An update of Antarctic minke whales abundance estimate based on JARPA data including comparison to IDCR/SOWER estimates.

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ABSTRACT

On one side, abundances for Antarctic minke whales (*Balaenoptera bonaerensis*) from IDCR/SOWER data have been estimated taking the effect of closing mode on the estimate into consideration (Branch and Butterworth, 2001). On the other side, the abundance from JARPA data had been estimated without taking this effect into account because sighting survey in passing mode had not been conducted up to 1996/97. It is investigated for the first time if this effect on the abundance from JARPA is statistically significant or not. Because it is found that the effect is significant, we corrected the bias of the abundance estimate due to this effect. Second, we examined the effect of sampling activity and skipping (proceed along track lines in the night without surveying) on abundance estimates by comparing the abundance estimate for SSVs and SV. This examination is an update of Hakamada *et al*. (2001). As the significant effect of the sampling activity and skipping was detected, we corrected the bias due to this effect. These two corrections enable to obtain abundance estimate from JARPA that comparable to those from IDCR/SOWER. From the results, underestimate of the abundance from JARPA that pointed out at the JARPA review meeting in 1997, is almost due to the effect of closing mode and of sampling activity. Abundance estimate derived from this method would be used to estimate biological parameters more preciously. Further, we estimated abundance trend in Areas IV and V. It is shown that no significant increase or decrease of the abundance is detected.

KEY WORDS: ANTARCTIC MINKE WHALE, ABUNDANCE ESTIMATE, TRENDS

INTRODUCTION

The Japanese Whale Research Program under Special Permit in the Antarctic (JARPA) has been conducting sighting surveys and biological research of minke whales in Antarctic since 1987/1988. Estimation of the biological parameters to improve the stock management of the Antarctic minke whale is one of the main objectives of JARPA. Because biological samples are collected by two-stage random sampling, estimates of abundance based on these data are necessary for the estimation of biological parameters (Kishino *et al*., 1989). Abundance estimation for the minke from JARPA data had been conducted (Kasamatsu *et al*, 1990; 1991; Kishino *et at*., 1991; Nishiwaki *et al*., 1992; 1994; 1997). At the JARPA review meeting in 1997, it was pointed out that bias of abundance estimate results from the higher-density-under-surveying feature of the JARPA survey design. Burt and Borchers (1997) proposed a method to correct the bias, but there were discussions that adjustment approach in Burt and Borchers (1997) may be unreliable at this meeting (IWC, 1998). Since then, some analyses to examine appropriate methods of adjusting the abundance estimates were conducted (Tanaka, 1999; Clarke *et al*., 1999; 2000). Tanaka (1999) showed that adjustment approach in Burt and Borchers (1997) results in overestimate. Clarke *et al*. (1999; 2000) investigated the performance of GAM-based estimator by simulation. Marques *et al*. (2003) and Burt *et al*. (2005) estimates abundance in Areas IV and V derived from spatial modelling, respectively.

In Hakamada *et al*. (2001), abundance for the minke whale in Areas IV and V from JARPA up to 2000/01 were estimated. In this paper, the abundances in 2001/02 and 2002/03 are also estimated. In addition, abundances in eastern part of Area III (35-70^{o}E) and in western part of Area VI (145-170^{o}W) are also estimated. We investigated (1) the effect of sampling activities（comparison between SSV and SV in closing mode）and (2) the effect of closing mode (comparison between SV in closing mode and that in passing mode). If these effects are statistically significant, the abundance estimates derived from standard methodology (i.e. DISTANCE without adjustment) would be corrected by correction factors. As for the effect (1), we updated the estimate by adding data in recent 3 years and taking school size estimation into consideration. As for the effect (2), we used SV data in passing mode, which has been conducted since 1997/98. We estimated the degree of under-estimate of the abundance due to closing mode by a method in Haw (1991).

MATERIALS AND METHODS

Survey methodology

For details, see Nishiwaki *et al*., (2005). In this section, type of survey vessels and survey mode are explained for understanding this paper.

Sampling and Sighting Vessel (SSV)

Sighting surveys by Sampling and Sighting Vessels (SSV) have been conducted since the beginning of JARPA. Researchers search for school until a school is detected and confirm its species and school size after the detection. It is the same survey procedure as that of Sighting Vessel (SV) in closing mode. Different from SV, SSVs try to catch targeted minke whales after confirmation. As it takes much time to catch and carry a sample to research base ship, SSVs could not cover planned distance in high density area, and, if necessary, they proceed the rest of the distance without surveying to the starting point of the next day survey.

Sighting Vessel (SV)

Sighting Vessel was introduced in southern strata in 1991/92 and sighting surveys by SV have been conducted in all strata since 1992/93. Fundamentally, survey protocols of JARPA follow that of IDCR. All sighting survey was conducted in closing mode by 1996/97, but sighting survey in passing mode has been conducted science 1997/98. Except in 1997/98, passing mode is conducted for first 8 hours in a day and closing mode is conducted during rest of the day. Therefore, allocation of effort in passing mode and closing mode is systematic as well as IDCR/SOWER. SV seldom surveys with skipping except due to bad weather conditions, therefore the effect of sampling activity and skipping due to under-surveying in higher density area can be examined by comparing whale density from SSV data to that from SV in closing mode.

As for comparison between SSV and SV in closing mode, the sighting data in 1991/92 or later were used. As for comparison between SV in closing mode and SV in passing mode, data in 1997/98 or later were used.

