UL |
|---|---|---|---|---|
| Early (May and June) | | | | |
| Immature male | 204 | 0.14 | 161 | 273 |
| Immature female | 198 | 0.14 | 156 | 265 |
| Mature male | 268 | 0.14 | 211 | 359 |
| Mature female | 289 | 0.14 | 228 | 387 |
| Late (July to September) | | | | |
| Immature male | 193 | 0.18 | 139 | 282 |
| Immature female | 196 | 0.18 | 142 | 287 |
| Mature male | 243 | 0.19 | 173 | 365 |
| Mature female | 262 | 0.18 | 187 | 381 |

Sei whales

| Maturity stage | Consumption | CV | 95% CI LL | 95% CI UL |
|---|---|---|---|---|
| Early (May and June) | | | | |
| Immature male | 182 | 0.15 | 142 | 247 |
| Immature female | 196 | 0.15 | 152 | 269 |
| Mature male | 217 | 0.15 | 169 | 296 |
| Mature female | 247 | 0.14 | 192 | 336 |
| Late (July to September) | | | | |
| Immature male | 170 | 0.19 | 124 | 259 |
| Immature female | 182 | 0.19 | 132 | 274 |
| Mature male | 208 | 0.19 | 152 | 313 |
| Mature female | 231 | 0.19 | 168 | 348 |

**Eq-3-1**

Common minke whales

| Maturity stage | Consumption | CV | 95% CI LL | 95% CI UL |
|---|---|---|---|---|
| Early (May and June) | | | | |
| Immature male | 108 | 0.15 | 85 | 150 |
| Immature female | 103 | 0.15 | 81 | 143 |
| Mature male | 184 | 0.15 | 143 | 256 |
| Mature female | 220 | 0.15 | 171 | 306 |
| Late (July to September) | | | | |
| Immature male | 120 | 0.20 | 90 | 191 |
| Immature female | 120 | 0.20 | 89 | 193 |
| Mature male | 169 | 0.20 | 125 | 270 |
| Mature female | 211 | 0.20 | 159 | 343 |

Bryde's whales

| Maturity stage | Consumption | CV | 95% CI LL | 95% CI UL |
|---|---|---|---|---|
| Early (May and June) | | | | |
| Immature male | 590 | 0.14 | 464 | 792 |
| Immature female | 565 | 0.14 | 446 | 755 |
| Mature male | 889 | 0.14 | 702 | 1,183 |
| Mature female | 994 | 0.14 | 784 | 1,327 |
| Late (July to September) | | | | |
| Immature male | 412 | 0.18 | 412 | 828 |
| Immature female | 586 | 0.19 | 417 | 855 |
| Mature male | 806 | 0.18 | 582 | 1,179 |
| Mature female | 903 | 0.19 | 645 | 1,322 |

Sei whales

| Maturity stage | Consumption | CV | 95% CI LL | 95% CI UL |
|---|---|---|---|---|
| Early (May and June) | | | | |
| Immature male | 585 | 0.15 | 456 | 797 |
| Immature female | 654 | 0.15 | 512 | 898 |
| Mature male | 762 | 0.15 | 598 | 1,042 |
| Mature female | 923 | 0.15 | 720 | 1,264 |
| Late (July to September) | | | | |
| Immature male | 553 | 0.19 | 402 | 836 |
| Immature female | 610 | 0.19 | 442 | 925 |
| Mature male | 742 | 0.19 | 543 | 1,129 |
| Mature female | 872 | 0.19 | 635 | 1,318 |

**Eq-4**

Common minke whales

| Maturity stage | Consumption | CV | 95% CI LL | 95% CI UL |
|---|---|---|---|---|
| Early (May and June) | | | | |
| Immature male | 98 | 0.15 | 76 | 136 |
| Immature female | 93 | 0.15 | 72 | 129 |
| Mature male | 162 | 0.15 | 127 | 227 |
| Mature female | 193 | 0.15 | 151 | 268 |
| Late (July to September) | | | | |
| Immature male | 107 | 0.20 | 80 | 170 |
| Immature female | 107 | 0.20 | 80 | 174 |
| Mature male | 149 | 0.20 | 112 | 239 |
| Mature female | 184 | 0.20 | 137 | 295 |

Bryde's whales

| Maturity stage | Consumption | CV | 95% CI LL | 95% CI UL |
|---|---|---|---|---|
| Early (May and June) | | | | |
| Immature male | 508 | 0.14 | 404 | 679 |
| Immature female | 488 | 0.14 | 386 | 647 |
| Mature male | 753 | 0.14 | 596 | 1,013 |
| Mature female | 837 | 0.14 | 659 | 1,121 |
| Late (July to September) | | | | |
| Immature male | 491 | 0.18 | 352 | 718 |
| Immature female | 502 | 0.19 | 357 | 735 |
| Mature male | 682 | 0.19 | 485 | 1,000 |
| Mature female | 760 | 0.18 | 543 | 1,105 |

Sei whales

| Maturity stage | Consumption | CV | 95% CI LL | 95% CI UL |
|---|---|---|---|---|
| Early (May and June) | | | | |
| Immature male | 497 | 0.15 | 390 | 679 |
| Immature female | 553 | 0.15 | 433 | 754 |
| Mature male | 640 | 0.15 | 502 | 874 |
| Mature female | 770 | 0.15 | 602 | 1,048 |
| Late (July to September) | | | | |
| Immature male | 469 | 0.19 | 343 | 716 |
| Immature female | 516 | 0.19 | 373 | 780 |
| Mature male | 622 | 0.19 | 456 | 949 |
| Mature female | 727 | 0.19 | 529 | 1,108 |

**Combined**

Common minke whales

| Maturity stage | Consumption | CV | 95% CI LL | 95% CI UL |
|---|---|---|---|---|
| Early (May and June) | | | | |
| Immature male | 86 | 0.20 | 56 | 125 |
| Immature female | 83 | 0.20 | 54 | 119 |
| Mature male | 141 | 0.23 | 84 | 209 |
| Mature female | 166 | 0.23 | 99 | 249 |
| Late (July to September) | | | | |
| Immature male | 94 | 0.25 | 58 | 154 |
| Immature female | 94 | 0.25 | 58 | 155 |
| Mature male | 129 | 0.26 | 76 | 212 |
| Mature female | 158 | 0.27 | 91 | 265 |

Bryde's whales

| Maturity stage | Consumption | CV | 95% CI LL | 95% CI UL |
|---|---|---|---|---|
| Early (May and June) | | | | |
| Immature male | 434 | 0.24 | 246 | 637 |
| Immature female | 417 | 0.24 | 235 | 614 |
| Mature male | 637 | 0.26 | 330 | 953 |
| Mature female | 707 | 0.26 | 373 | 1,063 |
| Late (July to September) | | | | |
| Immature male | 419 | 0.27 | 221 | 655 |
| Immature female | 428 | 0.28 | 225 | 674 |
| Mature male | 577 | 0.29 | 287 | 918 |
| Mature female | 642 | 0.29 | 318 | 1,014 |

Sei whales

| Maturity stage | Consumption | CV | 95% CI LL | 95% CI UL |
|---|---|---|---|---|
| Early (May and June) | | | | |
| Immature male | 421 | 0.15 | 328 | 577 |
| Immature female | 468 | 0.15 | 364 | 640 |
| Mature male | 539 | 0.15 | 420 | 736 |
| Mature female | 647 | 0.15 | 503 | 884 |
| Late (July to September) | | | | |
| Immature male | 397 | 0.19 | 288 | 600 |
| Immature female | 436 | 0.19 | 318 | 663 |
| Mature male | 524 | 0.19 | 280 | 797 |
| Mature female | 610 | 0.19 | 450 | 926 |

**Table 13.** Seasonal prey consumption (thousand tons) consumed by whales in each model.

**Eq-2**

Common minke whales

| Period/Species | Consumption | CV | 95% CI LL | 95% CI UL |
|---|---|---|---|---|
| 2000-2007 | 45 | 0.32 | 33 | 115 |
| Krill | 2 | 0.33 | 1 | 5 |
| Anchovy | 19 | 0.38 | 12 | 52 |
| Saury | 22 | 0.29 | 16 | 52 |
| 2008-2014 | 38 | 0.31 | 29 | 97 |
| Krill | 10 | 0.35 | 7 | 27 |
| Anchovy | 8 | 0.32 | 6 | 21 |
| Saury | 13 | 0.45 | 7 | 44 |

Bryde's whales

| Period/Species | Consumption | CV | 95% CI LL | 95% CI UL |
|---|---|---|---|---|
| 2000-2007 | 216 | 0.24 | 153 | 398 |
| Krill | 32 | 0.26 | 24 | 67 |
| Anchovy | 180 | 0.25 | 124 | 329 |
| Sardine | 0 | | | |
| Mackerels | 1 | 0.03 | 1 | 1 |
| 2008-2014 | 310 | 0.35 | 191 | 760 |
| Krill | 77 | 0.39 | 42 | 200 |
| Anchovy | 222 | 0.35 | 138 | 536 |
| Sardine | 2 | 0.40 | 1 | 5 |
| Mackerels | 2 | 0.40 | 1 | 5 |

Sei whales

| Period/Species | Consumption | CV | 95% CI LL | 95% CI UL |
|---|---|---|---|---|
| 2002-2007 | 211 | 0.18 | 164 | 332 |
| Copepods | 31 | 0.18 | 24 | 49 |
| Krill | 49 | 0.19 | 37 | 79 |
| Anchovy | 108 | 0.19 | 83 | 170 |
| Saury | 6 | 0.23 | 4 | 11 |
| Mackerels | 17 | 0.22 | 12 | 28 |
| 2008-2014 | 176 | 0.21 | 132 | 292 |
| Copepods | 62 | 0.17 | 48 | 93 |
| Krill | 13 | 0.19 | 10 | 21 |
| Anchovy | 58 | 0.27 | 40 | 110 |
| Saury | 9 | 0.25 | 6 | 17 |
| Mackerels | 26 | 0.21 | 20 | 43 |

**Eq-3-1**

Common minke whales

| Period/Species | Consumption | CV | 95% CI LL | 95% CI UL |
|---|---|---|---|---|
| 2000-2007 | 107 | 0.31 | 80 | 270 |
| Krill | 4 | 0.33 | 3 | 11 |
| Anchovy | 44 | 0.38 | 28 | 124 |
| Saury | 52 | 0.29 | 39 | 125 |
| 2008-2014 | 91 | 0.30 | 69 | 233 |
| Krill | 24 | 0.35 | 16 | 62 |
| Anchovy | 19 | 0.32 | 14 | 50 |
| Saury | 33 | 0.45 | 17 | 107 |

Bryde's whales

| Period/Species | Consumption | CV | 95% CI LL | 95% CI UL |
|---|---|---|---|---|
| 2000-2007 | 698 | 0.25 | 494 | 1,296 |
| Krill | 103 | 0.26 | 78 | 218 |
| Anchovy | 581 | 0.25 | 397 | 1,050 |
| Sardine | 0 | | | |
| Mackerels | 1 | 0.08 | 1 | 1 |
| 2008-2014 | 990 | 0.36 | 600 | 2,412 |
| Krill | 244 | 0.26 | 136 | 631 |
| Anchovy | 709 | 0.35 | 449 | 1,702 |
| Sardine | 6 | 0.41 | 3 | 16 |
| Mackerels | 5 | 0.38 | 3 | 13 |

Sei whales

| Period/Species | Consumption | CV | 95% CI LL | 95% CI UL |
|---|---|---|---|---|
| 2002-2007 | 754 | 0.18 | 581 | 1,188 |
| Copepods | 111 | 0.18 | 85 | 174 |
| Krill | 176 | 0.19 | 134 | 282 |
| Anchovy | 385 | 0.19 | 296 | 611 |
| Saury | 22 | 0.23 | 16 | 38 |
| Mackerels | 60 | 0.22 | 43 | 100 |
| 2008-2014 | 626 | 0.21 | 467 | 1,044 |
| Copepods | 220 | 0.17 | 172 | 330 |
| Krill | 48 | 0.19 | 37 | 76 |
| Anchovy | 209 | 0.26 | 144 | 393 |
| Saury | 32 | 0.25 | 23 | 59 |
| Mackerels | 93 | 0.20 | 71 | 154 |

**Eq-4**

Common minke whales

| Period/Species | Consumption | CV | 95% CI LL | 95% CI UL |
|---|---|---|---|---|
| 2000-2007 | 95 | 0.32 | 80 | 270 |
| Krill | 4 | 0.33 | 3 | 10 |
| Anchovy | 39 | 0.38 | 25 | 111 |
| Saury | 46 | 0.29 | 34 | 110 |
| 2008-2014 | 80 | 0.31 | 59 | 203 |
| Krill | 22 | 0.36 | 14 | 55 |
| Anchovy | 17 | 0.32 | 13 | 45 |
| Saury | 29 | 0.45 | 16 | 95 |

Bryde's whales

| Period/Species | Consumption | CV | 95% CI LL | 95% CI UL |
|---|---|---|---|---|
| 2000-2007 | 593 | 0.25 | 417 | 1,092 |
| Krill | 88 | 0.26 | 66 | 185 |
| Anchovy | 493 | 0.26 | 333 | 905 |
| Sardine | 0 | | | |
| Mackerels | 1 | 0.08 | 1 | 1 |
| 2008-2014 | 842 | 0.35 | 521 | 2,040 |
| Krill | 208 | 0.39 | 114 | 533 |
| Anchovy | 603 | 0.35 | 377 | 1,441 |
| Sardine | 5 | 0.41 | 3 | 13 |
| Mackerels | 4 | 0.38 | 2 | 11 |

Sei whales

| Period/Species | Consumption | CV | 95% CI LL | 95% CI UL |
|---|---|---|---|---|
| 2002-2007 | 632 | 0.18 | 485 | 995 |
| Copepods | 93 | 0.18 | 72 | 145 |
| Krill | 148 | 0.19 | 113 | 236 |
| Anchovy | 323 | 0.19 | 248 | 512 |
| Saury | 19 | 0.23 | 13 | 32 |
| Mackerels | 50 | 0.22 | 36 | 83 |
| 2008-2014 | 525 | 0.21 | 392 | 876 |
| Copepods | 185 | 0.17 | 144 | 275 |
| Krill | 40 | 0.19 | 31 | 63 |
| Anchovy | 175 | 0.26 | 120 | 327 |
| Saury | 27 | 0.25 | 19 | 49 |
| Mackerels | 78 | 0.20 | 59 | 128 |

**Combined**

Common minke whales

| Period/Species | Consumption | CV | 95% CI LL | 95% CI UL |
|---|---|---|---|---|
| 2000-2007 | 82 | 0.34 | 55 | 207 |
| Krill | 3 | 0.36 | 2 | 9 |
| Anchovy | 34 | 0.41 | 20 | 96 |
| Saury | 40 | 0.32 | 27 | 95 |
| 2008-2014 | 70 | 0.33 | 47 | 176 |
| Krill | 19 | 0.39 | 11 | 48 |
| Anchovy | 15 | 0.35 | 10 | 40 |
| Saury | 25 | 0.50 | 12 | 85 |

Bryde's whales

| Period/Species | Consumption | CV | 95% CI LL | 95% CI UL |
|---|---|---|---|---|
| 2000-2007 | 502 | 0.30 | 291 | 950 |
| Krill | 74 | 0.31 | 47 | 158 |
| Anchovy | 418 | 0.32 | 225 | 783 |
| Sardine | 0 | | | |
| Mackerels | 1 | 0.08 | 1 | 1 |
| 2008-2014 | 714 | 0.41 | 371 | 1,760 |
| Krill | 176 | 0.45 | 80 | 462 |
| Anchovy | 511 | 0.40 | 273 | 1,239 |
| Sardine | 4 | 0.46 | 2 | 12 |
| Mackerels | 4 | 0.44 | 2 | 10 |

Sei whales

| Period/Species | Consumption | CV | 95% CI LL | 95% CI UL |
|---|---|---|---|---|
| 2002-2007 | 533 | 0.24 | 332 | 868 |
| Copepods | 78 | 0.25 | 48 | 128 |
| Krill | 124 | 0.26 | 75 | 209 |
| Anchovy | 272 | 0.25 | 165 | 452 |
| Saury | 16 | 0.30 | 8 | 29 |
| Mackerels | 42 | 0.30 | 23 | 75 |
| 2008-2014 | 442 | 0.27 | 264 | 764 |
| Copepods | 155 | 0.24 | 96 | 243 |
| Krill | 34 | 0.25 | 21 | 56 |
| Anchovy | 148 | 0.33 | 80 | 286 |
| Saury | 23 | 0.31 | 13 | 43 |
| Mackerels | 66 | 0.26 | 40 | 112 |

**Table 14.** The comparison among the prey consumption of three baleen whale species, the catch of fisheries and the abundance of fishes.

Japanese anchovy

| Year | Catch | Abundance | % | Estimated prey consumption by three baleen whale species (thousand tons) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Eq-2 | % of biomass | Eq 3-1 | % of biomass | Eq 4 | % of biomass | Eq combined | % of biomass |
| 2000 | 213.0 | N.D. | - | 307.0 | - | 1,010.0 | - | 855.0 | - | 724.0 | - |
| 2001 | 198.0 | N.D. | - | 307.0 | - | 1,010.0 | - | 855.0 | - | 724.0 | - |
| 2002 | 334.0 | N.D. | - | 307.0 | - | 1,010.0 | - | 855.0 | - | 724.0 | - |
| 2003 | 408.0 | N.D. | - | 307.0 | - | 1,010.0 | - | 855.0 | - | 724.0 | - |
| 2004 | 402.0 | 2,840.0 | 14.2 | 307.0 | 10.8 | 1,010.0 | 35.6 | 855.0 | 30.1 | 724.0 | 25.5 |
| 2005 | 238.0 | 1,520.0 | 15.7 | 307.0 | 20.2 | 1,010.0 | 66.4 | 855.0 | 56.3 | 724.0 | 47.6 |
| 2006 | 303.0 | 3,360.0 | 9.0 | 307.0 | 9.1 | 1,010.0 | 30.1 | 855.0 | 25.4 | 724.0 | 21.5 |
| 2007 | 242.0 | 2,760.0 | 8.8 | 307.0 | 11.1 | 1,010.0 | 36.6 | 855.0 | 31.0 | 724.0 | 26.2 |
| 2008 | 209.0 | N.D. | - | 288.0 | - | 937.0 | - | 795.0 | - | 674.0 | - |
| 2009 | 241.0 | N.D. | - | 288.0 | - | 937.0 | - | 795.0 | - | 674.0 | - |
| 2010 | 248.0 | N.D. | - | 288.0 | - | 937.0 | - | 795.0 | - | 674.0 | - |
| 2011 | 160.0 | N.D. | - | 288.0 | - | 937.0 | - | 795.0 | - | 674.0 | - |
| 2012 | 155.0 | N.D. | - | 288.0 | - | 937.0 | - | 795.0 | - | 674.0 | - |
| 2013 | 155.0 | N.D. | - | 288.0 | - | 937.0 | - | 795.0 | - | 674.0 | - |

Mackerels

| Year | Catch | Abundance | % | Estimated prey consumption by three baleen whale species (thousand tons) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Eq-2 | % of biomass | Eq 3-1 | % of biomass | Eq 4 | % of biomass | Eq combined | % of biomass |
| 2000 | 93.7 | 243.0 | 38.6 | 17.8 | 7.3 | 61.0 | 25.1 | 51.0 | 21.0 | 43.0 | 17.7 |
| 2001 | 55.8 | 152.0 | 36.7 | 17.8 | 11.7 | 61.0 | 40.1 | 51.0 | 33.6 | 43.0 | 28.3 |
| 2002 | 48.2 | 210.0 | 22.9 | 17.8 | 8.5 | 61.0 | 29.0 | 51.0 | 24.3 | 43.0 | 20.5 |
| 2003 | 76.7 | 230.0 | 33.3 | 17.8 | 7.7 | 61.0 | 26.5 | 51.0 | 22.2 | 43.0 | 18.7 |
| 2004 | 180.7 | 743.0 | 24.3 | 17.8 | 2.4 | 61.0 | 8.2 | 51.0 | 6.9 | 43.0 | 5.8 |
| 2005 | 226.5 | 868.0 | 26.1 | 17.8 | 2.1 | 61.0 | 7.0 | 51.0 | 5.9 | 43.0 | 5.0 |
| 2006 | 239.0 | 786.0 | 30.4 | 17.8 | 2.3 | 61.0 | 7.8 | 51.0 | 6.5 | 43.0 | 5.5 |
| 2007 | 182.1 | 614.0 | 29.7 | 17.8 | 2.9 | 61.0 | 9.9 | 51.0 | 8.3 | 43.0 | 7.0 |
| 2008 | 173.4 | 550.0 | 31.5 | 28.0 | 5.1 | 98.0 | 17.8 | 82.0 | 14.9 | 70.0 | 12.7 |
| 2009 | 127.2 | 649.0 | 19.6 | 28.0 | 4.3 | 98.0 | 15.1 | 82.0 | 12.6 | 70.0 | 10.8 |
| 2010 | 123.3 | 862.0 | 14.3 | 28.0 | 3.2 | 98.0 | 11.4 | 82.0 | 9.5 | 70.0 | 8.1 |
| 2011 | 103.0 | 106.0 | 97.2 | 28.0 | 26.4 | 98.0 | 92.5 | 82.0 | 77.4 | 70.0 | 66.0 |
| 2012 | 122.0 | 1030.0 | 11.8 | 28.0 | 2.7 | 98.0 | 9.5 | 82.0 | 8.0 | 70.0 | 6.8 |
| 2013 | 220.0 | 1360.0 | 16.2 | 28.0 | 2.1 | 98.0 | 7.2 | 82.0 | 6.0 | 70.0 | 5.1 |