Abundance estimation

Methodology of abundance estimation used in this study was described in Burt and Stahl (2000) which is the standard methodology adopted by IWC. The program DISTANCE (Buckland *et al.*, 1993) was used for abundance estimation. Following formula was used for abundance estimation.

$$P = \frac{AE(s)n}{2wL} \qquad (1)$$

Where

P = abundance estimate

A = area of stratum

$E(s)$ = estimated mean school size

n= numbers of schools primary sightings (after smearing)

w = effective search half-width for schools

L = search effort

The CV of P is calculated as follows

$$\mathrm{CV}(P) = \sqrt{\{\mathrm{CV}(\frac{n}{L})\}^2 + \{\mathrm{CV}(E(s))\}^2 + \{\mathrm{CV}(w)\}^2} \qquad (2)$$

Assuming abundance is log-normally distributed, 95% confidential interval of the abundance estimate was calculated as (P/C, CP) where

$$C = \exp(Z_{0.025}\sqrt{\log_e[1 + \{\mathrm{CV}(P)\}^2]}) \qquad (3)$$

$Z_{0.025}$ represents 2.5-percentage point of standard normal distribution. To see more detail, please refer to, for example, Buckland et al. (1993) or Branch and Butterworth (2001).

Distance and angle estimation experiment

To correct biases of distance and angle estimation, distance and angle estimation experiment was conducted on each vessel. Bias was estimated for each platform. Linear regression models with standard error proportional to true (radar) distance were conducted to detect significant bias of estimated distance at 5% level. In order to correct significant biases, estimated distance was divided by the estimated slope through the origin. Linear regression models with constant variance were conducted to detect significant bias of estimated angle at 5% level. In order to correct significant biases, estimated angle was divided by the estimated slope through the origin.

Smearing and truncation

The radial distance and angle data for each sighting are smeared using the method II of Buckland and Anganuzzi (1988). Smearing parameter was shown in Table 2. After smearing, the perpendicular distance distribution is truncated at 1.5 n.miles. The smeared and truncated number of detection was substitute to formula (1).

Effective search half-width

Hazard rate model with no adjustment terms was used as a detection function model. It was assumed that $g(0)=1$ (i.e. Probability of detection of whale on the track line is 1.). Effective search half-width was estimated for each stratum.

Mean school size

Only the sightings for which school size is confirmed are used for estimation. We used the method of estimation of mean school size described Buckland *et al.* (1993). Regression of log of school size on $g(x)$ was conducted to estimate mean school size. If the regression coefficient was not significant at 15% level, mean of observed school size was substituted to formula (1). If estimated school size is less than 1, mean of observed school size was substituted to formula (1) even if the regression coefficient was significant. Similar to the case for IDCR/SOWER, we use SV closing mode data for estimation of mean school size for SV passing mode.

Stratification

SV abundance was estimated for each stratum. From 1997/98 to 2003/04, abundances were estimated from data in closing mode and those in passing mode, respectively. And SSV abundances were estimated for each track line. SSV abundance for each stratum was estimated by effort-weighted average of that for each track line.

Estimation correction factor $R1$ and $R2$

A ratio ($R1$) of whale density for SSV to that for SV closing mode and a ratio ($R2$) of whale density for SV closing mode to that for SV passing mode were estimated by using the method of Haw (1991). $R1$ and $R2$ were estimated for each stratum by calculating inverse-variance-weighted average of $R1/R2$-values for all years. We show formulas in the case of estimate of a ratio of whale density for SSV to that for SV closing mode. The index i indicates strata. For simplicity, we wrote $R1$ and $R2$ as R in rest of this section.

$$\overline{\ln R} = \sum_i \frac{\mathrm{Var}(\ln R_i)}{\sum_j \mathrm{Var}(R_j)} \ln R_i \qquad (4\text{-}1)$$

$$\mathrm{Var}(\overline{\ln R}) = \left\{ \sum_i \mathrm{Var}(R_i) \right\}^{-1} \qquad (4\text{-}2)$$

$$R = \exp(\overline{\ln R} + \mathrm{Var}(\overline{\ln R}) / 2) \qquad (4\text{-}3)$$

$$\mathrm{se}(R) = \sqrt{R\{\exp(\mathrm{Var}(\overline{\ln R})) - 1\}} \qquad (4\text{-}4)$$

where $$R_i = \frac{D_{i,\mathrm{SSV}}}{D_{i,\mathrm{SV\text{-}closing}}} \qquad (4\text{-}5)$$

$$\mathrm{CV}(R_i) = \sqrt{\{\mathrm{CV}(D_{i,\mathrm{SSV}})\}^2 + \{\mathrm{CV}(D_{i,\mathrm{SV\text{-}closing}})\}^2} \qquad (4\text{-}6)$$

$$\mathrm{Var}(\ln R_i) = \ln[\{CV(R_i)\}^2 - 1] \qquad (4\text{-}7)$$

R for whole Area IV and whole Area V also estimated by 'super-strata' method described by Haw (1991). To conduct this method, D_w for 'super-strata' (weighted by Area of each stratum) is estimated by

$$W_i = \frac{A_i}{\sum_i A_i} \qquad (5\text{-}1)$$

$$\overline{D} = \frac{1}{2\hat{w}} \sum_i W_i \left(\frac{n}{L}\right)_i \qquad (5\text{-}2)$$

$$\mathrm{CV}(\overline{D}) = \sqrt{\{\mathrm{CV}(\hat{w})\}^2 + \frac{\sum_i W_i^2 \left(\frac{n}{L}\right)_i^2 \left[\mathrm{CV}\left\{\left(\frac{n}{L}\right)_i\right\}\right]^2}{\left\{\sum_i W_i \left(\frac{n}{L}\right)_i\right\}^2}} \qquad (5\text{-}3)$$

where $\hat{w}$ is pooled estimate of effective search half- width. R for 'super-strata' is estimated similarly.

Combining abundance estimates

For the purpose of adjusting SSV abundance that might be affected by sampling activity, SSV abundance was divided by estimated R1. CV of 'Pseudo SV-C' abundance was calculated by

$$\mathrm{CV}(P_{PseudoSV-C}) = \sqrt{\{\mathrm{CV}(P_{SSV})\}^2 + \{\mathrm{CV}(R)\}^2} \tag{6-1}$$

Next, inverse-variance-weighted average of P_{Pseudo} and P_{SSV} (P_1) and its CV was calculated by following formula,

$$P_1 = \frac{\mathrm{Var}(P_{PseudoSV-C})P_{SV-C} + \mathrm{Var}(P_{SV-C})P_{PseudoSV-C}}{\mathrm{Var}(P_{SV-C}) + \mathrm{Var}(P_{PseudoSV-C})} \tag{6-2}$$

$$\mathrm{CV}(P_1) = \frac{\sqrt{\{\mathrm{Var}(P_{PsedoSV-C})\}^2 \mathrm{Var}(P_{SV-C}) + \{\mathrm{Var}(P_{SV-C})\}^2 \mathrm{Var}(P_{PseudoSV-C})}}{\{\mathrm{Var}(P_{SV-C}) + \mathrm{Var}(P_{PseudoSV-C})\}P_1} \tag{6-3}$$

Similarly, in order to consider the effects of closing mode on abundance estimates, the combined estimate of P_1 and $P_{\text{SV-P}}$ (the abundance estimates for SV in passing mode) (P_{combined}) and its CV are obtained. The formulas are

$$P_{combined} = \frac{\mathrm{Var}(P_{PseudoSV-P})P_{SV-P} + \mathrm{Var}(P_{SV-P})P_{PseudoSV-P}}{\mathrm{Var}(P_{SV-P}) + \mathrm{Var}(P_{PseudoSV-P})} \tag{6-4}$$

$$\mathrm{CV}(P_1) = \frac{\sqrt{\{\mathrm{Var}(P_{PsedoSV-P})\}^2 \mathrm{Var}(P_{SV-P}) + \{\mathrm{Var}(P_{SV-P})\}^2 \mathrm{Var}(P_{PseudoSV-P})}}{\{\mathrm{Var}(P_{SV-P}) + \mathrm{Var}(P_{PseudoSV-P})\}P_1} \tag{6-5}$$

where $P_{\text{pseudoSV-P}}$ is P_1 divided by estimated R2.

Estimation of trend

At first, abundance trend was estimated using the time series of SV abundance estimate in Areas IV and V respectively. Linear regression log of abundance on year was conducted to estimate instantaneous increasing rate and its 95% confidential interval. The result suggests that trend estimates using SV abundance is not precious enough, therefore, similarly, abundance trend was estimated from time series of combined abundance. It should be taken into consideration that combined abundance estimates are not independent, because they were calculated using common R estimated from abundance estimate for all year. To overcome this difficulty, Monte Carlo Simulation was conducted.

Monte Carlo simulation

We denote abundance estimated from SSV in year y as $P_{1,y}$, abundance estimated from SV in closing mode in year y as $P_{2,y}$ and abundance estimated from SV in passing mode in year y as $P_{3,y}$. Superscript p indicate that it was Pseudo data. Pseudo data set was produced according to equations (7-1) – (7-3).

$$(\sigma_{i,y})^2 = \ln(1+\{\mathrm{CV}(P_{i,y})\}^2 \qquad (i=1,2,3) \qquad (7\text{-}1)$$

$$P_{i,y}^{p} = P_{i,y}\exp(\varepsilon_{i,y}^{p})$$ where $\varepsilon_{i,y}^{p}$ is a random number from N (0, $(\sigma_{i,y})^2$) (i=1,2,3) (7-2)

and for the simplicity, it was assumed that CV of $P_{i,y}^{p}$ (i = 1,2) is constant. Standard errors of $P_{i,y}^{p}$ (i = 1,2) are calculated by

$$\mathrm{se}(P_{i,y}^{p}) = P_{i,y}^{p}\mathrm{CV}(P_{i,y}) \qquad (i=1,2,3) \qquad (7\text{-}3)$$

Combined abundance estimate was calculated from the Pseudo data set and estimated trend similarly. This procedure was repeated 99 times. 95% confidential interval of estimated slope was estimated by $\left(\frac{a_2+a_3}{2}, \frac{a_{97}+a_{98}}{2}\right)$, where a_i is the *i* th slope estimated from produced data set arranging increasing order.

RESULTS

Abundance estimate from SSV, SV in closing mode and SV in passing mode

Table 1-a, 1-b, 1-c and 1-d shows abundance estimate from SSV in Area IV, Area V, the eastern part of Area III and the western part of Area VI, respectively. Estimates from SSV was tend to be much smaller than those from SVbut they were occasionally more than estimates from SV in some recent years.

Estimate of R1 and R2 and corrected abundance in Areas IV and V

Estimated correction factor between SSV and SV in closing mode is $R1$=0.816 (CV=0.086) and estimated correction factor between SV in closing mode and SV in passing mode is $R2$=0.689 (CV=0.137). Both $R1$ and $R2$ are significantly different from 0. This means that the effect of sampling activity and that of closing mode is significant. So, abundance estimates in Table 1 are corrected using correction factors $R1$ and $R2$.

Table 2-a and 2-b shows uncorrected and corrected abundance in Areas IV and V and eastern part of Area III and western part of Area VI, respectively.