Pacific saury

| Year | Catch | Abundance | % | Estimated prey consumption by three baleen whale species (thousand tons) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Eq-2 | % of biomass | Eq 3-1 | % of biomass | Eq 4 | % of biomass | Eq combined | % of biomass |
| 2000 | 281.9 | N.D. | - | 28.0 | - | 74.0 | - | 65.0 | - | 56.0 | - |
| 2001 | 367.4 | N.D. | - | 28.0 | - | 74.0 | - | 65.0 | - | 56.0 | - |
| 2002 | 328.6 | N.D. | - | 28.0 | - | 74.0 | - | 65.0 | - | 56.0 | - |
| 2003 | 440.3 | 2,490.5 | 17.7 | 28.0 | 1.1 | 74.0 | 3.0 | 65.0 | 2.6 | 56.0 | 2.2 |
| 2004 | 353.8 | 2,634.5 | 13.4 | 28.0 | 1.1 | 74.0 | 2.8 | 65.0 | 2.5 | 56.0 | 2.1 |
| 2005 | 469.1 | 2,355.5 | 19.9 | 28.0 | 1.2 | 74.0 | 3.1 | 65.0 | 2.8 | 56.0 | 2.4 |
| 2006 | 389.6 | 2,207.0 | 17.7 | 28.0 | 1.3 | 74.0 | 3.4 | 65.0 | 2.9 | 56.0 | 2.5 |
| 2007 | 519.3 | 1,135.5 | 45.7 | 28.0 | 2.5 | 74.0 | 6.5 | 65.0 | 5.7 | 56.0 | 4.9 |
| 2008 | 606.0 | 2,435.0 | 24.9 | 22.0 | 0.9 | 65.0 | 2.7 | 56.0 | 2.3 | 48.0 | 2.0 |
| 2009 | 469.7 | 2,097.0 | 22.4 | 22.0 | 1.0 | 65.0 | 3.1 | 56.0 | 2.7 | 48.0 | 2.3 |
| 2010 | 415.7 | 690.5 | 60.2 | 22.0 | 3.2 | 65.0 | 9.4 | 56.0 | 8.1 | 48.0 | 7.0 |
| 2011 | 448.7 | 1,248.5 | 35.9 | 22.0 | 1.8 | 65.0 | 5.2 | 56.0 | 4.5 | 48.0 | 3.8 |
| 2012 | 455.4 | 817.5 | 55.7 | 22.0 | 2.7 | 65.0 | 8.0 | 56.0 | 6.9 | 48.0 | 5.9 |
| 2013 | 404.0 | 1,008.0 | 40.1 | 22.0 | 2.2 | 65.0 | 6.4 | 56.0 | 5.6 | 48.0 | 4.8 |

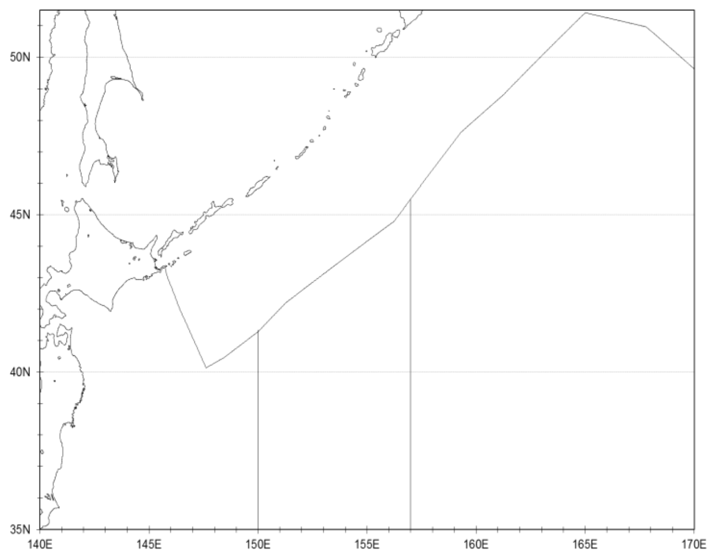



**Figure 1.** The definition of sub-areas for research area.

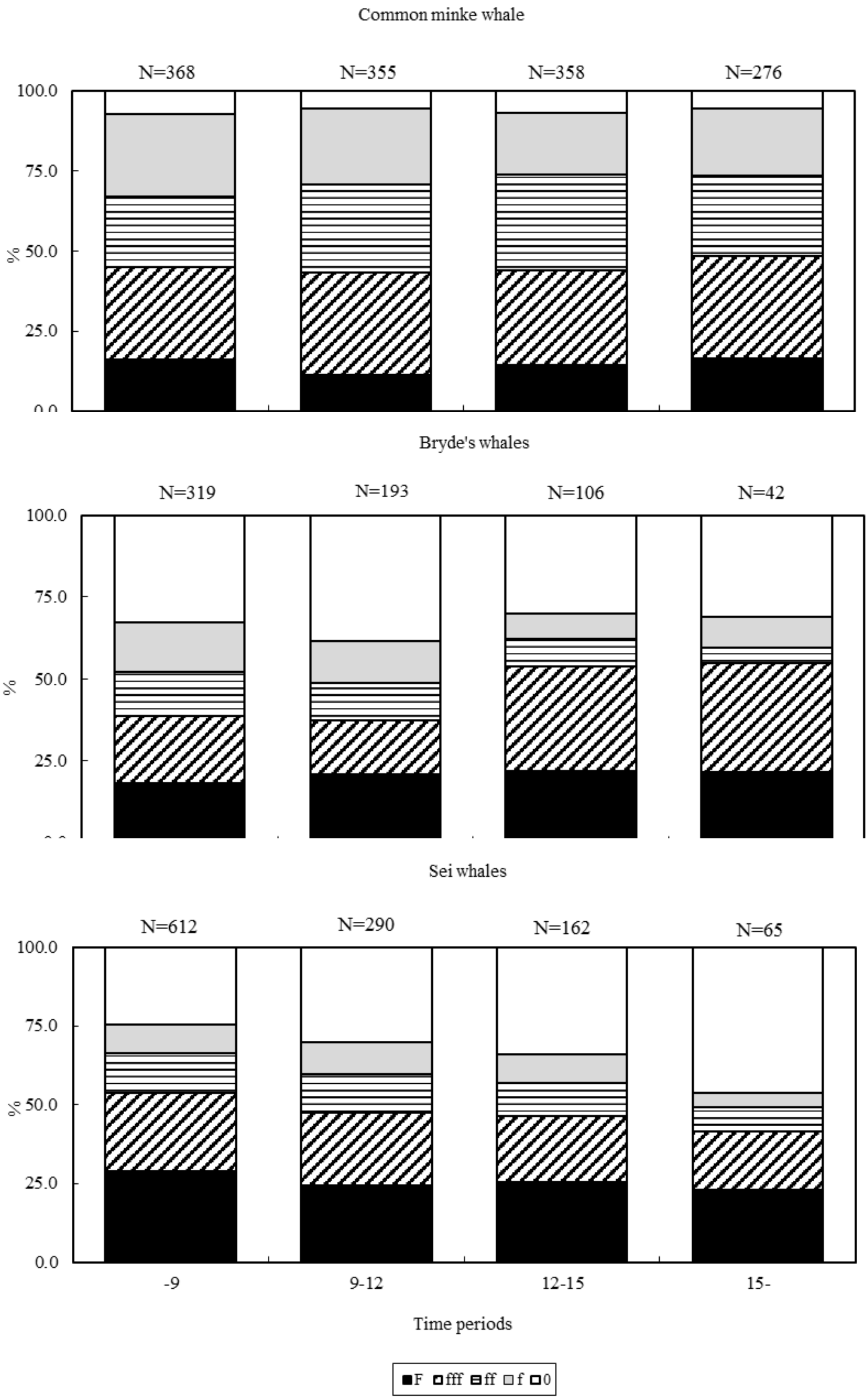



**Figure 2.** Composition of prey freshness categories throughout the day in each whale species

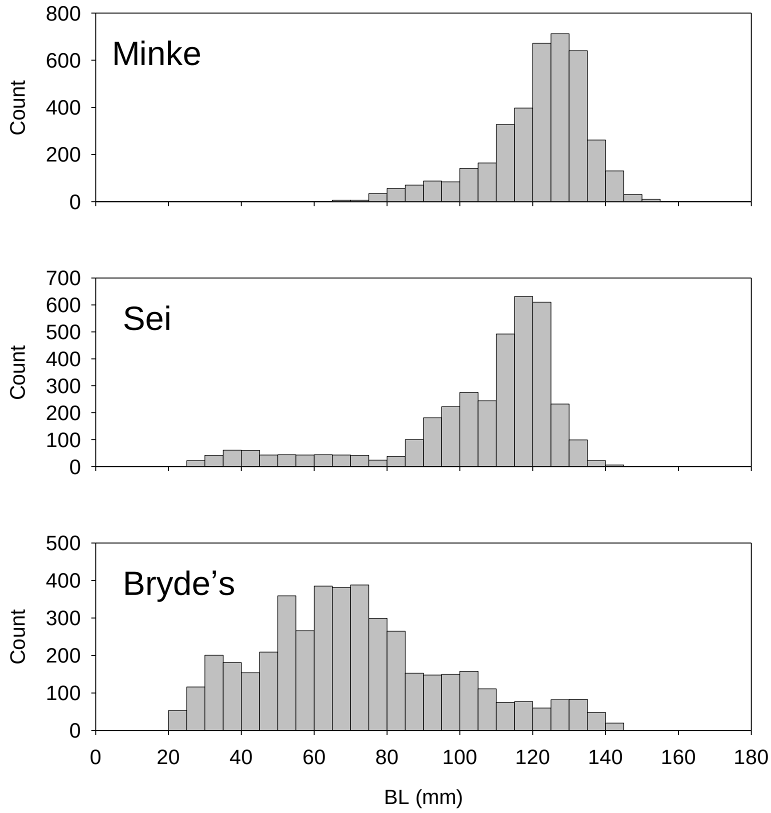



**Figure 3-1.** The size distribution of Japanese anchovy in the stomach contents of three baleen whale species.

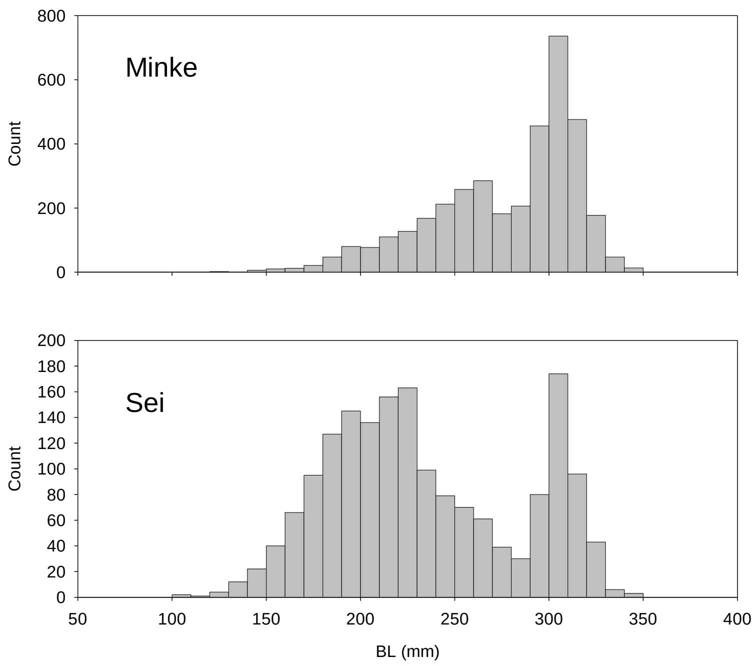



**Figure 3-2.** The size distribution of Pacific saury in the stomach contents of three baleen whales.

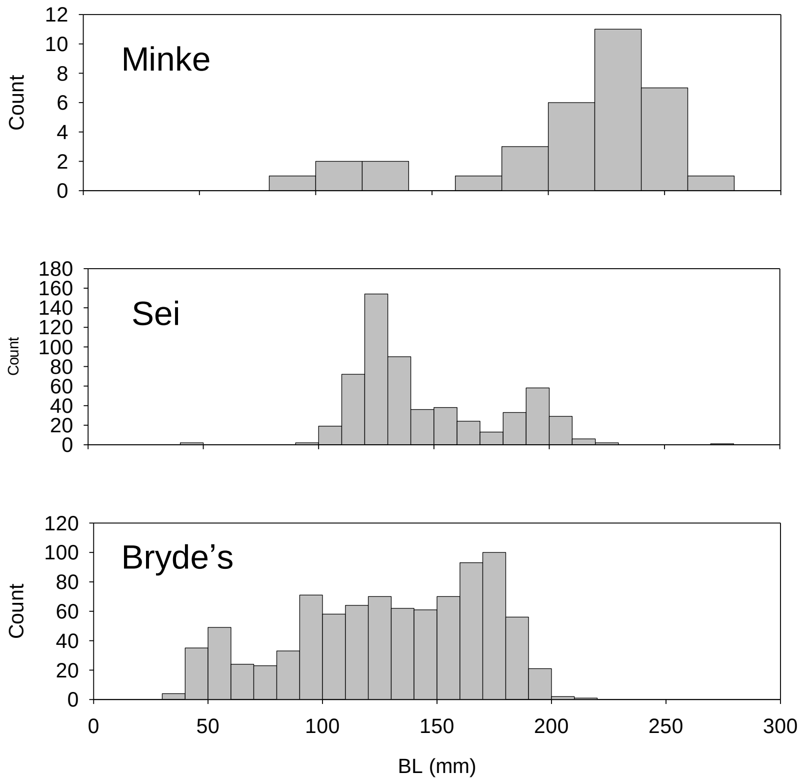
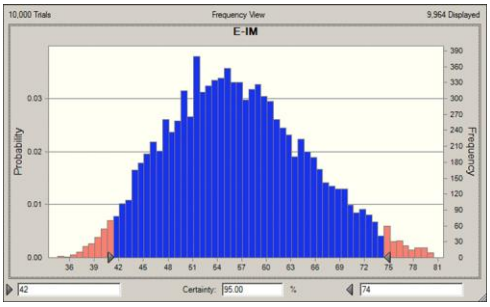



**Figure 3-3.** The size distribution of mackerels in the stomach contents of three baleen whales.

# Appendix 1. The results of simulations

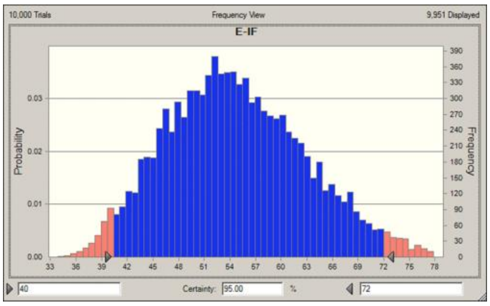
- Daily consumption of common minke whales *per capita*
- Equation-2
- Early season (May and June)

Immature male



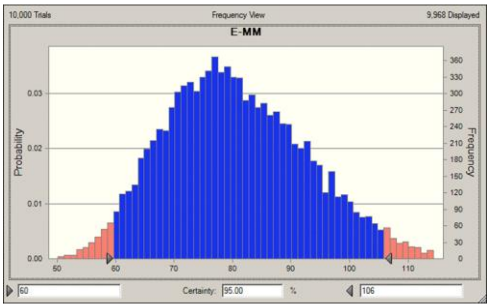

| Forecast: E-IM | |
|---|---|
| Statistic | Forecast va |
| Trials | 10,000 |
| Base Case | 53 |
| Mean | 57 |
| Median | 56 |
| Mode | '--- |
| Standard D | 9 |
| Variance | 73 |
| Skewness | 0.3002 |
| Kurtosis | 2.72 |
| Coeff. of V | 0.1513 |
| Minimum | 35 |
| Maximum | 89 |
| Mean Std. | 0 |

Immature female



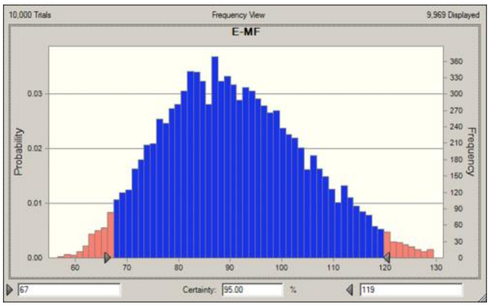

| Forecast: E-IF | |
|---|---|
| Statistic | Forecast va |
| Trials | 10,000 |
| Base Case | 52 |
| Mean | 55 |
| Median | 54 |
| Mode | '--- |
| Standard D | 8 |
| Variance | 67 |
| Skewness | 0.3433 |
| Kurtosis | 2.82 |
| Coeff. of V | 0.1499 |
| Minimum | 34 |
| Maximum | 86 |
| Mean Std. | 0 |

Mature male




| Forecast: E-MM | |
|---|---|
| Statistic | Forecast va |
| Trials | 10,000 |
| Base Case | 76 |
| Mean | 81 |
| Median | 80 |
| Mode | '--- |
| Standard D | 12 |
| Variance | 145 |
| Skewness | 0.3214 |
| Kurtosis | 2.71 |
| Coeff. of V | 0.1494 |
| Minimum | 50 |
| Maximum | 121 |
| Mean Std. | 0 |

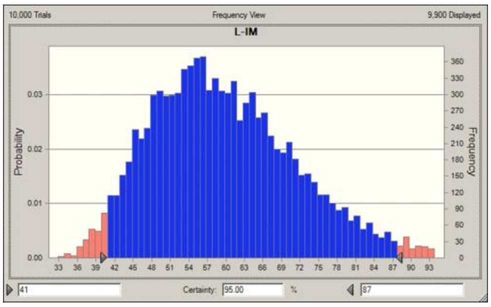
Mature female




| Forecast: E-MF | |
|---|---|
| Statistic | Forecast va |
| Trials | 10,000 |
| Base Case | 86 |
| Mean | 91 |
| Median | 90 |
| Mode | '--- |
| Standard D | 14 |
| Variance | 189 |
| Skewness | 0.3165 |
| Kurtosis | 2.69 |
| Coeff. of V | 0.1515 |
| Minimum | 57 |
| Maximum | 140 |
| Mean Std. | 0 |

- Daily consumption of common minke whales *per capita*
- Equation-2
- Late season (From July to September)

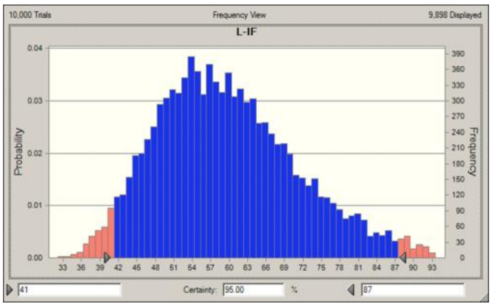
Immature male




Forecast: L-IM

| Statistic | Forecast va |
|---|---|
| Trials | 10,000 |
| Base Case | 54 |
| Mean | 60 |
| Median | 59 |
| Mode | '--- |
| Standard D | 12 |
| Variance | 145 |
| Skewness | 0.647 |
| Kurtosis | 3.39 |
| Coeff. of V | 0.2003 |
| Minimum | 33 |
| Maximum | 113 |
| Mean Std. | 0 |

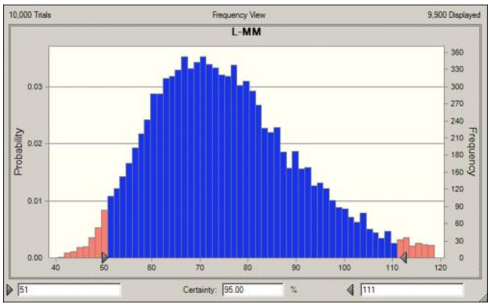
Immature female




Forecast: L-IF

| Statistic | Forecast va |
|---|---|
| Trials | 10,000 |
| Base Case | 55 |
| Mean | 60 |
| Median | 59 |
| Mode | '--- |
| Standard D | 12 |
| Variance | 142 |
| Skewness | 0.6573 |
| Kurtosis | 3.43 |
| Coeff. of V | 0.1989 |
| Minimum | 32 |
| Maximum | 113 |
| Mean Std. | 0 |