Abundance trends in Areas IV and V and abundance estimate for the minke whale of a stock in 35-165^{o}E

From recent study of stock identity, there is one stock (Eastern Indian stock: I-stock) in the longitudinal sector 35–165^{o}E (Pastene *et al.*, 2005). It is necessary to consider annual increasing rate in Areas IV and V, because we have to combine abundance in Area IV and western part of Area V. Estimated annual increasing rate is 0.27% (95%CI: (-4.57%, 3.91%)) in Area IV and 2.50% (95%CI: (-1.36%, 6.17%)) in

Area V. Because it can be concluded that estimated trends were not significant from estimated 95% confidential interval, it is assumed that the abundances of the stock neither increase nor decrease. So we simply summed up abundance estimate in different year without adjustment to estimate the abundance of the stock. The abundance estimate is shown in Table 3.

DISCUSSION

Interpretation of possible bias due to under-surveying in higher density area

At the JARPA review meeting in 1997, it was discussed that JARPA abundance estimate is possibly underestimated due to under-surveying in higher density area, which was supported by that previous abundance estimate from JARPA survey is less than the estimate from IDCR in CP II. Comparing corrected abundance from JARPA to that from IDCR (Table 4), except for the estimate in 1992/93, 95% confidential intervals of JARPA estimates have intersection with 95% confidential intervals of IDCR in CP II in both Area IV and V. Therefore, it can be concluded that the underestimate of abundance discussed in 1997 is almost due to the effect of sampling activities and the effect of closing mode. Abundance estimate of solitary whales and whales of school size 2+ derived from approach in this paper is expected to estimate biological parameters more preciously.

Comparison to abundance derived from spatial modelling

The abundance estimates in this study are much larger than those derived from spatial modeling (Table 5), and the latters are rather similar to estimates of uncorrected SSV. This may suggest that spatial modelling hasn’t succeeded in correcting the effects on the abundance estimate yet. The method in Haw (1991) applied in this study is examined the averaged effects in each stratum, whereas spatial modeling could be examine the effect in finer scale. However, on applying the model to real data, the most adequate length of segment to examine the effect is unknown and the abundance estimate might depend on the scale. These should be investigated in future. Estimated extent of the effects on abundance estimate derived from the method in Haw (1991) is more reliable than those derived from spatial modeling until such investigations have been completed.

Consistency with other studies than spatial modelling.

Comparing to estimate in Burt and Borchers (1997), the estimate in this study is more than theirs in Area IV. Although, different from this study, estimated encounter late from SSV data was extrapolated to unsurveyed area and they didn’t correct the bias due to closing mode, abundance estimate multiplied by 1.4 in Area IV and by 2.2 in Area V by their correction method. In this study, correction factor between SSV and SV in closing mode is estimated as 1.2 (=1/0.816). Therefore, this study supports that correction method in Burt and Borchers (1997) results in overestimation of abundance, as it was discussed in JARPA review and Tanaka (1999).

Heterogeneity of correction factor *R*1 among strata and years

Statistical test showed that significant differences were not detected between northern strata and southern strata or between earlier years (1989/90 to 1996/97) and later years (after 1997/98), therefore we corrected abundance with constant *R*1 estimate for all cases. But average of *R*1 in earlier years is less than that in later years in southern strata in both Areas IV and V, respectively. And average *R*1 in southern strata is smaller (i.e. abundance is biased more) than in northern strata though the difference is not significant in both Area IV and V. Impact of this on abundance estimate is thought to be small at this stage. It may be necessary to estimate *R*1 by GLM in a similar way to Brandao and Butterworth (2002) to investigate (1) whether *R*1 are different between Northern strata and Southern strata and (2) whether *R*1 is different among years in future.

Possible relationship between abundance estimate and ice condition

In Table 2, the smallest abundance estimate in Area IV among the years is the estimate in 1997/98 when pack ice prevent to survey in Prydz Bay. In 1998/99 SOWER survey, similar situation was observed and the abundance estimate is much smaller than in this study. These suggest that abundance have some relation with ice condition. Anyway, the relationship between abundance and ice condition should be investigate further.

Possible underestimate due to survey period in eastern part of Areas III and western part of Area VI

In this study, the abundance in eastern part of Areas III and western part of AreaVI are estimated using data out of main season, whereas the abundance in Areas IV and V are estimated using data during main season. This may be cause of possible under estimate of the abundance in the part of Area III and VI. It is necessary to consider the seasonal effect when survey was conducted to estimate abundance in future.

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REFERENCE

Branch, T. A. and Butterworth, D. S. 2001. Southern Hemisphere minke whales: standardised abundance estimates from the 1978/79 to 1997/98 IDCR-SOWER surveys. *J. Cetacean Res. Manage.* 3:143-174.

Brandao, A. and Butterworth, D. S. 2002. Further results concerning the closing : IO mode density ratio *R*, for the IDCR-SOWER surveys. Paper SC/54/IA26 presented to IWC scientific committee. April 2002 (unpublished). 13pp.

Buckland S. T. and Anganuzzi A. A. 1988. Comparison of smearing methods in the analysis of minke sightings data from IWC/IDCR Antarctic cruises. *Rep. Int. Whal. Commn* 38: 257-63.

Buckland, S.T., Anderson, D. R., Burnham, K. P. and Laake, J. L. 1993. DISTANCE sampling estimating abundance of biological populations. Chapman & Hall. London. 446pp.

Burt, M. L. and Borchers, D. L. 1997. Minke whale abundance estimate from the 1991/92 and 1992/93 JARPA sighting surveys. Paper presented to the JARPA review meeting, May 1997 (unpublished). 16pp.

Burt *et al*. 2005. Spatial modelling of JARPA survey data in Area V. Paper JA/J05/PJR20 presented to this meeting. January 2005 (unpublished). 19pp.

Clarke, E. D., Burt M. L. and Borchers, D. L. 1999. Simulation of JARPA surveys to test abundance estimation methods. Paper SC/51/RMP16 presented to the IWC Scientific Committee, May 1999 17pp.

Clarke, E.D., Burt, M.L. and Borchers, D.L. 2000 *Investigation of bias in GAM-based abundance estimation methods and their suitability for JARPA survey data.* Paper SC/52/IA19 presented to the Scientific Committee of the International Whaling Commission, June 2000 (unpublished). 15pp.

Hakamada, T., Matsuoka, K., Nishiwaki, S., Murase, H. and Tanaka, S. 2001. Abundance trend of Southern Hemisphere minke whales in Areas IV and V obtained from JARPA data. Paper SC/53/IA12 presented to IWC scientific commttee. July 2002 (unpublished). 35pp.

Haw, M.D. 1991. An investigation into the differences in minke whale school density estimates from passing mode and closing mode surveys in IDCR Antarctic assessment cruises. *Rep. int. Whal. Commn* 41: 313–30.

International Whaling Commission, 1998. Report of the Scientific Committee. *Rep. int. Whal. Commn.* 48: 239-247.

Kasamatsu, F., Kishino, H. and Hiroyama, H. 1990. Estimation of number of minke whale (*Balaenoptera acutorostata*) schools and individuals based on the 1987/88 Japanese feasibility study data. *Rep. int. Whal. Commn.* 40: 239-247.

Kasamatsu, F., Kishino, H. and Taga, Y. 1991. Estimation of Southern minke whale abundance and school size composition based on the 1988/89 Japanese feasibility study data. *Rep. int. Whal. Commn.* 41: 293-301.

Kishino, H., Kato, H., Kasamatsu, F., and Fujise, Y. 1989. Estimation of population abundance and biological parameters from line transect sampling. Paper SC/41/SHMi3 presented to the IWC Scientific Committee, May 1989. (unpublished). pp.

Kishino, H., Taga, Y., Nishiwaki, S. and Kasamatsu, F. 1991. Abundance estimate of the Southern Hemisphere minke whales in Area IV from the sighting in the 1989/90 Japanese research take. Paper SC/43/Mi22 presented to the IWC Scientific Committee, May 1991 (unpublished). 15pp.

Marques, F.F.C., Hedley, S.L., Hakamada, T., and Matsuoka, K. 2003. Spatial modeling of JARPA survey data in Area IV. Paper SC/55/IA3 presented to the Scientific Committee of the International Whaling

Commission, June 2003 (unpublished). 25pp.

Nishiwaki, S., Kawasaki, M. Kishino, H. and Taga, Y. 1992. Abundance estimations of Southern Hemesphere minke whale in Area V from the sightings in the Japanese research in 1990/91. Paper SC/44/SHB8 presented to the IWC Scientific Committee, June 1992 (unpublished). 12pp.

Nishiwaki, S., Matsuoka, K. and Kawasaki, M. 1994. Abundance estimates of Southern Hemisphere minke whale in 1991/92 and 1992/93 seasons using data from Japanese whale research programme under special permit in the Antarctic. Paper SC/46/SH12 presented to the IWC Scientific Committee, May 1994 (unpublished). 14pp.

Nishiwaki, S., Matsuoka, K., Kawasaki, M., Kishino, H. and Kasamatsu, K. 1997. Review of the sighting surveys in the JARPA. Paper SC/M97/1 presented to the JARPA review meeting, May 1997 (unpublished). 15pp.

Nishiwaki, S., Ishikawa, H. and Fujise, Y. 2005. Review of general methodology and survey procedure under the JARPA. Paper JA/J05/PJR1 presented to this meeting (unpublished) 27pp.

Pastene, L. A., Goto, M., Kanda, N., Bando, T., Zenitani, R., Hakamada, T. Otani, S. and Fujise, Y. 2005. A new interpretation of the stock identity in the Antarctic minke whale (*Balaenoptera bonaerensis*) based on analyses of genetics and non-genetics markers. paper presented to this meeting. (unpublished).

Tanaka, S. 1999. Bias in density estimates when the speed of whale sampling vessels is reduced in high density areas. Paper SC/51/CAWS12 presented to the IWC Scientific Committee, May 1999 (unpublished). 18pp.

Table 1. Antarctic minke whale abundance for each stratum estimated from SSV, SV in closing mode and SV in passing mode, respectively.