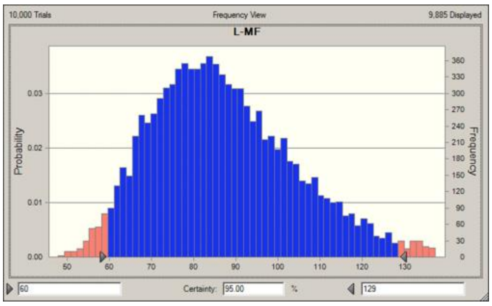
Mature male




Forecast: L-MM

| Statistic | Forecast va |
|---|---|
| Trials | 10,000 |
| Base Case | 69 |
| Mean | 76 |
| Median | 74 |
| Mode | '--- |
| Standard D | 15 |
| Variance | 236 |
| Skewness | 0.668 |
| Kurtosis | 3.43 |
| Coeff. of V | 0.2034 |
| Minimum | 40 |
| Maximum | 144 |
| Mean Std. | 0 |

Mature female

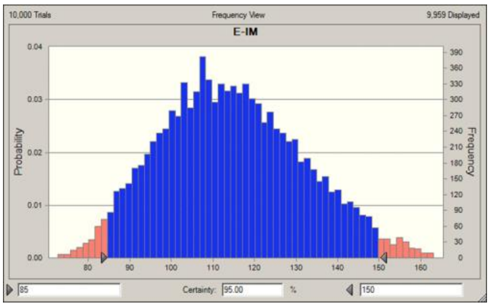



Forecast: L-MF

| Statistic | Forecast va |
|---|---|
| Trials | 10,000 |
| Base Case | 80 |
| Mean | 88 |
| Median | 85 |
| Mode | '--- |
| Standard D | 18 |
| Variance | 313 |
| Skewness | 0.7169 |
| Kurtosis | 3.57 |
| Coeff. of V | 0.2018 |
| Minimum | 48 |
| Maximum | 166 |
| Mean Std. | 0 |

- Daily consumption of common minke whales *per capita*
- Equation-3-1
- Early season (May and June)

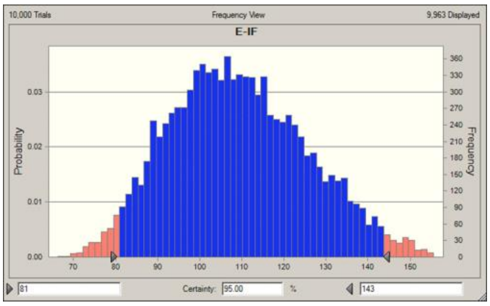
Immature male




Forecast: E-IM

| Statistic | Forecast va |
|---|---|
| Trials | 10,000 |
| Base Case | 108 |
| Mean | 115 |
| Median | 114 |
| Mode | '--- |
| Standard D | 17 |
| Variance | 297 |
| Skewness | 0.314 |
| Kurtosis | 2.76 |
| Coeff. of V | 0.1501 |
| Minimum | 73 |
| Maximum | 180 |
| Mean Std. | 0 |

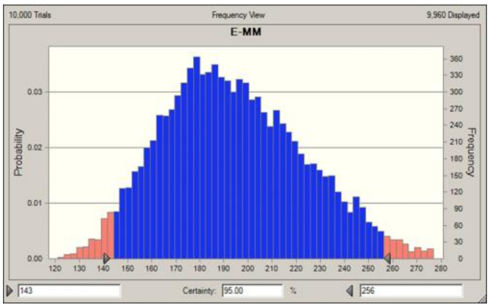
Immature female




Forecast: E-IF

| Statistic | Forecast va |
|---|---|
| Trials | 10,000 |
| Base Case | 103 |
| Mean | 109 |
| Median | 108 |
| Mode | '--- |
| Standard D | 16 |
| Variance | 271 |
| Skewness | 0.3159 |
| Kurtosis | 2.75 |
| Coeff. of V | 0.1506 |
| Minimum | 66 |
| Maximum | 171 |
| Mean Std. | 0 |

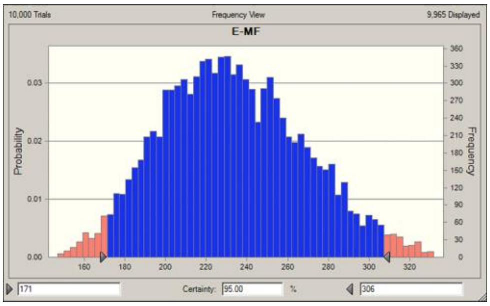
Mature male




Forecast: E-MM

| Statistic | Forecast va |
|---|---|
| Trials | 10,000 |
| Base Case | 184 |
| Mean | 194 |
| Median | 192 |
| Mode | '--- |
| Standard D | 30 |
| Variance | 871 |
| Skewness | 0.3591 |
| Kurtosis | 2.79 |
| Coeff. of V | 0.1520 |
| Minimum | 121 |
| Maximum | 311 |
| Mean Std. | 0 |

Mature female

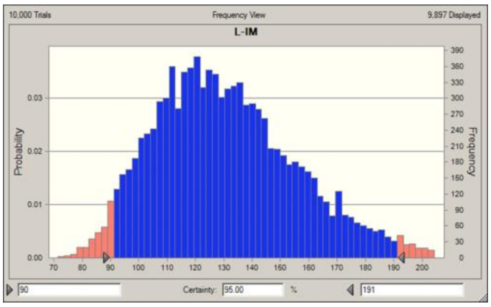



Forecast: E-MF

| Statistic | Forecast va |
|---|---|
| Trials | 10,000 |
| Base Case | 220 |
| Mean | 233 |
| Median | 231 |
| Mode | '--- |
| Standard D | 35 |
| Variance | 1,232 |
| Skewness | 0.2926 |
| Kurtosis | 2.75 |
| Coeff. of V | 0.1504 |
| Minimum | 147 |
| Maximum | 356 |
| Mean Std. | 0 |

- Daily consumption of common minke whales *per capita*
- Equation-3-1
- Late season (From July to September)

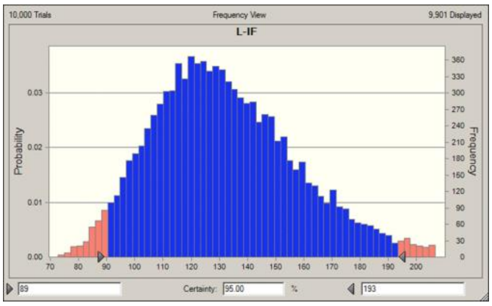
Immature male




Forecast: L-IM

| Statistic | Forecast va |
|---|---|
| Trials | 10,000 |
| Base Case | 120 |
| Mean | 131 |
| Median | 128 |
| Mode | '--- |
| Standard D | 26 |
| Variance | 676 |
| Skewness | 0.6605 |
| Kurtosis | 3.42 |
| Coeff. of V | 0.1979 |
| Minimum | 72 |
| Maximum | 245 |
| Mean Std. | 0 |

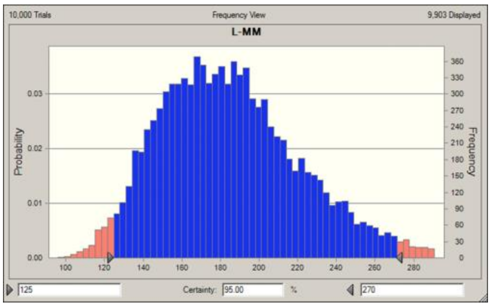
Immature female




Forecast: L-IF

| Statistic | Forecast va |
|---|---|
| Trials | 10,000 |
| Base Case | 120 |
| Mean | 133 |
| Median | 130 |
| Mode | '--- |
| Standard D | 26 |
| Variance | 696 |
| Skewness | 0.6502 |
| Kurtosis | 3.48 |
| Coeff. of V | 0.1988 |
| Minimum | 73 |
| Maximum | 258 |
| Mean Std. | 0 |

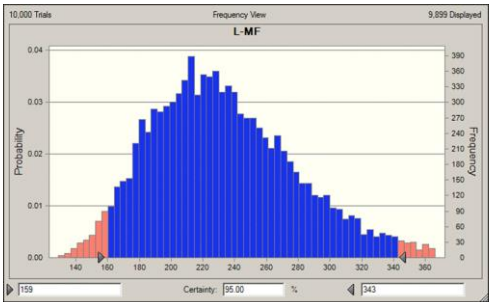
Mature male




Forecast: L-MM

| Statistic | Forecast va |
|---|---|
| Trials | 10,000 |
| Base Case | 169 |
| Mean | 186 |
| Median | 182 |
| Mode | '--- |
| Standard D | 37 |
| Variance | 1,397 |
| Skewness | 0.6494 |
| Kurtosis | 3.48 |
| Coeff. of V | 0.2011 |
| Minimum | 96 |
| Maximum | 357 |
| Mean Std. | 0 |

Mature female

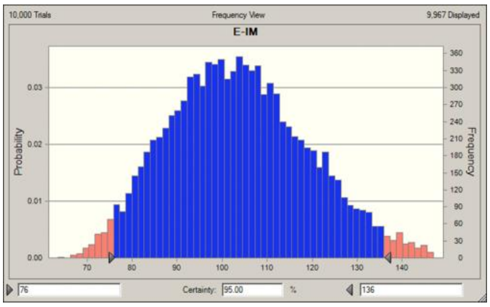



Forecast: L-MF

| Statistic | Forecast va |
|---|---|
| Trials | 10,000 |
| Base Case | 211 |
| Mean | 234 |
| Median | 229 |
| Mode | '--- |
| Standard D | 47 |
| Variance | 2,214 |
| Skewness | 0.6536 |
| Kurtosis | 3.39 |
| Coeff. of V | 0.2009 |
| Minimum | 129 |
| Maximum | 459 |
| Mean Std. | 0 |

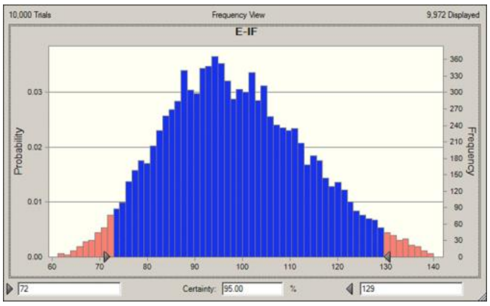
- Daily consumption of common minke whales *per capita*
- Equation-4
- Early season (May and June)

Immature male



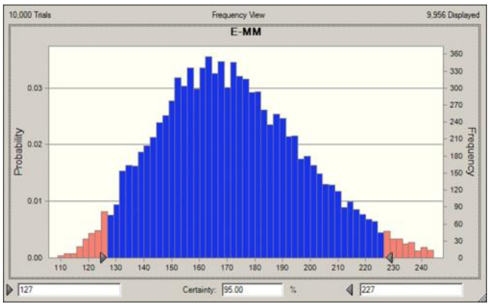

| Forecast: E-IM | |
|---|---|
| Statistic | Forecast va |
| Trials | 10,000 |
| Base Case | 98 |
| Mean | 104 |
| Median | 103 |
| Mode | '--- |
| Standard D | 15 |
| Variance | 237 |
| Skewness | 0.292 |
| Kurtosis | 2.73 |
| Coeff. of V | 0.1484 |
| Minimum | 64 |
| Maximum | 158 |
| Mean Std. | 0 |

Immature female



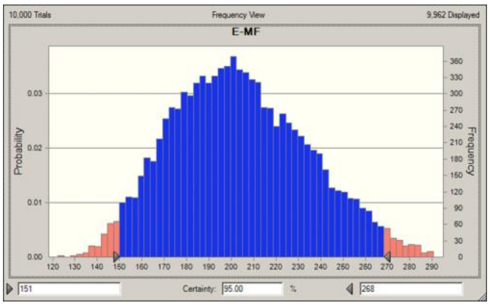

| Forecast: E-IF | |
|---|---|
| Statistic | Forecast va |
| Trials | 10,000 |
| Base Case | 93 |
| Mean | 99 |
| Median | 97 |
| Mode | '--- |
| Standard D | 15 |
| Variance | 219 |
| Skewness | 0.2972 |
| Kurtosis | 2.71 |
| Coeff. of V | 0.1503 |
| Minimum | 61 |
| Maximum | 153 |
| Mean Std. | 0 |

Mature male




| Forecast: E-MM | |
|---|---|
| Statistic | Forecast va |
| Trials | 10,000 |
| Base Case | 162 |
| Mean | 172 |
| Median | 170 |
| Mode | '--- |
| Standard D | 26 |
| Variance | 670 |
| Skewness | 0.3656 |
| Kurtosis | 2.81 |
| Coeff. of V | 0.1506 |
| Minimum | 109 |
| Maximum | 271 |
| Mean Std. | 0 |

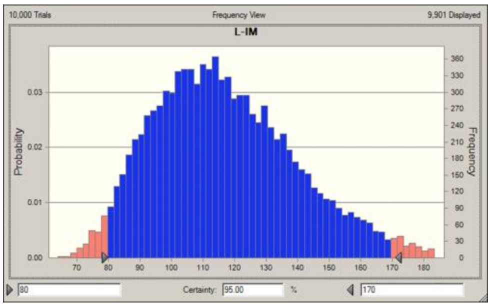
Mature female




| Forecast: E-MF | |
|---|---|
| Statistic | Forecast va |
| Trials | 10,000 |
| Base Case | 193 |
| Mean | 204 |
| Median | 202 |
| Mode | '--- |
| Standard D | 31 |
| Variance | 947 |
| Skewness | 0.3291 |
| Kurtosis | 2.76 |
| Coeff. of V | 0.1507 |
| Minimum | 122 |
| Maximum | 318 |
| Mean Std. | 0 |

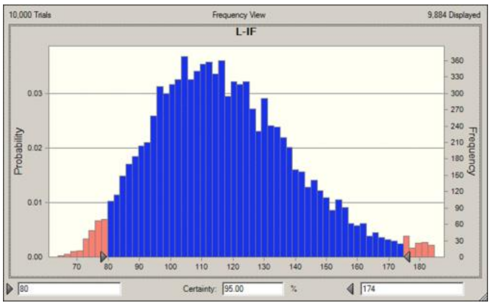
- Daily consumption of common minke whales *per capita*
- Equation-4
- Late season (From July to September)

Immature male



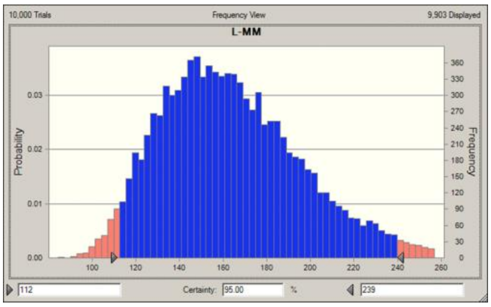

| Forecast: L-IM | |
|---|---|
| Statistic | Forecast va |
| Trials | 10,000 |
| Base Case | 107 |
| Mean | 118 |
| Median | 115 |
| Mode | '--- |
| Standard D | 23 |
| Variance | 552 |
| Skewness | 0.6447 |
| Kurtosis | 3.38 |
| Coeff. of V | 0.1998 |
| Minimum | 64 |
| Maximum | 224 |
| Mean Std. | 0 |

Immature female



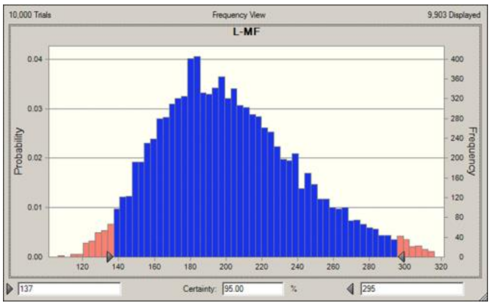

| Forecast: L-IF | |
|---|---|
| Statistic | Forecast va |
| Trials | 10,000 |
| Base Case | 107 |
| Mean | 118 |
| Median | 116 |
| Mode | '--- |
| Standard D | 24 |
| Variance | 561 |
| Skewness | 0.7055 |
| Kurtosis | 3.69 |
| Coeff. of V | 0.2005 |
| Minimum | 64 |
| Maximum | 231 |
| Mean Std. | 0 |

Mature male




| Forecast: L-MM | |
|---|---|
| Statistic | Forecast va |
| Trials | 10,000 |
| Base Case | 149 |
| Mean | 164 |
| Median | 161 |
| Mode | '--- |
| Standard D | 33 |
| Variance | 1,086 |
| Skewness | 0.6581 |
| Kurtosis | 3.39 |
| Coeff. of V | 0.2005 |
| Minimum | 85 |
| Maximum | 325 |
| Mean Std. | 0 |

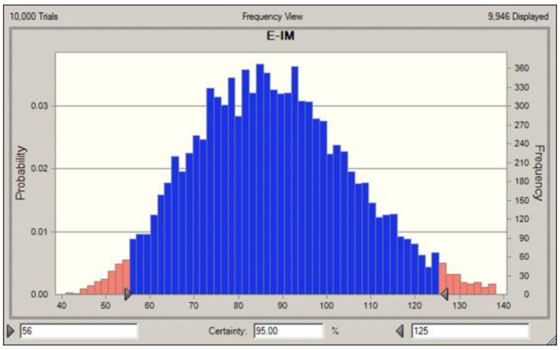
Mature female




| Forecast: L-MF | |
|---|---|
| Statistic | Forecast va |
| Trials | 10,000 |
| Base Case | 184 |
| Mean | 203 |
| Median | 198 |
| Mode | '--- |
| Standard D | 40 |
| Variance | 1,637 |
| Skewness | 0.6594 |
| Kurtosis | 3.48 |
| Coeff. of V | 0.1995 |
| Minimum | 106 |
| Maximum | 394 |
| Mean Std. | 0 |

- Daily consumption of common minke whales *per capita*
- Equation-Combined
- Early season (May and June)

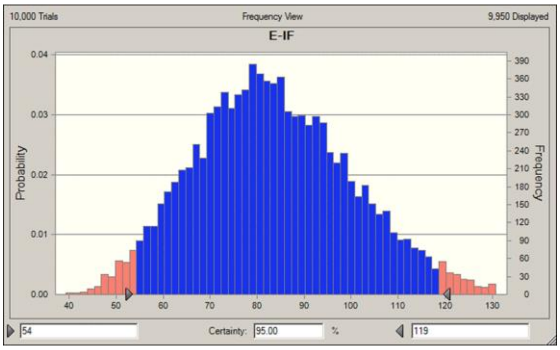
Immature male




Forecast: E-IM

| Statistic | Forecast va |
|---|---|
| Trials | 10,000 |
| Base Case | 86 |
| Mean | 88 |
| Median | 87 |
| Mode | '--- |
| Standard D | 18 |
| Variance | 322 |
| Skewness | 0.3165 |
| Kurtosis | 2.91 |
| Coeff. of V | 0.2041 |
| Minimum | 41 |
| Maximum | 158 |
| Mean Std. | 0 |

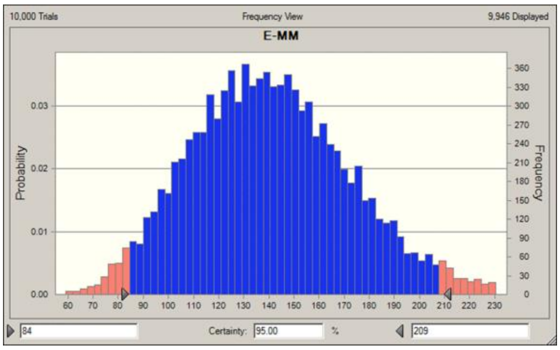
Immature female




Forecast: E-IF

| Statistic | Forecast va |
|---|---|
| Trials | 10,000 |
| Base Case | 83 |
| Mean | 84 |
| Median | 83 |
| Mode | '--- |
| Standard D | 17 |
| Variance | 282 |
| Skewness | 0.3272 |
| Kurtosis | 2.92 |
| Coeff. of V | 0.2007 |
| Minimum | 39 |
| Maximum | 150 |
| Mean Std. | 0 |

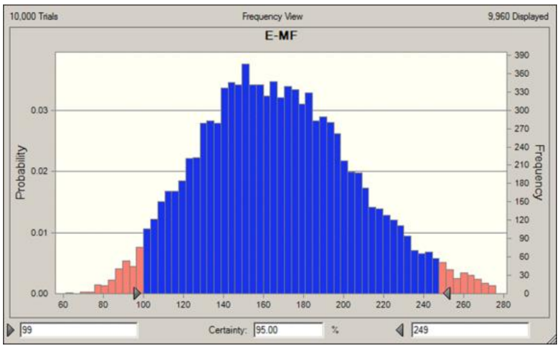
Mature male




Forecast: E-MM

| Statistic | Forecast va |
|---|---|
| Trials | 10,000 |
| Base Case | 141 |
| Mean | 141 |
| Median | 139 |
| Mode | '--- |
| Standard D | 32 |
| Variance | 1,014 |
| Skewness | 0.3564 |
| Kurtosis | 2.99 |
| Coeff. of V | 0.2258 |
| Minimum | 59 |
| Maximum | 283 |
| Mean Std. | 0 |