1-a. SSV in Area IV

Year	Stratum	area	period	TL	n	L	n/L*100	CV	esw	CV	E(s)	CV	D*100	P	CV	95% CI LL	95% CI UL
1989/90	NW	218,378	2/8-16	TL1	14.3	646.9	2.208	0.325	0.452	0.397	1.133	0.080	2.765	6,038	0.520	2,316	15,739
				TL2	17.6	656.8	2.679	0.360	0.452	0.397	1.529	0.139	4.527	9,887	0.554	3,587	27,253
				TL3	18.0	683.9	2.632	0.323	0.452	0.397	1.389	0.085	4.040	8,822	0.519	3,388	22,974
				combined	49.9	1987.6	2.509	0.196	0.452	0.397	1.360	0.066	3.786	**8,268**	**0.315**	4,521	15,118
	NE	213,661	1/11-19	TL1	15.0	684.2	2.192	0.519	0.576	0.124	1.676	0.182	3.190	6,816	0.564	2,435	19,080
				TL2	17.0	710.0	2.394	0.455	0.576	0.124	3.188	0.197	6.627	14,159	0.511	5,510	36,387
				TL3	17.0	570.2	2.981	0.158	0.576	0.124	1.647	0.137	4.264	9,111	0.243	5,694	14,578
				combined	49.0	1964.4	2.494	0.230	0.576	0.124	2.250	0.119	4.744	**10,136**	**0.297**	5,737	17,908
	SW	41,683	1/21-2/1	TL1	30.0	877.1	3.420	0.278	0.463	0.236	1.889	0.111	6.977	2,908	0.381	1,413	5,986
				TL2	22.0	823.5	2.670	0.277	0.463	0.236	1.864	0.113	5.373	2,240	0.381	1,089	4,608
				TL3	32.3	817.7	3.945	0.158	0.463	0.236	2.094	0.129	8.921	3,718	0.312	2,046	6,757
				combined	84.2	2518.3	3.345	0.137	0.463	0.236	1.963	0.071	7.084	**2,953**	**0.206**	1,981	4,400
	SE	40,371	12/31-1/10	TL1	49.6	495.7	10.010	0.275	0.657	0.124	1.959	0.094	14.924	6,025	0.315	3,295	11,019
				TL2	49.3	431.3	11.421	0.257	0.657	0.124	2.231	0.098	19.392	7,829	0.301	4,394	13,948
				TL3	50.1	435.2	11.507	0.377	0.657	0.124	2.200	0.112	19.265	7,778	0.412	3,580	16,896
				combined	149.0	1362.2	10.935	0.178	0.657	0.124	2.096	0.057	17.726	**7,156**	**0.202**	4,838	10,584
	PB	34,628	2/3-6	TL1	14.0	308.6	4.521	0.557	0.709	0.194	1.846	0.172	5.883	2,037	0.615	672	6,178
				TL2	12.0	308.4	3.885	0.631	0.709	0.194	1.667	0.171	4.563	1,580	0.682	470	5,308
				TL3	15.6	214.9	7.281	0.519	0.709	0.194	1.750	0.152	8.979	3,109	0.574	1,092	8,855
				combined	41.6	831.9	4.998	0.326	0.709	0.194	1.756	0.093	6.194	**2,145**	**0.358**	1,087	4,233
	Total	548,721			373.7	8664.4							5.587	**30,657**	**0.142**	23,254	40,418
1991/92	NW	219,773	2/15-25	TL1	23.7	748.8	3.168	0.205	0.432	0.195	1.550	0.099	5.682	12,488	0.300	7,029	22,189
				TL2	25.8	845.8	3.047	0.294	0.432	0.195	1.583	0.107	5.582	12,268	0.369	6,091	24,709
				TL3	25.8	888.1	2.906	0.277	0.432	0.195	1.960	0.240	6.591	14,485	0.415	6,628	31,656
				combined	75.3	2482.7	3.033	0.153	0.432	0.195	1.710	0.108	5.973	**13,127**	**0.219**	8,585	20,072
	NE	217,764	1/1-9	TL1	13.0	632.5	2.053	0.962	0.530	0.540	1.308	0.134	2.532	5,514	1.111	951	31,960
				TL2	6.6	684.7	0.959	0.863	0.530	0.540	1.429	0.208	1.292	2,814	1.039	526	15,052
				TL3	4.0	856.7	0.467	0.446	0.530	0.540	1.000	0.000	0.440	959	0.700	278	3,305
				combined	23.6	2173.9	1.083	0.587	0.530	0.540	1.304	0.102	1.317	**2,869**	**0.705**	826	9,967
	SW	34,259	1/27-2/6	TL1	23.9	606.8	3.941	0.298	0.649	0.230	2.046	0.122	6.212	2,128	0.396	1,008	4,494
				TL3	32.6	592.6	5.507	0.626	0.649	0.230	2.424	0.108	10.288	3,525	0.676	1,060	11,724
				combined	56.6	1199.4	4.715	0.383	0.649	0.230	2.028	0.088	8.226	**2,818**	**0.444**	1,227	6,472
	SE	34,871	1/16-26	TL1	19.8	641.6	3.087	0.385	0.486	0.248	3.000	0.151	9.532	3,324	0.482	1,357	8,140
				TL3	19.0	716.1	2.653	0.244	0.486	0.248	2.146	0.192	5.861	2,044	0.397	965	4,329
				combined	38.8	1357.7	2.858	0.230	0.486	0.248	3.100	0.117	7.596	**2,649**	**0.328**	1,415	4,959
	PB	27,733	2/9-14	TL1	32.2	209.0	15.390	0.491	0.562	0.324	2.839	0.155	38.849	10,774	0.608	3,590	32,332
				TL3	30.5	161.4	18.874	0.380	0.562	0.324	1.652	0.107	27.731	7,691	0.510	2,995	19,750
				combined	62.6	370.4	16.908	0.313	0.562	0.324	2.426	0.105	34.005	**9,430**	**0.432**	4,194	21,206
	Total	534,400			256.8	7584.1								**30,893**	**0.181**	21,728	43,926
1993/94	NW	230,748	2/15-3/3	TL1	28.2	1191.5	2.366	0.381	0.582	0.148	1.292	0.087	2.624	6,056	0.418	2,760	13,288
				TL3	25.0	1338.8	1.867	0.361	0.582	0.148	1.500	0.114	2.405	5,550	0.407	2,578	11,949
				combined	53.2	2530.3	2.102	0.264	0.582	0.148	1.391	0.072	2.508	**5,788**	**0.291**	3,308	10,128
	NE	161,376	1/5-20	TL1	30.5	965.2	3.158	0.350	0.466	0.240	1.552	0.122	5.257	8,484	0.442	3,708	19,412
				TL3	28.2	916.4	3.081	0.315	0.466	0.240	1.679	0.111	5.548	8,953	0.411	4,128	19,419
				combined	58.7	1881.6	3.120	0.236	0.466	0.240	1.614	0.082	5.399	**8,712**	**0.427**	3,908	19,425
	SW	35,428	1/22-2/4	TL1	58.3	650.4	8.969	0.322	0.751	0.178	2.121	0.077	12.663	4,486	0.376	2,201	9,145
				TL3	43.9	702.5	6.255	0.559	0.751	0.178	1.506	0.085	6.272	2,222	0.592	759	6,509
				combined	102.3	1352.9	7.560	0.302	0.751	0.178	1.846	0.059	9.344	**3,310**	**0.320**	1,795	6,107
	SE	40,813	12/21-1/4	TL1	39.3	627.2	6.263	1.019	0.660	0.218	2.410	0.091	11.432	4,666	1.046	865	25,154
				TL3	24.0	791.9	3.031	0.466	0.660	0.218	2.696	0.196	6.187	2,525	0.550	921	6,921
				combined	63.3	1419.1	4.459	0.657	0.660	0.218	2.285	0.089	8.505	**3,471**	**0.660**	1,068	11,284
	PB	35,196	2/6-14	TL1	22.7	283.0	8.013	0.258	0.521	0.143	1.857	0.077	14.281	5,026	0.305	2,803	9,012
				TL3	21.8	279.3	7.789	0.356	0.521	0.143	2.353	0.109	17.588	6,190	0.399	2,916	13,140
				combined	44.4	562.3	7.902	0.218	0.521	0.143	2.079	0.069	15.924	**5,605**	**0.258**	3,406	9,223
	Total	503,561			321.9	7746.2								**26,887**	**0.187**	18,713	38,631

(Table 1-a continue)

Year	Stratum	area	period	TL	n	L	n/L*100	CV	esw	CV	E(s)	CV	D*100	P	CV	95% CI LL	95% CI UL
1995/96	NW	217,044	1/10-26	TL1	17.7	893.0	1.980	0.690	0.890	0.120	1.708	0.133	1.898	4,121	0.713	1,173	14,472
				TL2	21.0	921.1	2.280	0.612	0.890	0.120	2.294	0.184	2.937	6,375	0.650	1,991	20,413
				TL3	19.3	922.8	2.092	0.459	0.890	0.120	1.891	0.140	2.222	4,822	0.495	1,927	12,067
				combined	58.0	2736.9	2.119	0.342	0.890	0.120	1.922	0.085	2.357	**5,116**	**0.366**	2,552	10,255
	NE	231,845	2/10-19	TL1	19.0	715.1	2.654	0.349	0.481	0.344	1.125	0.114	3.102	7,192	0.503	2,835	18,242
				TL2	23.0	697.4	3.295	0.310	0.481	0.344	1.667	0.162	5.707	13,232	0.490	5,330	32,852
				TL3	21.1	711	2.967	0.376	0.481	0.344	1.207	0.134	3.719	8,623	0.527	3,268	22,750
				combined	63.1	2123.5	2.969	0.199	0.481	0.344	1.420	0.074	4.164	**9,655**	**0.299**	5,441	17,133
	SW	29,610	12/22-1/9	TL1	55.3	827.5	6.684	0.393	0.957	0.083	1.880	0.075	6.562	1,943	0.408	900	4,195
				TL2	49.8	623.2	7.994	0.296	0.957	0.083	2.152	0.099	8.985	2,660	0.323	1,435	4,932
				TL3	37.4	686.3	5.445	0.616	0.957	0.083	1.593	0.099	4.529	1,341	0.629	433	4,159
				combined	142.5	2137	6.668	0.245	0.957	0.083	1.885	0.052	6.616	**1,959**	**0.245**	1,220	3,145
	SE	30,123	2/20-29	TL1	39.6	469.2	8.438	0.139	0.765	0.112	1.900	0.119	10.479	3,157	0.215	2,083	4,784
				TL2	45.5	502.9	9.042	0.166	0.765	0.112	2.696	0.166	15.932	4,799	0.260	2,907	7,923
				TL3	32.3	489.4	6.592	0.293	0.765	0.112	1.977	0.114	8.519	2,566	0.334	1,358	4,851
				combined	117.3	1461.5	8.028	0.113	0.765	0.112	2.121	0.067	11.699	**3,524**	**0.159**	2,586	4,803
	PB	27,929	1/27-2/6	TL1	27.6	341.5	8.075	0.352	0.795	0.208	1.321	0.078	6.710	1,874	0.417	856	4,105
				TL2	34.3	247.3	13.854	0.663	0.795	0.208	1.500	0.077	13.067	3,650	0.700	1,059	12,574
				TL3	27.4	257.8	10.638	0.329	0.795	0.208	1.357	0.097	9.081	2,536	0.401	1,189	5,410
				combined	89.3	846.6	10.544	0.295	0.795	0.208	1.336	0.045	9.289	**2,594**	**0.334**	1,371	4,908
	Total	536,551			470.1	9305.5								**22,848**	**0.159**	16,774	31,122
1997/98	NW	224,230	1/1-15	TL1	25.3	845.2	2.989	0.415	0.891	0.224	1.588	0.156	2.665	5,975	0.497	2,380	15,002
				TL2	20.7	909.7	2.272	0.568	0.891	0.224	2.591	0.222	3.304	7,409	0.650	2,316	23,698
				TL3	25.0	861.4	2.903	0.384	0.891	0.224	3.185	0.353	5.190	11,637	0.568	4,130	32,788
				combined	70.9	2616.3	2.711	0.260	0.891	0.224	1.880	0.105	3.718	**8,338**	**0.349**	4,293	16,193
	NE	224,567	1/31-2/13	TL1	20.3	812.1	2.497	0.531	0.645	0.325	1.300	0.113	2.515	5,649	0.633	1,811	17,620
				TL2	19.9	894.7	2.223	0.378	0.645	0.325	1.254	0.118	2.160	4,850	0.512	1,884	12,490
				TL3	16.1	936.5	1.724	0.492	0.645	0.325	2.563	0.367	3.424	7,689	0.694	2,250	26,279
				combined	56.3	2643.3	2.131	0.273	0.645	0.325	1.732	0.166	2.717	**6,101**	**0.384**	2,950	12,621
	SW	31,505	2/14-3/1	TL1	29.6	815.6	3.627	0.508	0.757	0.182	1.516	0.142	3.631	1,144	0.558	413	3,172