Mature female

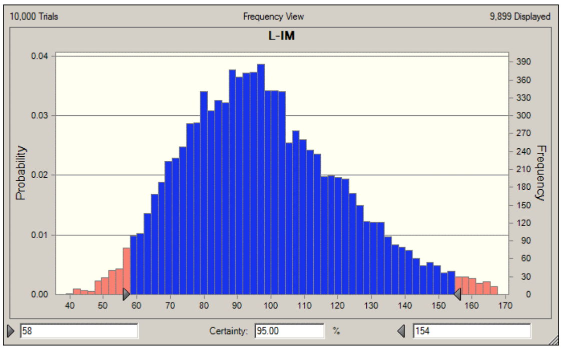



Forecast: E-MF

| Statistic | Forecast va |
|---|---|
| Trials | 10,000 |
| Base Case | 166 |
| Mean | 167 |
| Median | 165 |
| Mode | '--- |
| Standard D | 39 |
| Variance | 1,510 |
| Skewness | 0.3247 |
| Kurtosis | 2.86 |
| Coeff. of V | 0.2327 |
| Minimum | 61 |
| Maximum | 314 |
| Mean Std. | 0 |

- Daily consumption of common minke whales *per capita*
- Equation-Combined
- Late season (From July to September)

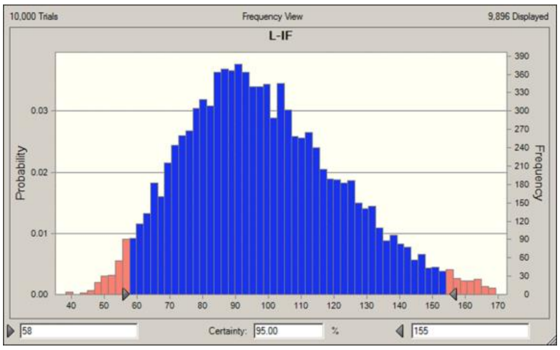
Immature male




Forecast: L-IM

| Statistic | Forecast va |
|---|---|
| Trials | 10,000 |
| Base Case | 94 |
| Mean | 99 |
| Median | 96 |
| Mode | '--- |
| Standard D | 25 |
| Variance | 606 |
| Skewness | 0.6533 |
| Kurtosis | 3.61 |
| Coeff. of V | 0.2499 |
| Minimum | 39 |
| Maximum | 221 |
| Mean Std. | 0 |

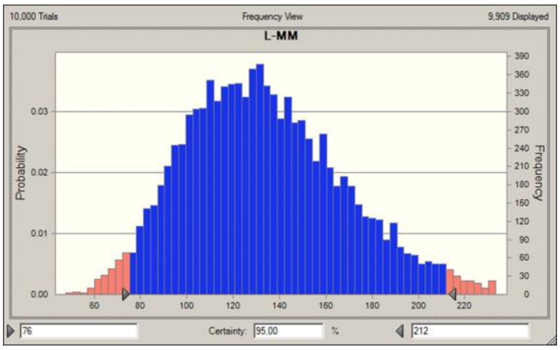
Immature female




Forecast: L-IF

| Statistic | Forecast va |
|---|---|
| Trials | 10,000 |
| Base Case | 94 |
| Mean | 99 |
| Median | 96 |
| Mode | '--- |
| Standard D | 25 |
| Variance | 628 |
| Skewness | 0.6659 |
| Kurtosis | 3.68 |
| Coeff. of V | 0.2529 |
| Minimum | 38 |
| Maximum | 235 |
| Mean Std. | 0 |

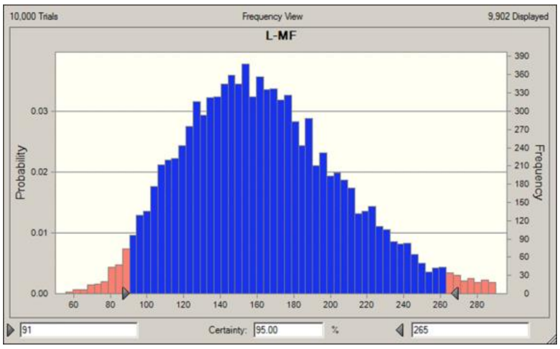
Mature male




Forecast: L-MM

| Statistic | Forecast va |
|---|---|
| Trials | 10,000 |
| Base Case | 129 |
| Mean | 134 |
| Median | 131 |
| Mode | '--- |
| Standard D | 35 |
| Variance | 1,248 |
| Skewness | 0.5984 |
| Kurtosis | 3.46 |
| Coeff. of V | 0.2631 |
| Minimum | 48 |
| Maximum | 306 |
| Mean Std. | 0 |

Mature female

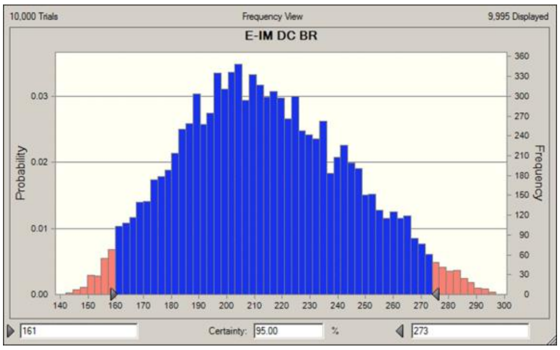



Forecast: L-MF

| Statistic | Forecast va |
|---|---|
| Trials | 10,000 |
| Base Case | 158 |
| Mean | 164 |
| Median | 160 |
| Mode | '--- |
| Standard D | 45 |
| Variance | 2,008 |
| Skewness | 0.6131 |
| Kurtosis | 3.5 |
| Coeff. of V | 0.2725 |
| Minimum | 56 |
| Maximum | 387 |
| Mean Std. | 0 |

- Daily consumption of common Bryde's whales *per capita*
- Equation-2
- Early season (May and June)

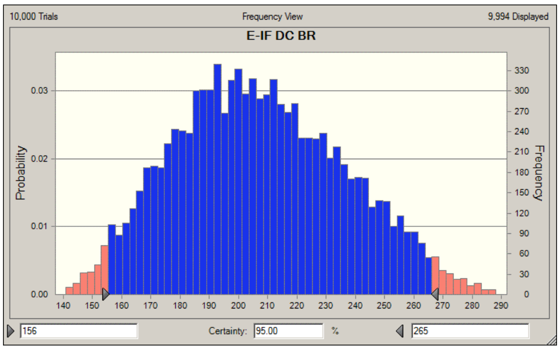
Immature male




Forecast: E-IM DC BR

| Statistic | Forecast va |
|---|---|
| Trials | 10,000 |
| Base Case | 204 |
| Mean | 214 |
| Median | 212 |
| Mode | '--- |
| Standard D | 30 |
| Variance | 881 |
| Skewness | 0.2192 |
| Kurtosis | 2.47 |
| Coeff. of V | 0.1389 |
| Minimum | 142 |
| Maximum | 302 |
| Mean Std. | 0 |

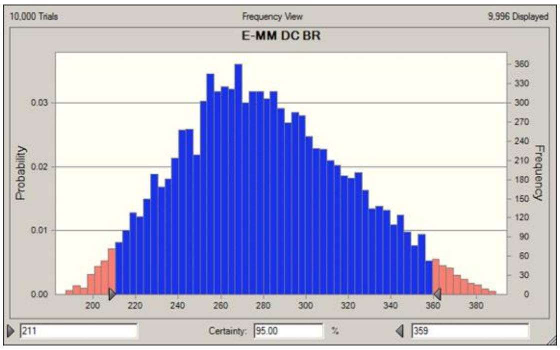
Immature female




Forecast: E-IF DC BR

| Statistic | Forecast va |
|---|---|
| Trials | 10,000 |
| Base Case | 198 |
| Mean | 207 |
| Median | 206 |
| Mode | '--- |
| Standard D | 29 |
| Variance | 828 |
| Skewness | 0.2185 |
| Kurtosis | 2.46 |
| Coeff. of V | 0.1387 |
| Minimum | 141 |
| Maximum | 292 |
| Mean Std. | 0 |

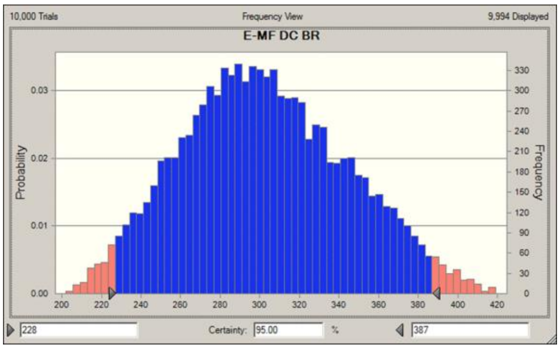
Mature male




Forecast: E-MM DC B

| Statistic | Forecast va |
|---|---|
| Trials | 10,000 |
| Base Case | 268 |
| Mean | 280 |
| Median | 278 |
| Mode | '--- |
| Standard D | 39 |
| Variance | 1,507 |
| Skewness | 0.2272 |
| Kurtosis | 2.51 |
| Coeff. of V | 0.1384 |
| Minimum | 187 |
| Maximum | 395 |
| Mean Std. | 0 |

Mature female

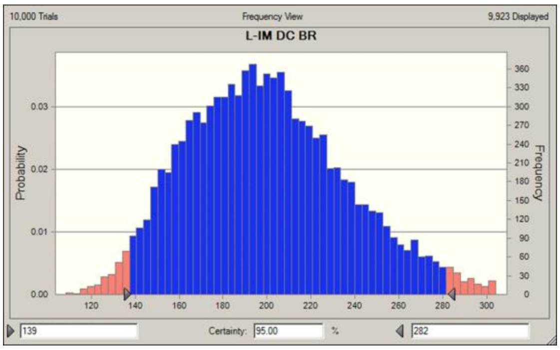



Forecast: E-MF DC BI

| Statistic | Forecast va |
|---|---|
| Trials | 10,000 |
| Base Case | 289 |
| Mean | 303 |
| Median | 300 |
| Mode | '--- |
| Standard D | 42 |
| Variance | 1,728 |
| Skewness | 0.1991 |
| Kurtosis | 2.52 |
| Coeff. of V | 0.1374 |
| Minimum | 202 |
| Maximum | 427 |
| Mean Std. | 0 |

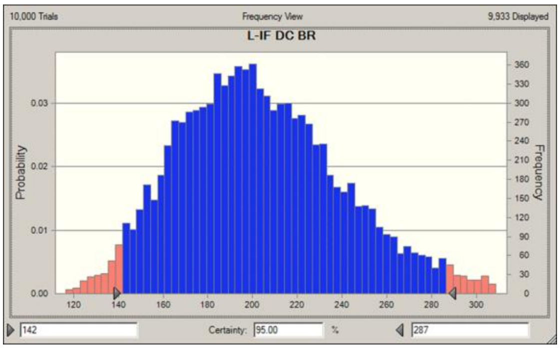
- Daily consumption of common Bryde's whales *per capita*
- Equation-2
- Late season (From July to September)

### Immature male




| Statistic | Forecast va |
|---|---|
| Trials | 10,000 |
| Base Case | 193 |
| Mean | 200 |
| Median | 197 |
| Mode | '--- |
| Standard D | 37 |
| Variance | 1,366 |
| Skewness | 0.4826 |
| Kurtosis | 3.08 |
| Coeff. of V | 0.1844 |
| Minimum | 109 |
| Maximum | 343 |
| Mean Std. | 0 |

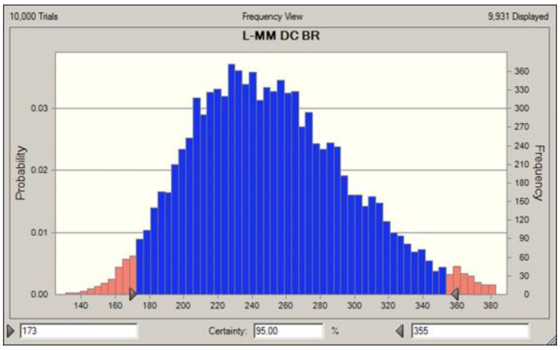
### Immature female




Forecast: L-IF DC BR

| Statistic | Forecast va |
|---|---|
| Trials | 10,000 |
| Base Case | 196 |
| Mean | 204 |
| Median | 200 |
| Mode | '--- |
| Standard D | 37 |
| Variance | 1,392 |
| Skewness | 0.5155 |
| Kurtosis | 3.18 |
| Coeff. of V | 0.1828 |
| Minimum | 117 |
| Maximum | 359 |
| Mean Std. | 0 |

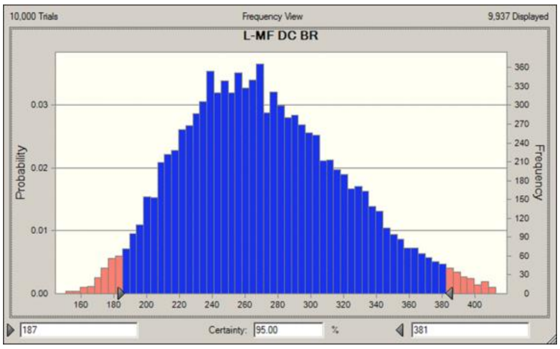
### Mature male




Forecast: L-MM DC B

| Statistic | Forecast va |
|---|---|
| Trials | 10,000 |
| Base Case | 243 |
| Mean | 252 |
| Median | 247 |
| Mode | '--- |
| Standard D | 47 |
| Variance | 2,186 |
| Skewness | 0.4883 |
| Kurtosis | 3.12 |
| Coeff. of V | 0.1858 |
| Minimum | 131 |
| Maximum | 458 |
| Mean Std. | 0 |

### Mature female

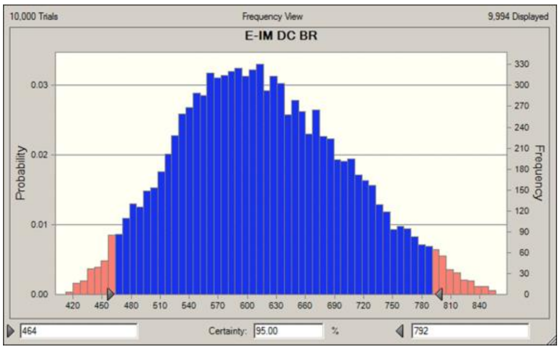



Forecast: L-MF DC BI

| Statistic | Forecast va |
|---|---|
| Trials | 10,000 |
| Base Case | 262 |
| Mean | 272 |
| Median | 268 |
| Mode | '--- |
| Standard D | 50 |
| Variance | 2,503 |
| Skewness | 0.4504 |
| Kurtosis | 2.96 |
| Coeff. of V | 0.1837 |
| Minimum | 151 |
| Maximum | 490 |
| Mean Std. | 1 |

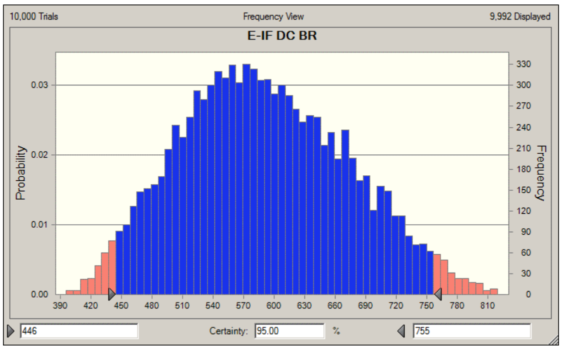
- Daily consumption of common Bryde's whales *per capita*
- Equation-3-1
- Early season (May and June)

Immature male



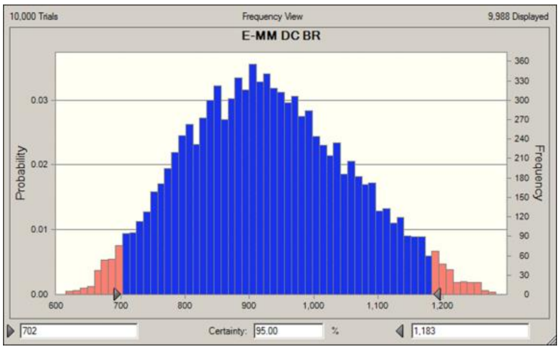

| Forecast: E-IM DC BR | |
|---|---|
| Statistic | Forecast va |
| Trials | 10,000 |
| Base Case | 590 |
| Mean | 616 |
| Median | 611 |
| Mode | '--- |
| Standard D | 86 |
| Variance | 7,336 |
| Skewness | 0.2367 |
| Kurtosis | 2.52 |
| Coeff. of V | 0.139 |
| Minimum | 413 |
| Maximum | 863 |
| Mean Std. | 1 |

Immature female



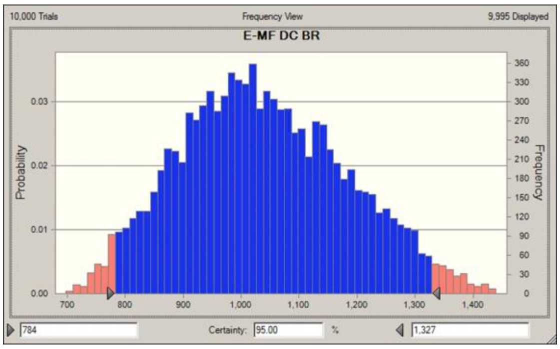

| Forecast: E-IF DC BR | |
|---|---|
| Statistic | Forecast va |
| Trials | 10,000 |
| Base Case | 565 |
| Mean | 591 |
| Median | 586 |
| Mode | '--- |
| Standard D | 82 |
| Variance | 6,646 |
| Skewness | 0.216 |
| Kurtosis | 2.49 |
| Coeff. of V | 0.138 |
| Minimum | 396 |
| Maximum | 829 |
| Mean Std. | 1 |

Mature male




| Forecast: E-MM DC B | |
|---|---|
| Statistic | Forecast va |
| Trials | 10,000 |
| Base Case | 889 |
| Mean | 929 |
| Median | 922 |
| Mode | '--- |
| Standard D | 126 |
| Variance | 15,890 |
| Skewness | 0.2036 |
| Kurtosis | 2.53 |
| Coeff. of V | 0.1357 |
| Minimum | 615 |
| Maximum | 1,317 |
| Mean Std. | 1 |

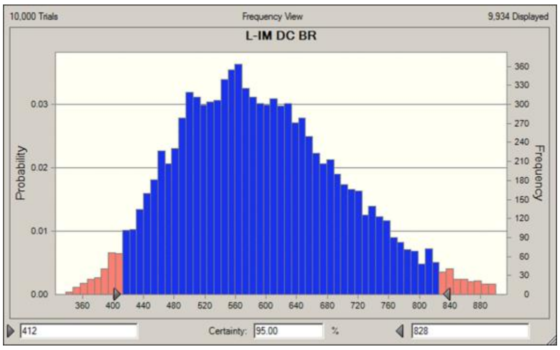
Mature female




| Forecast: E-MF DC BI | |
|---|---|
| Statistic | Forecast va |
| Trials | 10,000 |
| Base Case | 994 |
| Mean | 1,039 |
| Median | 1,028 |
| Mode | '--- |
| Standard D | 143 |
| Variance | 20,387 |
| Skewness | 0.2296 |
| Kurtosis | 2.52 |
| Coeff. of V | 0.1374 |
| Minimum | 698 |
| Maximum | 1,484 |
| Mean Std. | 1 |

- Daily consumption of common Bryde's whales *per capita*
- Equation-3-1
- Late season (From July to September)

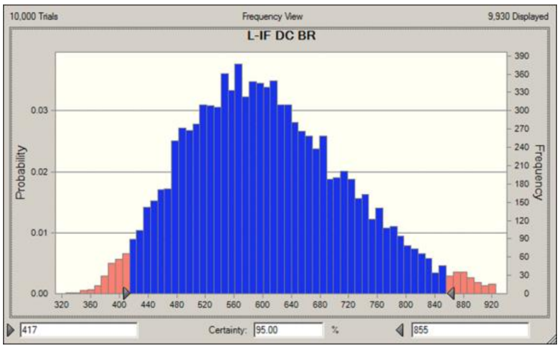
Immature male




Forecast: L-IM DC BR

| Statistic | Forecast va |
|---|---|
| Trials | 10,000 |
| Base Case | 572 |
| Mean | 594 |
| Median | 584 |
| Mode | '--- |
| Standard D | 109 |
| Variance | 11,856 |
| Skewness | 0.4784 |
| Kurtosis | 3.06 |
| Coeff. of V | 0.1832 |
| Minimum | 339 |
| Maximum | 1,065 |
| Mean Std. | 1 |

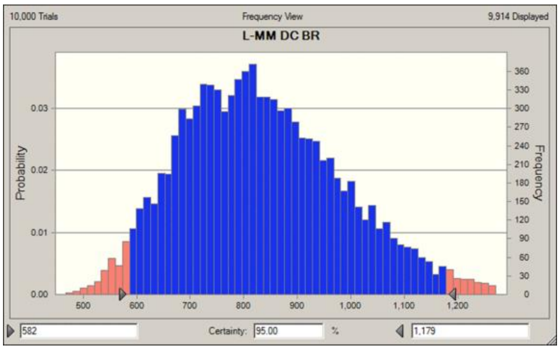
Immature female




Forecast: L-IF DC BR

| Statistic | Forecast va |
|---|---|
| Trials | 10,000 |
| Base Case | 586 |
| Mean | 607 |
| Median | 597 |
| Mode | '--- |
| Standard D | 113 |
| Variance | 12,850 |
| Skewness | 0.4908 |
| Kurtosis | 3.08 |
| Coeff. of V | 0.1867 |
| Minimum | 326 |
| Maximum | 1,105 |
| Mean Std. | 1 |

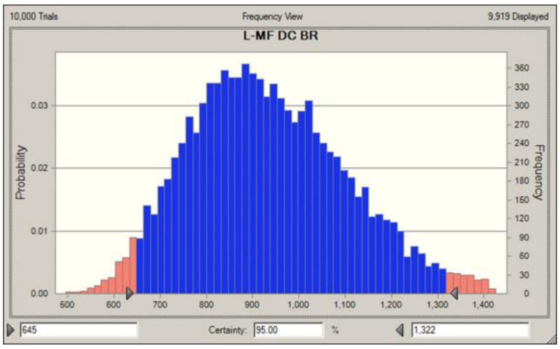
Mature male




Forecast: L-MM DC B

| Statistic | Forecast va |
|---|---|
| Trials | 10,000 |
| Base Case | 806 |
| Mean | 837 |
| Median | 821 |
| Mode | '--- |
| Standard D | 155 |
| Variance | 23,884 |
| Skewness | 0.5485 |
| Kurtosis | 3.23 |
| Coeff. of V | 0.1847 |
| Minimum | 468 |
| Maximum | 1,495 |
| Mean Std. | 2 |

Mature female

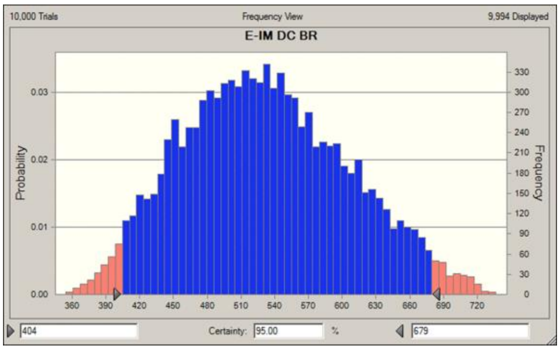



Forecast: L-MF DC BI

| Statistic | Forecast va |
|---|---|
| Trials | 10,000 |
| Base Case | 903 |
| Mean | 938 |
| Median | 920 |
| Mode | '--- |
| Standard D | 174 |
| Variance | 30,262 |
| Skewness | 0.504 |
| Kurtosis | 3.15 |
| Coeff. of V | 0.1855 |
| Minimum | 497 |
| Maximum | 1,704 |
| Mean Std. | 2 |

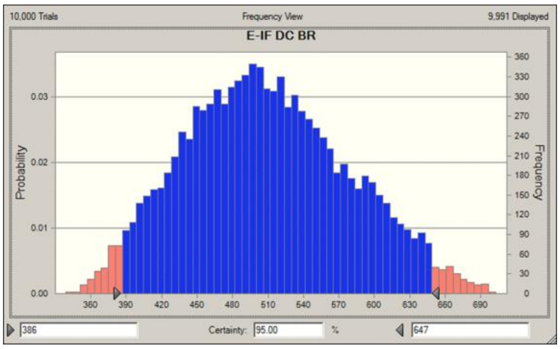
- Daily consumption of common Bryde's whales *per capita*
- Equation-4
- Early season (May and June)

Immature male



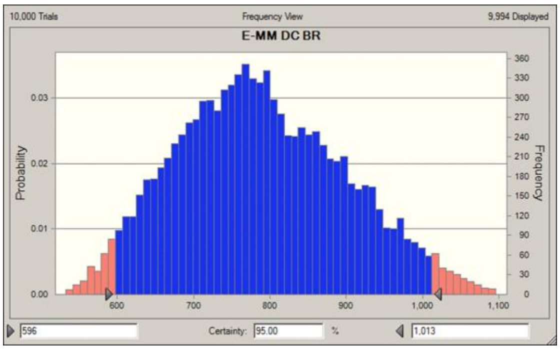

| Forecast: E-IM DC BR | |
|---|---|
| Statistic | Forecast va |
| Trials | 10,000 |
| Base Case | 508 |
| Mean | 532 |
| Median | 528 |
| Mode | '--- |
| Standard D | 73 |
| Variance | 5,324 |
| Skewness | 0.2277 |
| Kurtosis | 2.5 |
| Coeff. of V | 0.1372 |
| Minimum | 355 |
| Maximum | 750 |
| Mean Std. | 1 |

Immature female



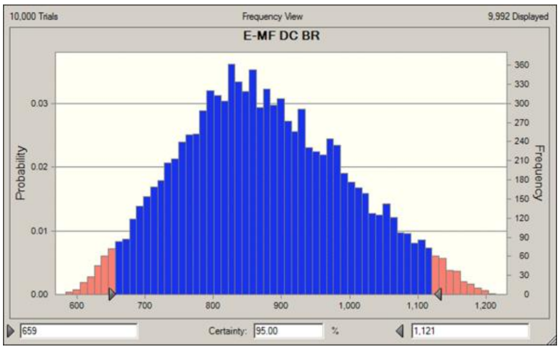

| Forecast: E-IF DC BR | |
|---|---|
| Statistic | Forecast va |
| Trials | 10,000 |
| Base Case | 488 |
| Mean | 509 |
| Median | 505 |
| Mode | '--- |
| Standard D | 69 |
| Variance | 4,769 |
| Skewness | 0.2194 |
| Kurtosis | 2.52 |
| Coeff. of V | 0.1357 |
| Minimum | 339 |
| Maximum | 718 |
| Mean Std. | 1 |

Mature male




| Forecast: E-MM DC B | |
|---|---|
| Statistic | Forecast va |
| Trials | 10,000 |
| Base Case | 753 |
| Mean | 789 |
| Median | 781 |
| Mode | '--- |
| Standard D | 110 |
| Variance | 12,017 |
| Skewness | 0.243 |
| Kurtosis | 2.52 |
| Coeff. of V | 0.1390 |
| Minimum | 533 |
| Maximum | 1,103 |
| Mean Std. | 1 |

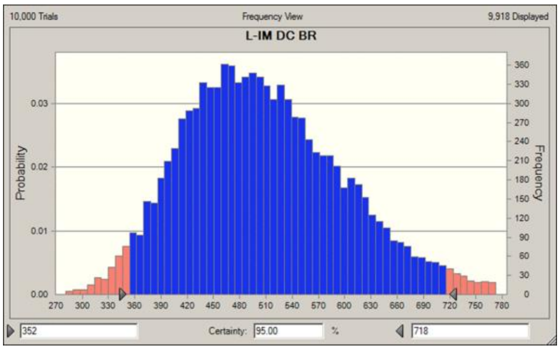
Mature female




| Forecast: E-MF DC BI | |
|---|---|
| Statistic | Forecast va |
| Trials | 10,000 |
| Base Case | 837 |
| Mean | 875 |
| Median | 866 |
| Mode | '--- |
| Standard D | 121 |
| Variance | 14,655 |
| Skewness | 0.2284 |
| Kurtosis | 2.5 |
| Coeff. of V | 0.1384 |
| Minimum | 584 |
| Maximum | 1,240 |
| Mean Std. | 1 |

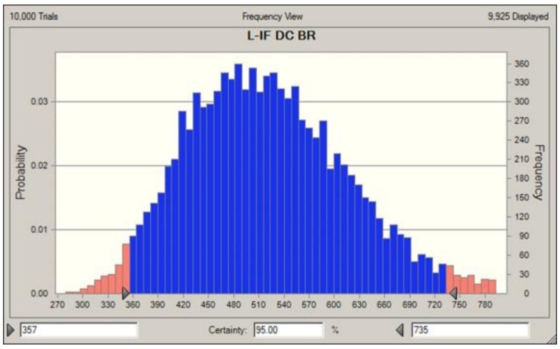
- Daily consumption of common Bryde’s whales *per capita*
- Equation-4
- Late season (From July to September)

Immature male



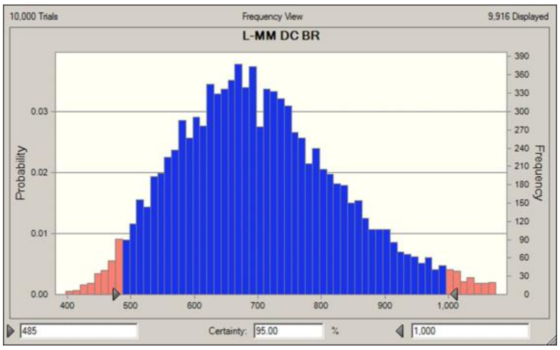

| Forecast: L-IM DC BR | |
|---|---|
| Statistic | Forecast va |
| Trials | 10,000 |
| Base Case | 491 |
| Mean | 510 |
| Median | 500 |
| Mode | '--- |
| Standard D | 94 |
| Variance | 8,795 |
| Skewness | 0.5337 |
| Kurtosis | 3.21 |
| Coeff. of V | 0.184 |
| Minimum | 282 |
| Maximum | 928 |
| Mean Std. | 1 |

Immature female



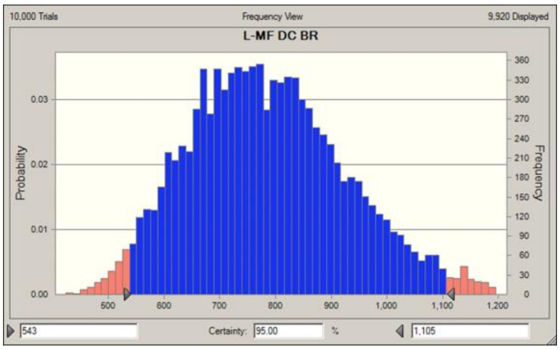

| Forecast: L-IF DC BR | |
|---|---|
| Statistic | Forecast va |
| Trials | 10,000 |
| Base Case | 502 |
| Mean | 522 |
| Median | 514 |
| Mode | '--- |
| Standard D | 97 |
| Variance | 9,347 |
| Skewness | 0.4744 |
| Kurtosis | 3.09 |
| Coeff. of V | 0.1854 |
| Minimum | 280 |
| Maximum | 920 |
| Mean Std. | 1 |

Mature male




| Forecast: L-MM DC B | |
|---|---|
| Statistic | Forecast va |
| Trials | 10,000 |
| Base Case | 682 |
| Mean | 705 |
| Median | 691 |
| Mode | '--- |
| Standard D | 132 |
| Variance | 17,337 |
| Skewness | 0.5513 |
| Kurtosis | 3.25 |
| Coeff. of V | 0.1868 |
| Minimum | 398 |
| Maximum | 1,231 |
| Mean Std. | 1 |

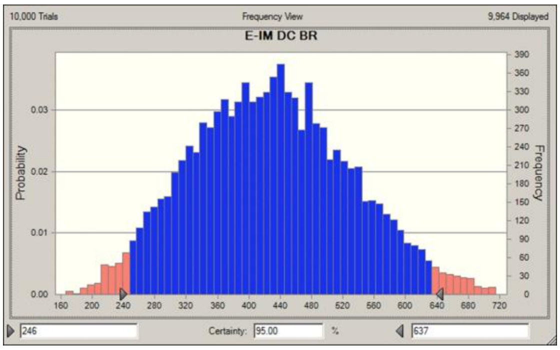
Mature female




| Forecast: L-MF DC BI | |
|---|---|
| Statistic | Forecast va |
| Trials | 10,000 |
| Base Case | 760 |
| Mean | 789 |
| Median | 777 |
| Mode | '--- |
| Standard D | 145 |
| Variance | 20,962 |
| Skewness | 0.4606 |
| Kurtosis | 3.09 |
| Coeff. of V | 0.1834 |
| Minimum | 424 |
| Maximum | 1,371 |
| Mean Std. | 1 |

- Daily consumption of common Bryde's whales *per capita*
- Equation-Combined
- Early season (May and June)

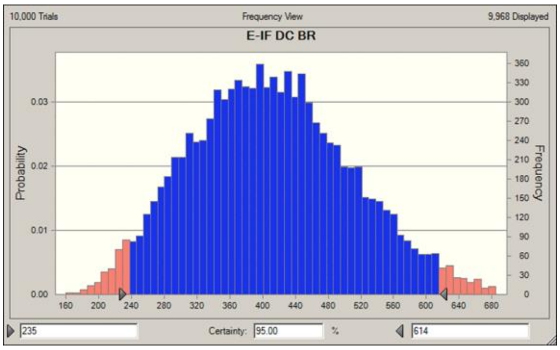
Immature male




Forecast: E-IM DC BR

| Statistic | Forecast va |
|---|---|
| Trials | 10,000 |
| Base Case | 434 |
| Mean | 430 |
| Median | 427 |
| Mode | '--- |
| Standard D | 102 |
| Variance | 10,369 |
| Skewness | 0.2294 |
| Kurtosis | 2.76 |
| Coeff. of V | 0.2371 |
| Minimum | 167 |
| Maximum | 824 |
| Mean Std. | 1 |

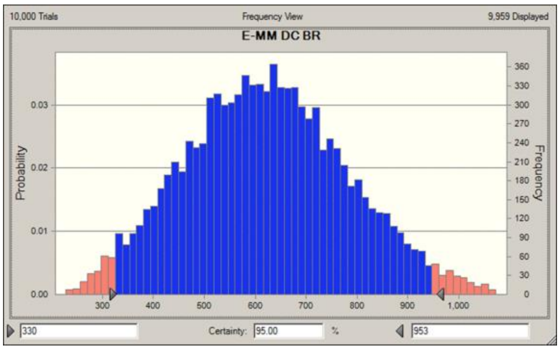
Immature female




Forecast: E-IF DC BR

| Statistic | Forecast va |
|---|---|
| Trials | 10,000 |
| Base Case | 417 |
| Mean | 411 |
| Median | 407 |
| Mode | '--- |
| Standard D | 98 |
| Variance | 9,533 |
| Skewness | 0.2537 |
| Kurtosis | 2.72 |
| Coeff. of V | 0.2377 |
| Minimum | 160 |
| Maximum | 751 |
| Mean Std. | 1 |

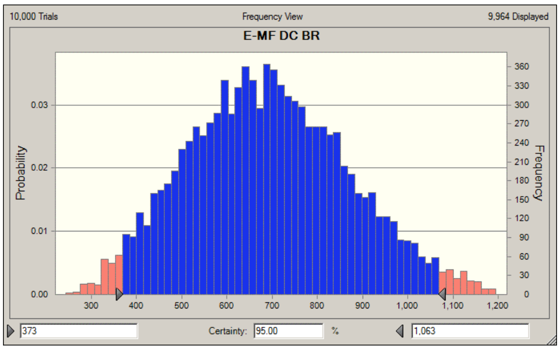
Mature male




Forecast: E-MM DC B

| Statistic | Forecast va |
|---|---|
| Trials | 10,000 |
| Base Case | 637 |
| Mean | 624 |
| Median | 619 |
| Mode | '--- |
| Standard D | 160 |
| Variance | 25,561 |
| Skewness | 0.2236 |
| Kurtosis | 2.81 |
| Coeff. of V | 0.2562 |
| Minimum | 229 |
| Maximum | 1,194 |
| Mean Std. | 2 |

Mature female

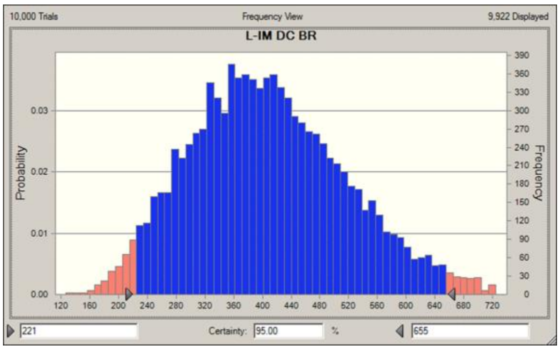



Forecast: E-MF DC BI

| Statistic | Forecast va |
|---|---|
| Trials | 10,000 |
| Base Case | 707 |
| Mean | 694 |
| Median | 687 |
| Mode | '--- |
| Standard D | 179 |
| Variance | 31,923 |
| Skewness | 0.2615 |
| Kurtosis | 2.79 |
| Coeff. of V | 0.2575 |
| Minimum | 244 |
| Maximum | 1,352 |
| Mean Std. | 2 |

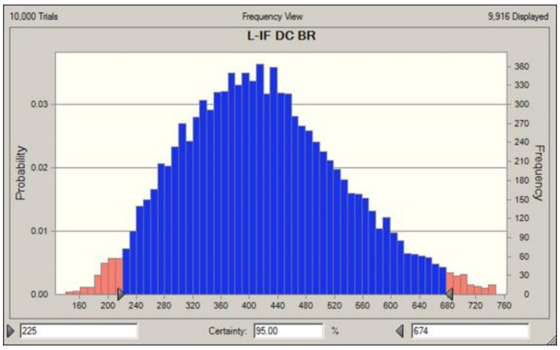
- Daily consumption of common Bryde's whales *per capita*
- Equation-Combined
- Late season (From July to September)

Immature male



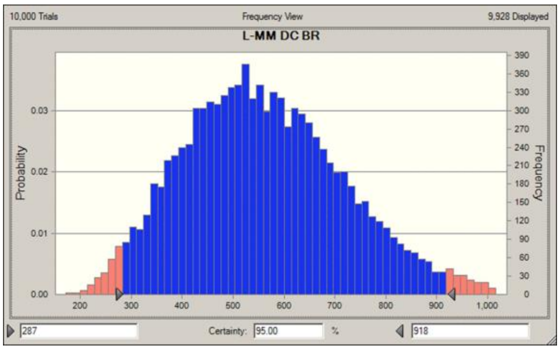

| Forecast: L-IM DC BR | |
|---|---|
| Statistic | Forecast va |
| Trials | 10,000 |
| Base Case | 419 |
| Mean | 410 |
| Median | 401 |
| Mode | '--- |
| Standard D | 112 |
| Variance | 12,564 |
| Skewness | 0.4931 |
| Kurtosis | 3.21 |
| Coeff. of V | 0.2732 |
| Minimum | 127 |
| Maximum | 908 |
| Mean Std. | 1 |

Immature female



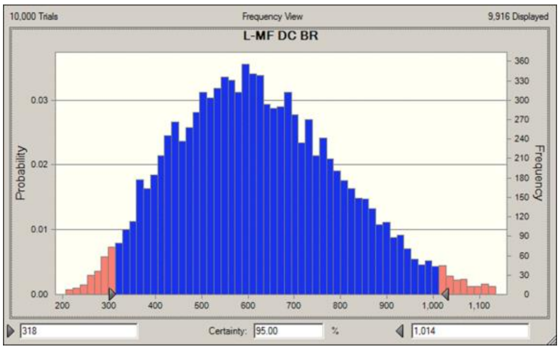

| Forecast: L-IF DC BR | |
|---|---|
| Statistic | Forecast va |
| Trials | 10,000 |
| Base Case | 428 |
| Mean | 421 |
| Median | 412 |
| Mode | '--- |
| Standard D | 116 |
| Variance | 13,555 |
| Skewness | 0.4894 |
| Kurtosis | 3.21 |
| Coeff. of V | 0.2763 |
| Minimum | 141 |
| Maximum | 944 |
| Mean Std. | 1 |

Mature male




| Forecast: L-MM DC B | |
|---|---|
| Statistic | Forecast va |
| Trials | 10,000 |
| Base Case | 577 |
| Mean | 564 |
| Median | 550 |
| Mode | '--- |
| Standard D | 161 |
| Variance | 25,965 |
| Skewness | 0.4652 |
| Kurtosis | 3.13 |
| Coeff. of V | 0.2858 |
| Minimum | 172 |
| Maximum | 1,243 |
| Mean Std. | 2 |

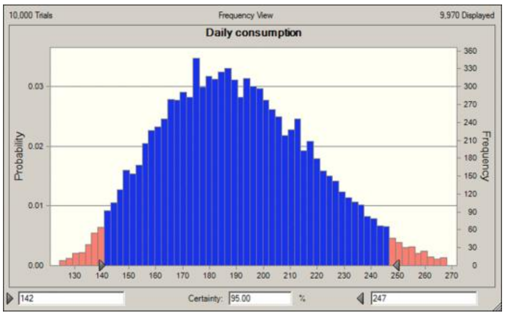
Mature female




| Forecast: L-MF DC BI | |
|---|---|
| Statistic | Forecast va |
| Trials | 10,000 |
| Base Case | 642 |
| Mean | 626 |
| Median | 611 |
| Mode | '--- |
| Standard D | 182 |
| Variance | 32,981 |
| Skewness | 0.4881 |
| Kurtosis | 3.22 |
| Coeff. of V | 0.2902 |
| Minimum | 207 |
| Maximum | 1,486 |
| Mean Std. | 2 |

- Daily consumption of common Sei whales *per capita*
- Equation-2
- Early season (May and June)

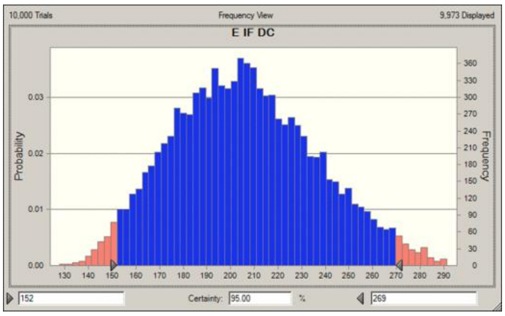
Immature male




Forecast: E IM DC

| Statistic | Forecast va |
| --- | --- |
| Trials | 10,000 |
| Base Case | 182 |
| Mean | 190 |
| Median | 188 |
| Mode | '--- |
| Standard D | 28 |
| Variance | 777 |
| Skewness | 0.3016 |
| Kurtosis | 2.66 |
| Coeff. of V | 0.1467 |
| Minimum | 124 |
| Maximum | 283 |
| Mean Std. | 0 |

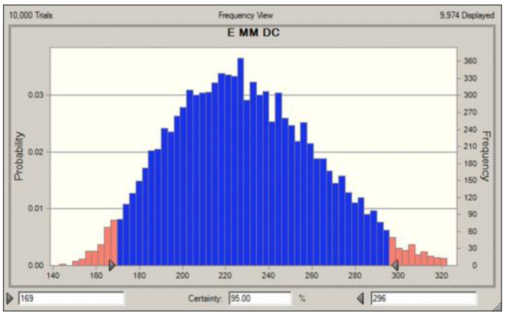
Immature female




Forecast: E IF DC

| Statistic | Forecast va |
| --- | --- |
| Trials | 10,000 |
| Base Case | 196 |
| Mean | 206 |
| Median | 205 |
| Mode | '--- |
| Standard D | 30 |
| Variance | 922 |
| Skewness | 0.2748 |
| Kurtosis | 2.68 |
| Coeff. of V | 0.1474 |
| Minimum | 128 |
| Maximum | 314 |
| Mean Std. | 0 |

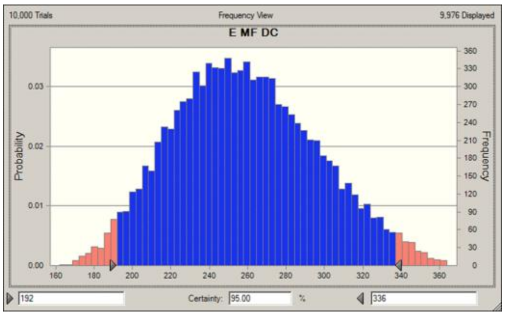
Mature male




Forecast: E MM DC

| Statistic | Forecast va |
| --- | --- |
| Trials | 10,000 |
| Base Case | 217 |
| Mean | 228 |
| Median | 226 |
| Mode | '--- |
| Standard D | 33 |
| Variance | 1,121 |
| Skewness | 0.2658 |
| Kurtosis | 2.63 |
| Coeff. of V | 0.1466 |
| Minimum | 143 |
| Maximum | 339 |
| Mean Std. | 0 |

Mature female

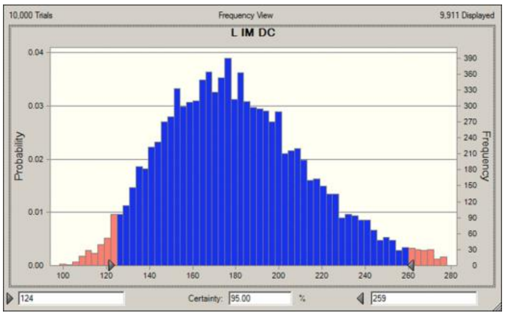



Forecast: E MF DC

| Statistic | Forecast va |
| --- | --- |
| Trials | 10,000 |
| Base Case | 247 |
| Mean | 259 |
| Median | 257 |
| Mode | '--- |
| Standard D | 37 |
| Variance | 1,397 |
| Skewness | 0.2523 |
| Kurtosis | 2.64 |
| Coeff. of V | 0.1443 |
| Minimum | 162 |
| Maximum | 394 |
| Mean Std. | 0 |

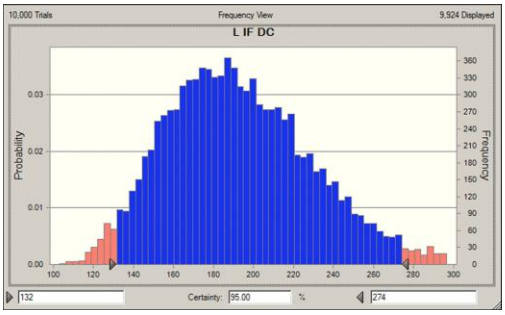
- Daily consumption of common Sei whales *per capita*
- Equation-2
- Late season (From July to September)

Immature male



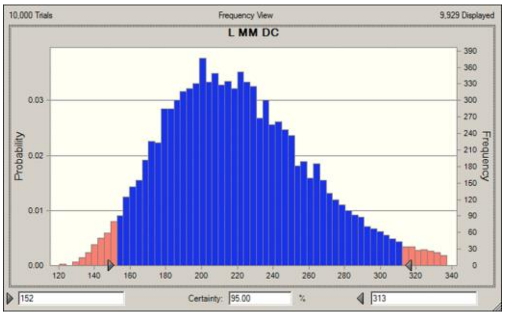

| Forecast: L IM DC | |
|---|---|
| Statistic | Forecast va |
| Trials | 10,000 |
| Base Case | 170 |
| Mean | 181 |
| Median | 178 |
| Mode | '--- |
| Standard D | 34 |
| Variance | 1,190 |
| Skewness | 0.595 |
| Kurtosis | 3.41 |
| Coeff. of V | 0.1904 |
| Minimum | 98 |
| Maximum | 345 |
| Mean Std. | 0 |

Immature female



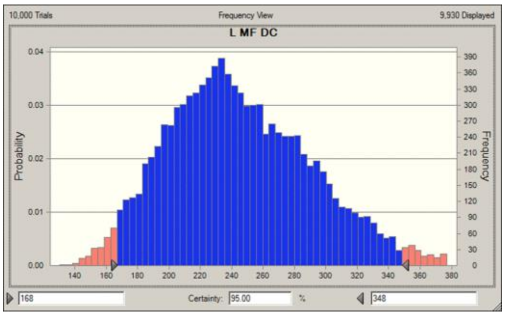

| Forecast: L IF DC | |
|---|---|
| Statistic | Forecast va |
| Trials | 10,000 |
| Base Case | 182 |
| Mean | 193 |
| Median | 190 |
| Mode | '--- |
| Standard D | 37 |
| Variance | 1,351 |
| Skewness | 0.5115 |
| Kurtosis | 3.15 |
| Coeff. of V | 0.19 |
| Minimum | 103 |
| Maximum | 339 |
| Mean Std. | 0 |

Mature male




| Forecast: L MM DC | |
|---|---|
| Statistic | Forecast va |
| Trials | 10,000 |
| Base Case | 208 |
| Mean | 221 |
| Median | 217 |
| Mode | '--- |
| Standard D | 42 |
| Variance | 1,727 |
| Skewness | 0.5671 |
| Kurtosis | 3.27 |
| Coeff. of V | 0.1883 |
| Minimum | 121 |
| Maximum | 405 |
| Mean Std. | 0 |

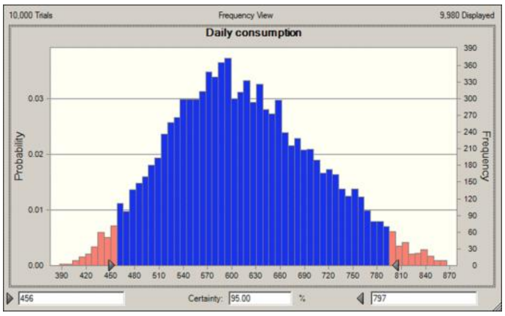
Mature female




| Forecast: L MF DC | |
|---|---|
| Statistic | Forecast va |
| Trials | 10,000 |
| Base Case | 231 |
| Mean | 246 |
| Median | 241 |
| Mode | '--- |
| Standard D | 47 |
| Variance | 2,185 |
| Skewness | 0.5022 |
| Kurtosis | 3.13 |
| Coeff. of V | 0.1901 |
| Minimum | 131 |
| Maximum | 445 |
| Mean Std. | 0 |

- Daily consumption of common Sei whales *per capita*
- Equation-3-1
- Early season (May and June)

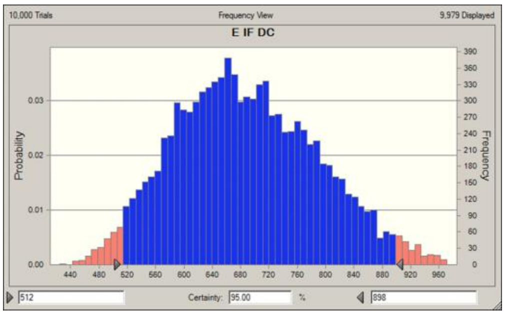
Immature male




Forecast: E IM DC

| Statistic | Forecast va |
|---|---|
| Trials | 10,000 |
| Base Case | 585 |
| Mean | 614 |
| Median | 608 |
| Mode | '--- |
| Standard D | 90 |
| Variance | 8,081 |
| Skewness | 0.2727 |
| Kurtosis | 2.62 |
| Coeff. of V | 0.1464 |
| Minimum | 387 |
| Maximum | 918 |
| Mean Std. | 1 |

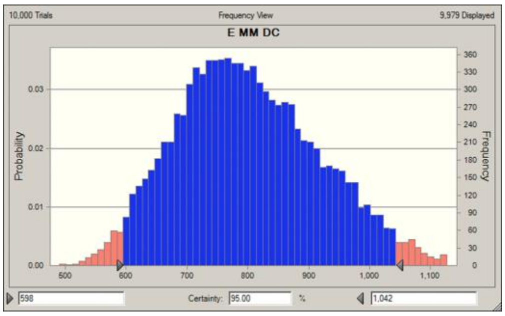
Immature female




Forecast: E IF DC

| Statistic | Forecast va |
|---|---|
| Trials | 10,000 |
| Base Case | 654 |
| Mean | 689 |
| Median | 681 |
| Mode | '--- |
| Standard D | 101 |
| Variance | 10,137 |
| Skewness | 0.2644 |
| Kurtosis | 2.63 |
| Coeff. of V | 0.1462 |
| Minimum | 425 |
| Maximum | 1,042 |
| Mean Std. | 1 |

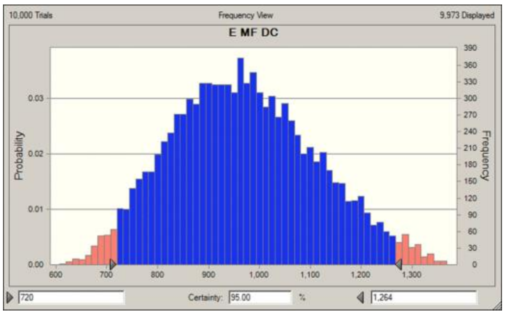
Mature male




Forecast: E MM DC

| Statistic | Forecast va |
|---|---|
| Trials | 10,000 |
| Base Case | 762 |
| Mean | 800 |
| Median | 791 |
| Mode | '--- |
| Standard D | 116 |
| Variance | 13,555 |
| Skewness | 0.3026 |
| Kurtosis | 2.67 |
| Coeff. of V | 0.1455 |
| Minimum | 491 |
| Maximum | 1,224 |
| Mean Std. | 1 |

Mature female

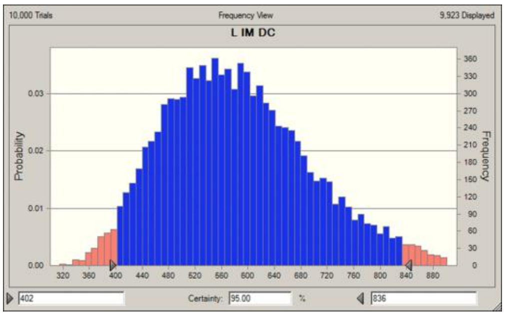



Forecast: E MF DC

| Statistic | Forecast va |
|---|---|
| Trials | 10,000 |
| Base Case | 923 |
| Mean | 970 |
| Median | 963 |
| Mode | '--- |
| Standard D | 142 |
| Variance | 20,105 |
| Skewness | 0.2634 |
| Kurtosis | 2.67 |
| Coeff. of V | 0.1461 |
| Minimum | 608 |
| Maximum | 1,490 |
| Mean Std. | 1 |

- Daily consumption of common Sei whales *per capita*
- Equation-3-1
- Late season (From July to September)

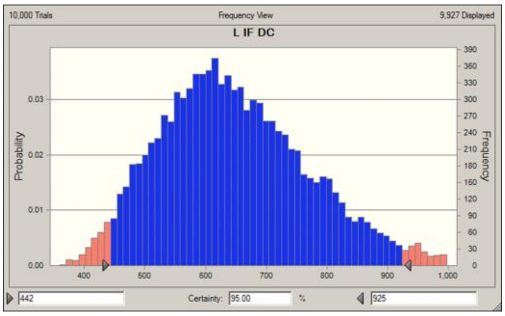
Immature male




Forecast: L IM DC

| Statistic | Forecast va |
|---|---|
| Trials | 10,000 |
| Base Case | 553 |
| Mean | 586 |
| Median | 575 |
| Mode | '--- |
| Standard D | 112 |
| Variance | 12,600 |
| Skewness | 0.5428 |
| Kurtosis | 3.14 |
| Coeff. of V | 0.1915 |
| Minimum | 315 |
| Maximum | 1,036 |
| Mean Std. | 1 |

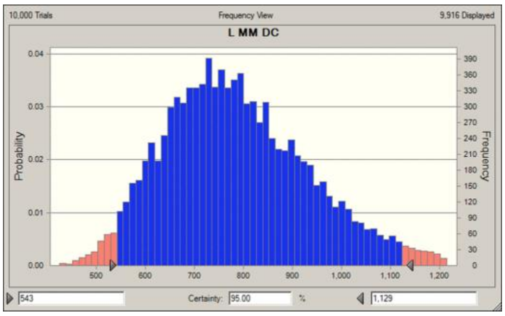
Immature female




Forecast: L IF DC

| Statistic | Forecast va |
|---|---|
| Trials | 10,000 |
| Base Case | 610 |
| Mean | 649 |
| Median | 636 |
| Mode | '--- |
| Standard D | 124 |
| Variance | 15,413 |
| Skewness | 0.5261 |
| Kurtosis | 3.14 |
| Coeff. of V | 0.1913 |
| Minimum | 360 |
| Maximum | 1,180 |
| Mean Std. | 1 |

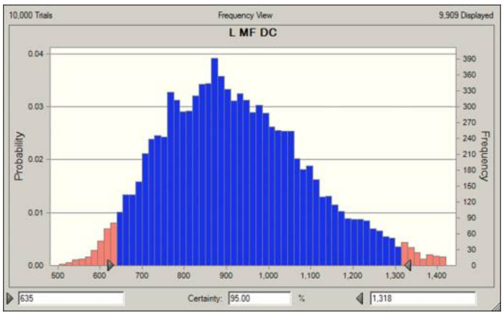
Mature male




Forecast: L MM DC

| Statistic | Forecast va |
|---|---|
| Trials | 10,000 |
| Base Case | 742 |
| Mean | 790 |
| Median | 773 |
| Mode | '--- |
| Standard D | 151 |
| Variance | 22,940 |
| Skewness | 0.5897 |
| Kurtosis | 3.32 |
| Coeff. of V | 0.1918 |
| Minimum | 425 |
| Maximum | 1,469 |
| Mean Std. | 2 |

Mature female

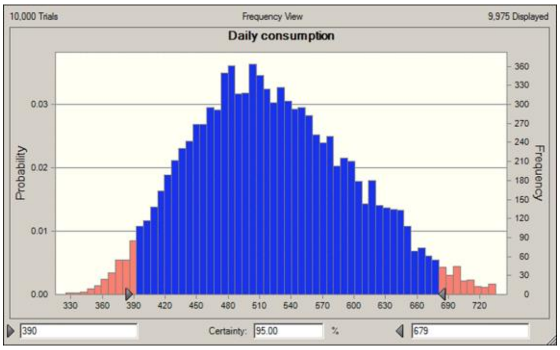



Forecast: L MF DC

| Statistic | Forecast va |
|---|---|
| Trials | 10,000 |
| Base Case | 872 |
| Mean | 926 |
| Median | 907 |
| Mode | '--- |
| Standard D | 176 |
| Variance | 31,059 |
| Skewness | 0.5701 |
| Kurtosis | 3.29 |
| Coeff. of V | 0.1903 |
| Minimum | 505 |
| Maximum | 1,725 |
| Mean Std. | 2 |

- Daily consumption of common Sei whales *per capita*
- Equation-4
- Early season (May and June)

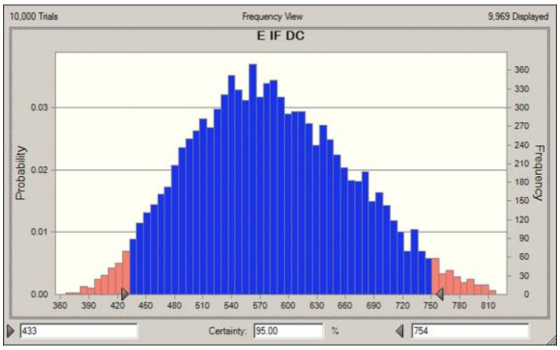
Immature male




Forecast: E IM DC

| Statistic | Forecast va |
|---|---|
| Trials | 10,000 |
| Base Case | 497 |
| Mean | 522 |
| Median | 516 |
| Mode | '--- |
| Standard D | 76 |
| Variance | 5,774 |
| Skewness | 0.2922 |
| Kurtosis | 2.63 |
| Coeff. of V | 0.1455 |
| Minimum | 326 |
| Maximum | 794 |
| Mean Std. | 1 |

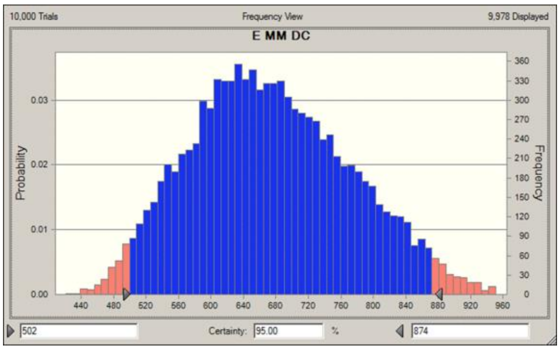
Immature female




Forecast: E IF DC

| Statistic | Forecast va |
|---|---|
| Trials | 10,000 |
| Base Case | 553 |
| Mean | 581 |
| Median | 576 |
| Mode | '--- |
| Standard D | 84 |
| Variance | 7,113 |
| Skewness | 0.2609 |
| Kurtosis | 2.66 |
| Coeff. of V | 0.145 |
| Minimum | 366 |
| Maximum | 869 |
| Mean Std. | 1 |

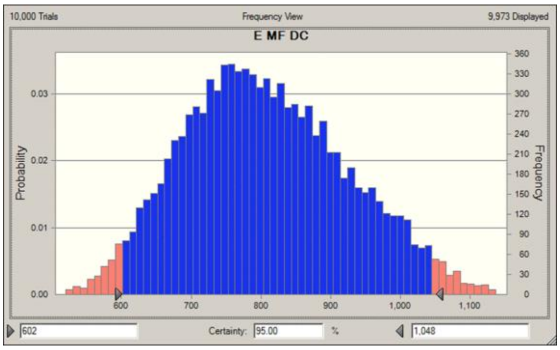
Mature male




Forecast: E MM DC

| Statistic | Forecast va |
|---|---|
| Trials | 10,000 |
| Base Case | 640 |
| Mean | 675 |
| Median | 668 |
| Mode | '--- |
| Standard D | 98 |
| Variance | 9,699 |
| Skewness | 0.2745 |
| Kurtosis | 2.62 |
| Coeff. of V | 0.1460 |
| Minimum | 422 |
| Maximum | 1,042 |
| Mean Std. | 1 |

Mature female



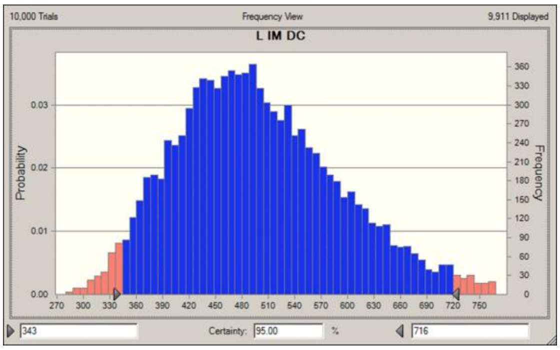

Forecast: E MF DC

| Statistic | Forecast va |
|---|---|
| Trials | 10,000 |
| Base Case | 770 |
| Mean | 808 |
| Median | 799 |
| Mode | '--- |
| Standard D | 117 |
| Variance | 13,748 |
| Skewness | 0.2856 |
| Kurtosis | 2.64 |
| Coeff. of V | 0.1451 |
| Minimum | 521 |
| Maximum | 1,244 |
| Mean Std. | 1 |

Daily consumption of common Sei whales *per capita*

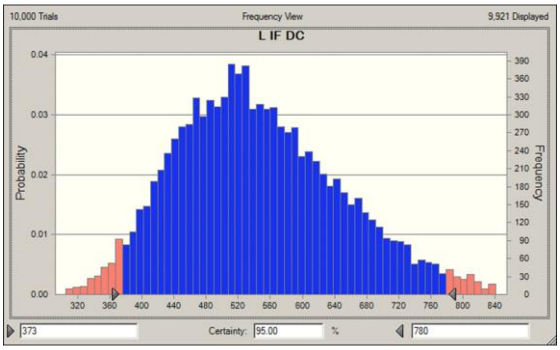
- Equation-4
- Late season (From July to September)

Immature male



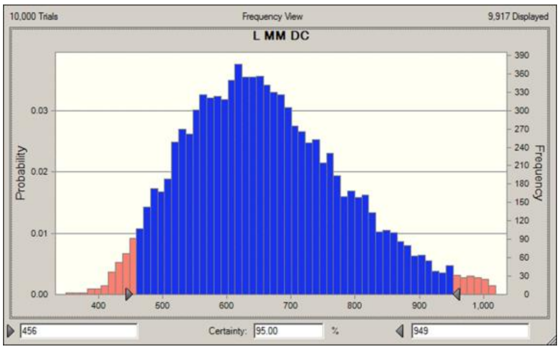

| Forecast: L IM DC | |
|---|---|
| Statistic | Forecast va |
| Trials | 10,000 |
| Base Case | 469 |
| Mean | 500 |
| Median | 489 |
| Mode | '--- |
| Standard D | 96 |
| Variance | 9,121 |
| Skewness | 0.5877 |
| Kurtosis | 3.27 |
| Coeff. of V | 0.191 |
| Minimum | 280 |
| Maximum | 920 |
| Mean Std. | 1 |

Immature female



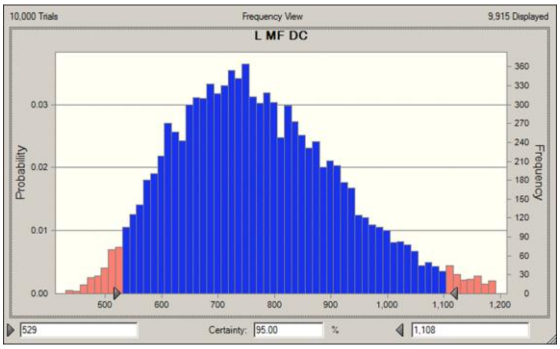

| Forecast: L IF DC | |
|---|---|
| Statistic | Forecast va |
| Trials | 10,000 |
| Base Case | 516 |
| Mean | 547 |
| Median | 535 |
| Mode | '--- |
| Standard D | 105 |
| Variance | 10,952 |
| Skewness | 0.5453 |
| Kurtosis | 3.2 |
| Coeff. of V | 0.1912 |
| Minimum | 306 |
| Maximum | 998 |
| Mean Std. | 1 |

Mature male




| Forecast: L MM DC | |
|---|---|
| Statistic | Forecast va |
| Trials | 10,000 |
| Base Case | 622 |
| Mean | 663 |
| Median | 650 |
| Mode | '--- |
| Standard D | 127 |
| Variance | 16,092 |
| Skewness | 0.5738 |
| Kurtosis | 3.25 |
| Coeff. of V | 0.1913 |
| Minimum | 350 |
| Maximum | 1,254 |
| Mean Std. | 1 |

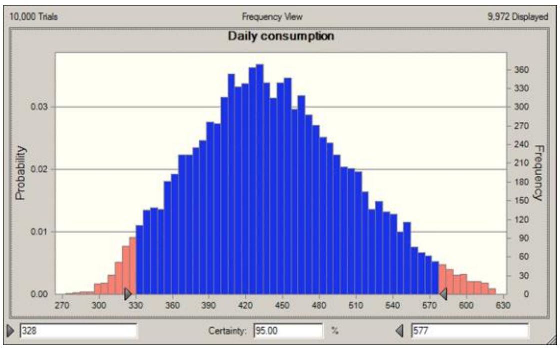
Mature female




| Coeff. of Variation | |
|---|---|
| Statistic | Forecast va |
| Trials | 10,000 |
| Base Case | 727 |
| Mean | 773 |
| Median | 756 |
| Mode | '--- |
| Standard D | 149 |
| Variance | 22,300 |
| Skewness | 0.5647 |
| Kurtosis | 3.22 |
| Coeff. of V | 0.1932 |
| Minimum | 430 |
| Maximum | 1,429 |
| Mean Std. | 1 |

- Daily consumption of common Sei whales *per capita*
- Equation-Combined
- Early season (May and June)

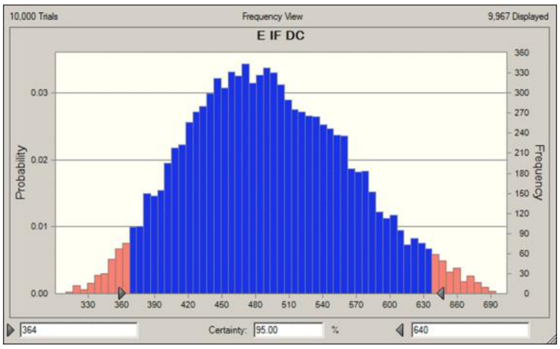
Immature male




Forecast: E IM DC

| Statistic | Forecast va |
|---|---|
| Trials | 10,000 |
| Base Case | 421 |
| Mean | 442 |
| Median | 438 |
| Mode | '--- |
| Standard D | 65 |
| Variance | 4,188 |
| Skewness | 0.2754 |
| Kurtosis | 2.7 |
| Coeff. of V | 0.1463 |
| Minimum | 273 |
| Maximum | 657 |
| Mean Std. | 1 |

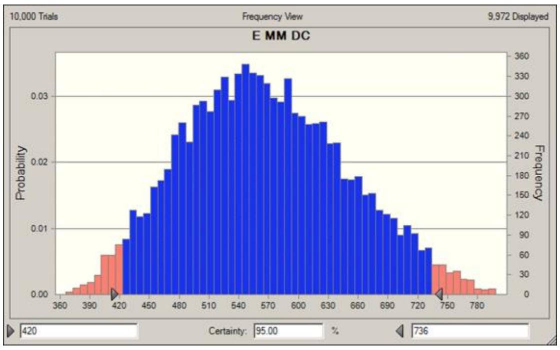
Immature female




Forecast: E IF DC

| Statistic | Forecast va |
|---|---|
| Trials | 10,000 |
| Base Case | 468 |
| Mean | 492 |
| Median | 487 |
| Mode | '--- |
| Standard D | 72 |
| Variance | 5,204 |
| Skewness | 0.2715 |
| Kurtosis | 2.67 |
| Coeff. of V | 0.1467 |
| Minimum | 311 |
| Maximum | 739 |
| Mean Std. | 1 |

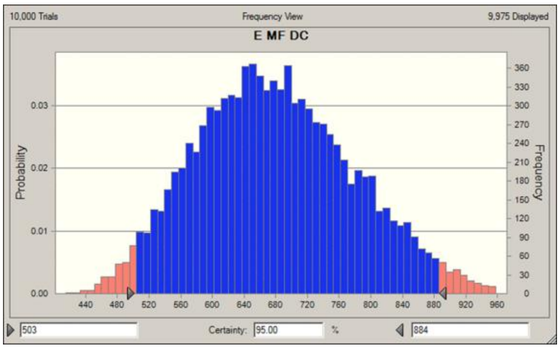
Mature male




Forecast: E MM DC

| Statistic | Forecast va |
|---|---|
| Trials | 10,000 |
| Base Case | 539 |
| Mean | 567 |
| Median | 562 |
| Mode | '--- |
| Standard D | 82 |
| Variance | 6,796 |
| Skewness | 0.2654 |
| Kurtosis | 2.64 |
| Coeff. of V | 0.1453 |
| Minimum | 366 |
| Maximum | 853 |
| Mean Std. | 1 |

Mature female

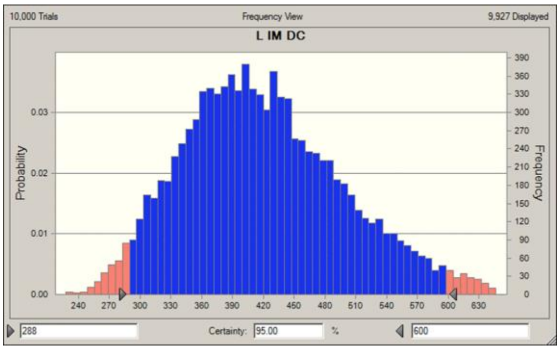



Forecast: E MF DC

| Statistic | Forecast va |
|---|---|
| Trials | 10,000 |
| Base Case | 647 |
| Mean | 680 |
| Median | 674 |
| Mode | '--- |
| Standard D | 99 |
| Variance | 9,806 |
| Skewness | 0.2555 |
| Kurtosis | 2.67 |
| Coeff. of V | 0.1456 |
| Minimum | 415 |
| Maximum | 998 |
| Mean Std. | 1 |

- Daily consumption of common Sei whales *per capita*
- Equation-Combined
- Late season (From July to September)

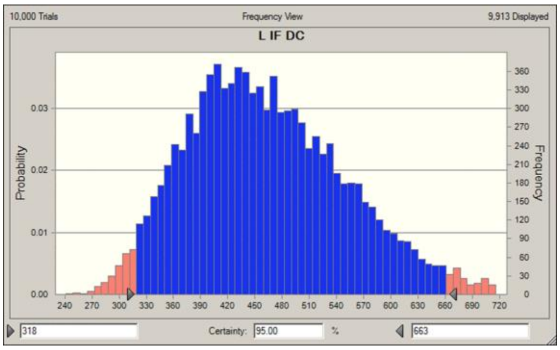
Immature male




Forecast: L IM DC

| Statistic | Forecast va |
|---|---|
| Trials | 10,000 |
| Base Case | 397 |
| Mean | 422 |
| Median | 413 |
| Mode | '--- |
| Standard D | 80 |
| Variance | 6,410 |
| Skewness | 0.5494 |
| Kurtosis | 3.24 |
| Coeff. of V | 0.1899 |
| Minimum | 228 |
| Maximum | 784 |
| Mean Std. | 1 |

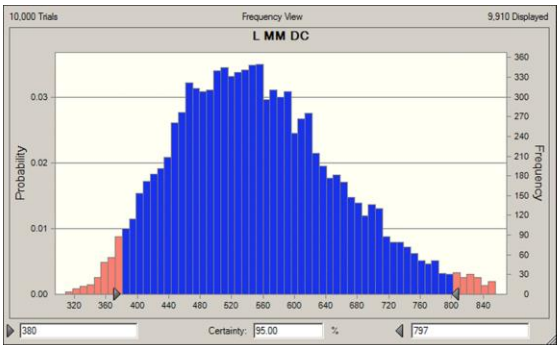
Immature female




Forecast: L IF DC

| Statistic | Forecast va |
|---|---|
| Trials | 10,000 |
| Base Case | 436 |
| Mean | 465 |
| Median | 455 |
| Mode | '--- |
| Standard D | 90 |
| Variance | 8,011 |
| Skewness | 0.5457 |
| Kurtosis | 3.14 |
| Coeff. of V | 0.1926 |
| Minimum | 242 |
| Maximum | 834 |
| Mean Std. | 1 |

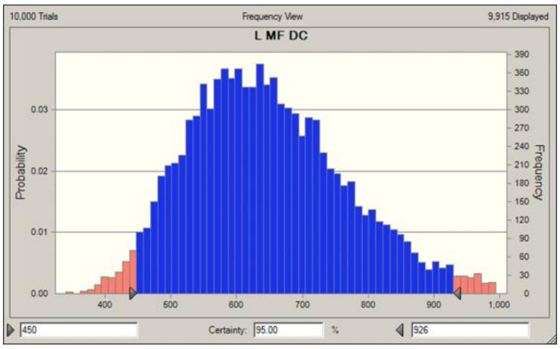
Mature male




Forecast: L MM DC

| Statistic | Forecast va |
|---|---|
| Trials | 10,000 |
| Base Case | 524 |
| Mean | 556 |
| Median | 546 |
| Mode | '--- |
| Standard D | 107 |
| Variance | 11,419 |
| Skewness | 0.5879 |
| Kurtosis | 3.33 |
| Coeff. of V | 0.1921 |
| Minimum | 309 |
| Maximum | 1,058 |
| Mean Std. | 1 |

Mature female

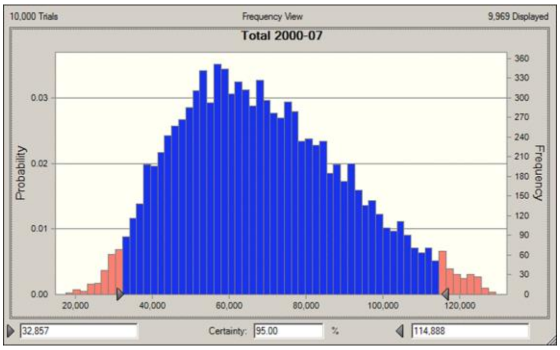



Forecast: L MF DC

| Statistic | Forecast va |
|---|---|
| Trials | 10,000 |
| Base Case | 610 |
| Mean | 650 |
| Median | 637 |
| Mode | '--- |
| Standard D | 123 |
| Variance | 15,052 |
| Skewness | 0.5951 |
| Kurtosis | 3.35 |
| Coeff. of V | 0.1889 |
| Minimum | 341 |
| Maximum | 1,215 |
| Mean Std. | 1 |

- Seasonal consumption of common minke whales (Period: 2000-2007)

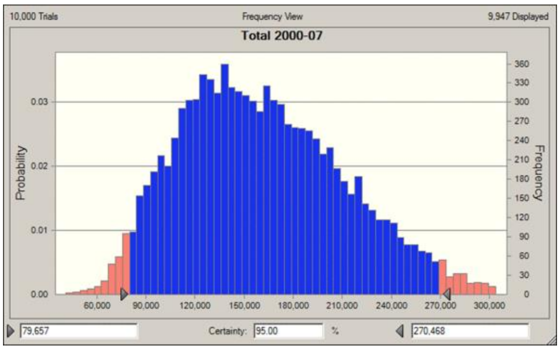
Equation-2




Coeff. of Variation

| Statistic | Forecast values |
|---|---|
| Trials | 10,000 |
| Base Case | 44,985 |
| Mean | 68,603 |
| Median | 66,503 |
| Mode | '--- |
| Standard D | 21,675 |
| Variance | 469,798,585 |
| Skewness | 0.4156 |
| Kurtosis | 2.67 |
| Coeff. of V | 0.3159 |
| Minimum | 17,578 |
| Maximum | 148,832 |
| Mean Std. | 217 |

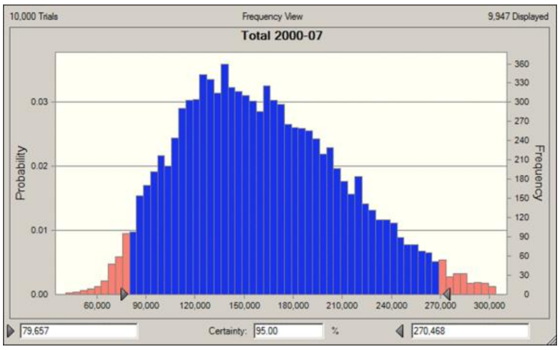
Equation-3-1




Forecast: Total 2000-07

| Statistic | Forecast values |
|---|---|
| Trials | 10,000 |
| Base Case | 107,358 |
| Mean | 162,045 |
| Median | 156,901 |
| Mode | '--- |
| Standard D | 50,589 |
| Variance | 2,559,293,269 |
| Skewness | 0.466 |
| Kurtosis | 2.82 |
| Coeff. of V | 0.3122 |
| Minimum | 41,147 |
| Maximum | 343,101 |
| Mean Std. | 506 |

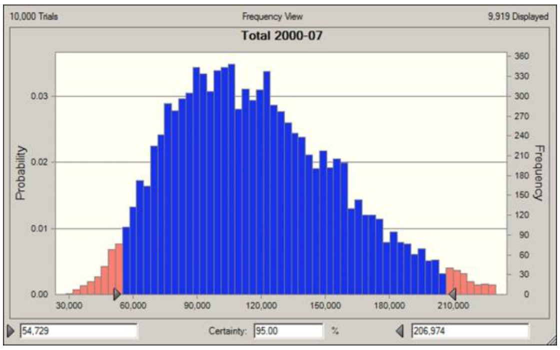
Equation-4




Forecast: Total 2000-07

| Statistic | Forecast va |
|---|---|
| Trials | 10,000 |
| Base Case | 94,773 |
| Mean | 143,941 |
| Median | 139,182 |
| Mode | '--- |
| Standard D | 45,386 |
| Variance | ######## |
| Skewness | 0.4631 |
| Kurtosis | 2.81 |
| Coeff. of V | 0.3153 |
| Minimum | 40,932 |
| Maximum | 317,567 |
| Mean Std. | 454 |

Equation-Combined

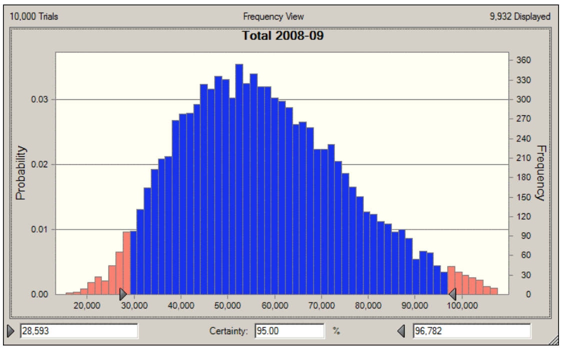



Forecast: Total 2000-07

| Statistic | Forecast va |
|---|---|
| Trials | 10,000 |
| Base Case | 82,372 |
| Mean | 118,250 |
| Median | 113,794 |
| Mode | '--- |
| Standard D | 39,855 |
| Variance | ######## |
| Skewness | 0.5996 |
| Kurtosis | 3.2 |
| Coeff. of V | 0.337 |
| Minimum | 28,552 |
| Maximum | 306,867 |
| Mean Std. | 399 |

- Seasonal consumption of common minke whales (Period: 2008-2014)

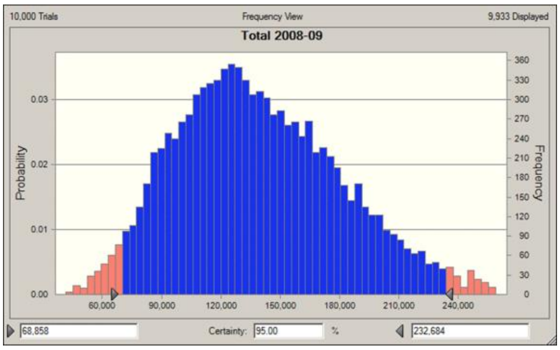
### Equation-2




Forecast: Total 2008-09

| Statistic | Forecast values |
|---|---|
| Trials | 10,000 |
| Base Case | 38,144 |
| Mean | 57,803 |
| Median | 56,113 |
| Mode | '--- |
| Standard D | 17,758 |
| Variance | 315,351,117 |
| Skewness | 0.5002 |
| Kurtosis | 3.04 |
| Coeff. of V | 0.3072 |
| Minimum | 15,537 |
| Maximum | 139,075 |
| Mean Std. | 178 |

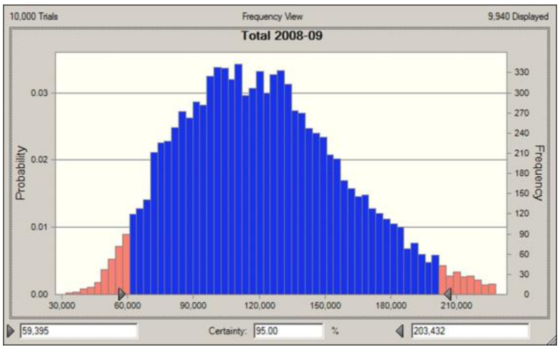
### Equation-3-1




Forecast: Total 2008-0

| Statistic | Forecast va |
|---|---|
| Trials | 10,000 |
| Base Case | 91,124 |
| Mean | 139,842 |
| Median | 135,250 |
| Mode | '--- |
| Standard D | 42,543 |
| Variance | ######## |
| Skewness | 0.4989 |
| Kurtosis | 3.05 |
| Coeff. of V | 0.3042 |
| Minimum | 41,740 |
| Maximum | 318,770 |
| Mean Std. | 425 |

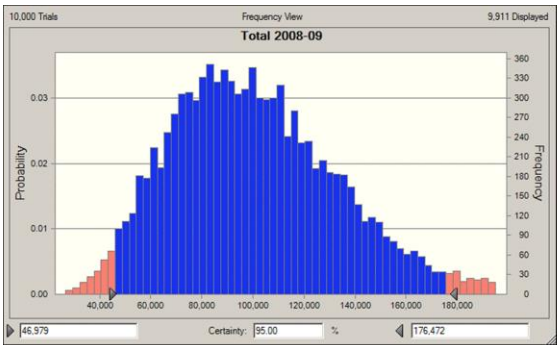
### Equation-4




Forecast: Total 2008-0

| Statistic | Forecast va |
|---|---|
| Trials | 10,000 |
| Base Case | 80,430 |
| Mean | 121,961 |
| Median | 118,984 |
| Mode | '--- |
| Standard D | 37,749 |
| Variance | ######## |
| Skewness | 0.4702 |
| Kurtosis | 2.97 |
| Coeff. of V | 0.3095 |
| Minimum | 31,983 |
| Maximum | 290,612 |
| Mean Std. | 377 |

### Equation-Combined

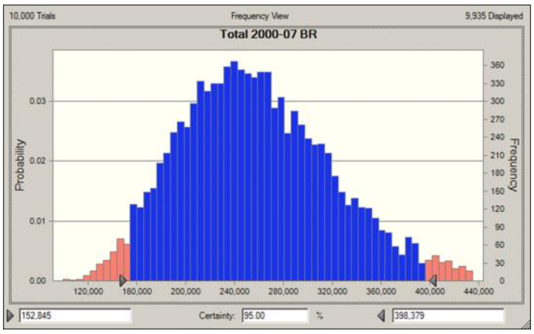



Forecast: Total 2008-0

| Statistic | Forecast va |
|---|---|
| Trials | 10,000 |
| Base Case | 69,899 |
| Mean | 101,285 |
| Median | 97,807 |
| Mode | '--- |
| Standard D | 33,427 |
| Variance | ######## |
| Skewness | 0.6149 |
| Kurtosis | 3.41 |
| Coeff. of V | 0.33 |
| Minimum | 26,753 |
| Maximum | 276,956 |
| Mean Std. | 334 |

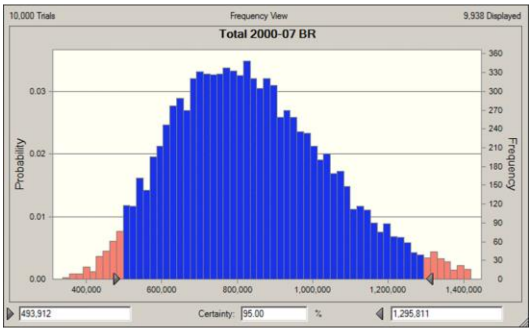
- Seasonal consumption of Bryde's whales (Period: 2000-2007)

Equation-2



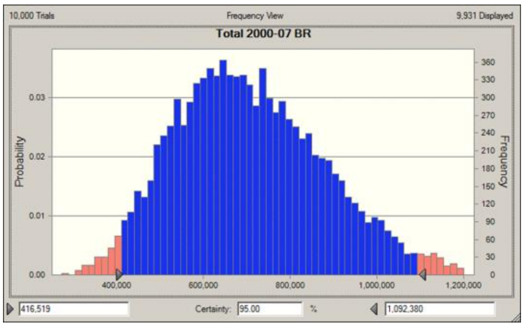

| | |
|---|---|
| Forecast: Total 2000-0 | |
| Statistic | Forecast va |
| Trials | 10,000 |
| Base Case | 216,311 |
| Mean | 258,508 |
| Median | 252,996 |
| Mode | '--- |
| Standard D | 62,932 |
| Variance | ######## |
| Skewness | 0.4783 |
| Kurtosis | 3.09 |
| Coeff. of V | 0.2434 |
| Minimum | 99,762 |
| Maximum | 529,349 |
| Mean Std. | 629 |

Equation-3-1



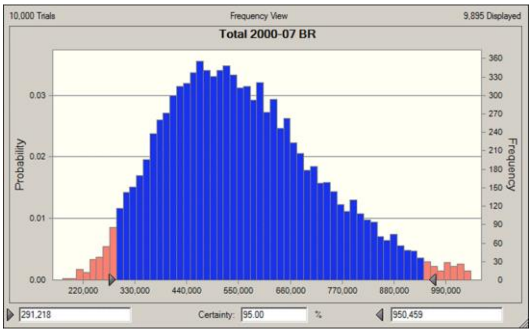

| | |
|---|---|
| Forecast: Total 2000-0 | |
| Statistic | Forecast va |
| Trials | 10,000 |
| Base Case | 697,828 |
| Mean | 838,508 |
| Median | 820,152 |
| Mode | '--- |
| Standard D | 206,974 |
| Variance | ######## |
| Skewness | 0.4749 |
| Kurtosis | 3.02 |
| Coeff. of V | 0.2468 |
| Minimum | 338,869 |
| Maximum | 1,772,378 |
| Mean Std. | 2,070 |

Equation-4




| | |
|---|---|
| Forecast: Total 2000-0 | |
| Statistic | Forecast va |
| Trials | 10,000 |
| Base Case | 592,830 |
| Mean | 709,972 |
| Median | 693,478 |
| Mode | '--- |
| Standard D | 174,757 |
| Variance | ######## |
| Skewness | 0.4718 |
| Kurtosis | 3.06 |
| Coeff. of V | 0.2461 |
| Minimum | 273,897 |
| Maximum | 1,451,402 |
| Mean Std. | 1,748 |

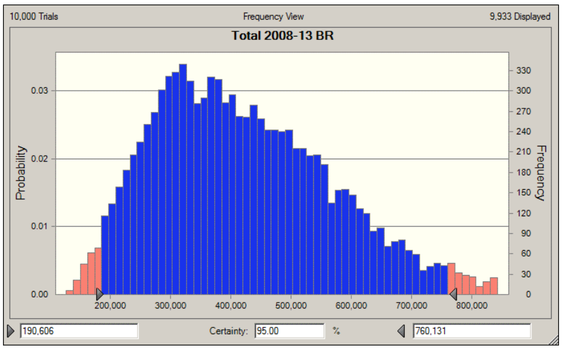
Equation-Combined




| | |
|---|---|
| Forecast: Total 2000-0 | |
| Statistic | Forecast va |
| Trials | 10,000 |
| Base Case | 502,323 |
| Mean | 562,673 |
| Median | 541,658 |
| Mode | '--- |
| Standard D | 171,384 |
| Variance | ######## |
| Skewness | 0.6805 |
| Kurtosis | 3.47 |
| Coeff. of V | 0.3046 |
| Minimum | 177,358 |
| Maximum | 1,351,787 |
| Mean Std. | 1,714 |

- Seasonal consumption of Bryde’s whales (Period: 2008-2014)

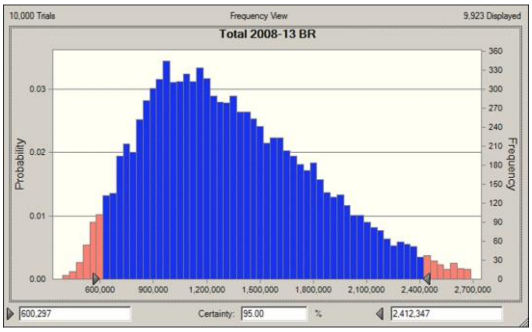
## Equation-2




Forecast: Total 2008-1

| Statistic | Forecast va |
| --- | --- |
| Trials | 10,000 |
| Base Case | 310,199 |
| Mean | 422,946 |
| Median | 402,896 |
| Mode | '--- |
| Standard D | 149,575 |
| Variance | ######## |
| Skewness | 0.6029 |
| Kurtosis | 3.02 |
| Coeff. of V | 0.3536 |
| Minimum | 127,272 |
| Maximum | 1,069,020 |
| Mean Std. | 1,496 |

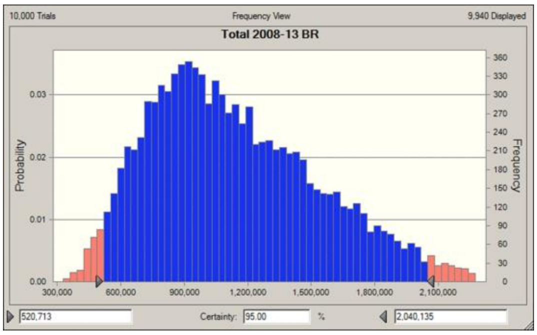
## Equation-3-1




Forecast: Total 2008-1

| Statistic | Forecast va |
| --- | --- |
| Trials | 10,000 |
| Base Case | 989,707 |
| Mean | 1,343,729 |
| Median | 1,276,498 |
| Mode | '--- |
| Standard D | 479,734 |
| Variance | ######## |
| Skewness | 0.6218 |
| Kurtosis | 3.02 |
| Coeff. of V | 0.3570 |
| Minimum | 389,790 |
| Maximum | 3,173,438 |
| Mean Std. | 4,797 |

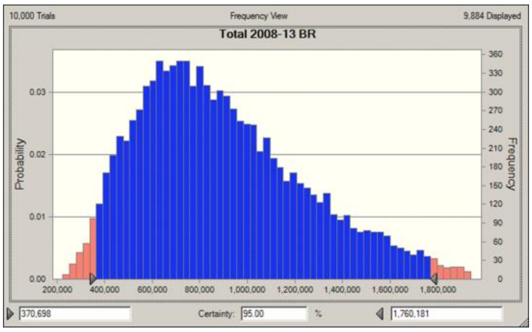
## Equation-4




Forecast: Total 2008-1

| Statistic | Forecast va |
| --- | --- |
| Trials | 10,000 |
| Base Case | 841,977 |
| Mean | 1,140,977 |
| Median | 1,076,095 |
| Mode | '--- |
| Standard D | 404,227 |
| Variance | ######## |
| Skewness | 0.6235 |
| Kurtosis | 2.96 |
| Coeff. of V | 0.3543 |
| Minimum | 329,063 |
| Maximum | 2,881,683 |
| Mean Std. | 4,042 |

## Equation-Combined

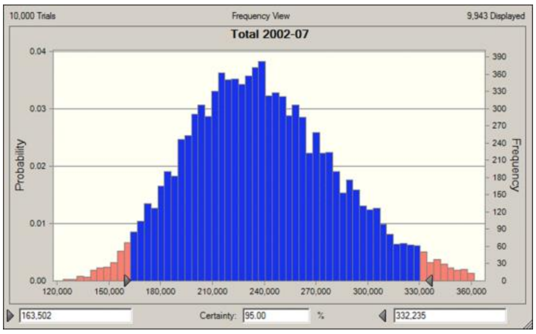



Forecast: Total 2008-1

| Statistic | Forecast va |
| --- | --- |
| Trials | 10,000 |
| Base Case | 713,961 |
| Mean | 906,350 |
| Median | 842,016 |
| Mode | '--- |
| Standard D | 367,968 |
| Variance | ######## |
| Skewness | 0.8607 |
| Kurtosis | 3.68 |
| Coeff. of V | 0.4060 |
| Minimum | 225,153 |
| Maximum | 2,956,664 |
| Mean Std. | 3,680 |

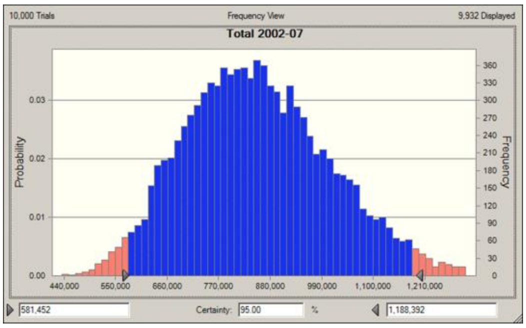
- Seasonal consumption of sei whales (Period: 2002-2007)

## Equation-2



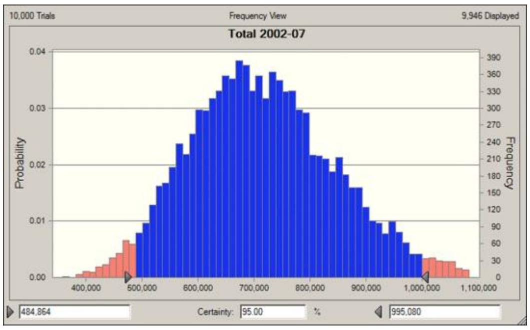

| | |
|---|---|
| Forecast: Total 2002-0 | |
| Statistic | Forecast va |
| Trials | 10,000 |
| Base Case | 211,250 |
| Mean | 239,326 |
| Median | 235,921 |
| Mode | '--- |
| Standard D | 43,653 |
| Variance | ######## |
| Skewness | 0.4008 |
| Kurtosis | 3.05 |
| Coeff. of V | 0.1824 |
| Minimum | 123,697 |
| Maximum | 433,950 |
| Mean Std. | 437 |

## Equation-3-1



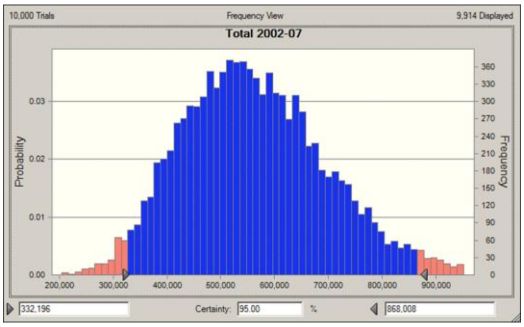

| | |
|---|---|
| Forecast: Total 2002-0 | |
| Statistic | Forecast va |
| Trials | 10,000 |
| Base Case | 754,258 |
| Mean | 856,025 |
| Median | 845,364 |
| Mode | '--- |
| Standard D | 157,301 |
| Variance | ######## |
| Skewness | 0.3927 |
| Kurtosis | 3.01 |
| Coeff. of V | 0.1838 |
| Minimum | 436,129 |
| Maximum | 1,565,693 |
| Mean Std. | 1,573 |

## Equation-4




| | |
|---|---|
| Forecast: Total 2002-0 | |
| Statistic | Forecast va |
| Trials | 10,000 |
| Base Case | 632,542 |
| Mean | 716,582 |
| Median | 707,782 |
| Mode | '--- |
| Standard D | 130,651 |
| Variance | ######## |
| Skewness | 0.3829 |
| Kurtosis | 3.1 |
| Coeff. of V | 0.1823 |
| Minimum | 359,384 |
| Maximum | 1,368,727 |
| Mean Std. | 1,307 |

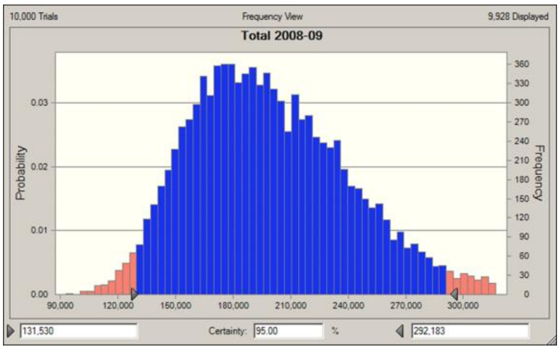
## Equation-Combined




| | |
|---|---|
| Forecast: Total 2002-0 | |
| Statistic | Forecast va |
| Trials | 10,000 |
| Base Case | 532,683 |
| Mean | 565,510 |
| Median | 553,781 |
| Mode | '--- |
| Standard D | 137,484 |
| Variance | ######## |
| Skewness | 0.522 |
| Kurtosis | 3.4 |
| Coeff. of V | 0.2431 |
| Minimum | 205,268 |
| Maximum | 1,300,198 |
| Mean Std. | 1,375 |

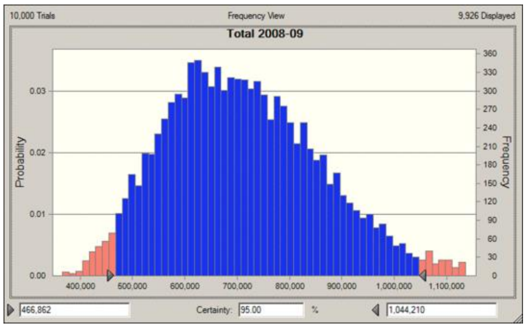
- Seasonal consumption of sei whales (Period: 2008-2014)

Equation-2



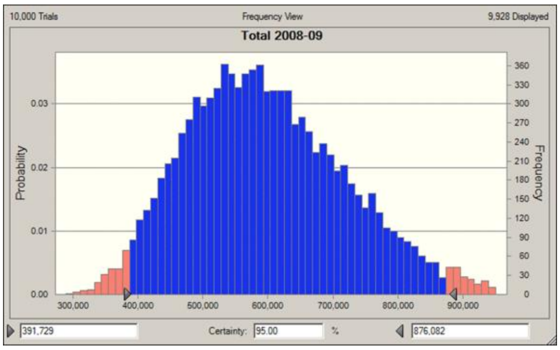

| Forecast: Total 2008-0 | |
|---|---|
| Statistic | Forecast va |
| Trials | 10,000 |
| Base Case | 175,500 |
| Mean | 199,642 |
| Median | 195,031 |
| Mode | '--- |
| Standard D | 41,817 |
| Variance | ######## |
| Skewness | 0.5448 |
| Kurtosis | 3.14 |
| Coeff. of V | 0.2095 |
| Minimum | 93,181 |
| Maximum | 389,023 |
| Mean Std. | 418 |

Equation-3-1



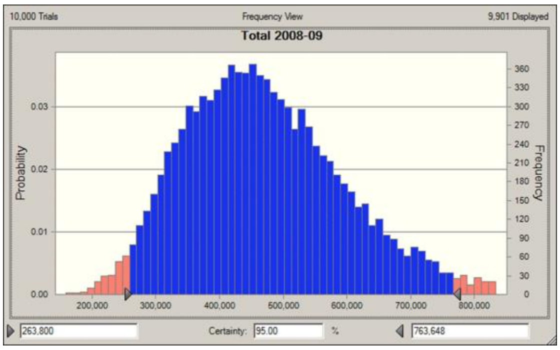

| Forecast: Total 2008-0 | |
|---|---|
| Statistic | Forecast va |
| Trials | 10,000 |
| Base Case | 626,265 |
| Mean | 714,765 |
| Median | 701,295 |
| Mode | '--- |
| Standard D | 150,237 |
| Variance | ######## |
| Skewness | 0.5297 |
| Kurtosis | 3.21 |
| Coeff. of V | 0.2102 |
| Minimum | 366,522 |
| Maximum | 1,413,425 |
| Mean Std. | 1,502 |

Equation-4




| Forecast: Total 2008-0 | |
|---|---|
| Statistic | Forecast va |
| Trials | 10,000 |
| Base Case | 525,241 |
| Mean | 599,679 |
| Median | 587,368 |
| Mode | '--- |
| Standard D | 125,095 |
| Variance | ######## |
| Skewness | 0.5036 |
| Kurtosis | 3.12 |
| Coeff. of V | 0.2086 |
| Minimum | 289,642 |
| Maximum | 1,171,361 |
| Mean Std. | 1,251 |

Equation-Combined




| Forecast: Total 2008-0 | |
|---|---|
| Statistic | Forecast va |
| Trials | 10,000 |
| Base Case | 442,335 |
| Mean | 472,803 |
| Median | 458,633 |
| Mode | '--- |
| Standard D | 128,594 |
| Variance | ######## |
| Skewness | 0.6325 |
| Kurtosis | 3.47 |
| Coeff. of V | 0.2720 |
| Minimum | 159,233 |
| Maximum | 1,093,408 |
| Mean Std. | 1,286 |