				TL2	28.8	864.6	3.334	0.565	0.757	0.179	1.828	0.165	4.025	1,268	0.616	417	3,852
				TL3	23.9	965.2	2.478	0.662	0.757	0.179	1.290	0.088	2.111	665	0.691	195	2,263
				combined	82.3	2645.4	3.112	0.331	0.757	0.179	1.494	0.068	3.205	**1,010**	**0.360**	510	2,001
	SE	41,450	1/16-30	TL1	27.4	814.4	3.369	0.128	0.554	0.287	1.038	0.089	3.155	1,308	0.326	701	2,439
				TL2	23.0	822.3	2.802	0.253	0.554	0.287	1.565	0.138	3.956	1,640	0.407	762	3,530
				TL3	30.2	733.7	4.110	0.189	0.554	0.287	1.936	0.155	7.175	2,974	0.377	1,456	6,074
				combined	80.6	2370.4	3.402	0.110	0.554	0.287	1.187	0.058	4.677	**1,939**	**0.228**	1,247	3,014
	PB	2,481	2/2-9	TL1	33.6	140.2	23.953	0.734	0.384	0.209	3.206	0.151	100.066	2,483	0.777	645	9,554
				TL2	20.0	136.1	14.695	0.790	0.384	0.209	1.613	0.176	30.895	767	0.835	184	3,190
				TL3	14.9	78.6	19.013	1.423	0.384	0.209	2.202	0.266	54.553	1,353	1.463	166	11,016
				combined	68.5	354.9	19.309	0.528	0.384	0.209	2.650	0.101	63.460	**1,574**	**0.580**	548	4,524
	Total	524,233			358.7	10630.3								**18,962**	**0.205**	12,742	28,218
1990/00	NW	236,307	12/28-1/13	TL1	14.0	522.0	2.682	0.550	0.895	0.192	1.077	0.071	1.614	3,815	0.587	1,313	11,082
				TL2	16.6	679.1	2.439	0.777	0.895	0.192	1.235	0.110	1.684	3,980	0.808	992	15,965
				TL3	15.9	625.1	2.542	0.455	0.895	0.192	1.188	0.158	1.687	3,987	0.518	1,533	10,369
				combined	46.5	1826.2	2.544	0.358	0.895	0.192	1.174	0.072	1.665	**3,935**	**0.389**	1,887	8,208
	NE	229,576	1/14-27	TL1	31.8	843.0	3.771	1.542	0.809	0.116	1.355	0.088	3.157	7,249	1.549	829	63,357
				TL2	31.7	850.4	3.726	0.982	0.809	0.116	1.095	0.062	2.521	5,788	0.991	1,144	29,286
				TL3	32.9	813.7	4.040	1.100	0.809	0.116	1.210	0.064	3.020	6,934	1.107	1,201	40,042
				combined	96.4	2507.1	3.843	0.710	0.809	0.116	1.217	0.038	2.897	**6,651**	**0.740**	1,820	24,302
	SW	34,825	2/19-3/1	TL1	72.1	556.2	12.971	0.486	0.861	0.084	2.951	0.106	22.240	7,745	0.504	3,047	19,689
			3/7-9	TL2	92.8	515.6	18.005	0.361	0.861	0.084	3.479	0.130	36.386	12,671	0.393	6,033	26,613
				TL3	61.6	594.1	10.372	0.299	0.861	0.084	3.361	0.171	20.250	7,052	0.354	3,595	13,834
				combined	226.6	1665.9	13.602	0.229	0.861	0.084	3.009	0.062	25.909	**9,023**	**0.244**	5,627	14,468
	SE	33,129	1/28-2/18	TL1	101.4	575.2	17.636	0.383	0.837	0.113	6.510	0.167	68.621	22,734	0.432	10,102	51,161
				TL2	102.8	696.7	14.757	0.435	0.837	0.113	5.870	0.130	51.769	17,150	0.467	7,176	40,986
				TL3	76.9	612.9	12.548	0.421	0.837	0.113	2.336	0.115	17.522	5,805	0.451	2,498	13,488
				combined	281.2	1884.8	14.917	0.240	0.837	0.113	4.986	0.084	45.775	**15,165**	**0.284**	8,792	26,157
	PB	27,000	3/2-6	TL1	40.2	240.6	16.716	0.280	0.813	0.111	1.610	0.125	16.546	4,468	0.326	2,396	8,332
				TL2	59.2	379	15.625	0.239	0.813	0.111	3.148	0.158	30.238	8,164	0.307	4,535	14,698
				TL3	30.4	233.3	13.041	0.238	0.813	0.111	2.194	0.133	17.588	4,749	0.294	2,700	8,353
				combined	129.9	852.9	15.226	0.150	0.813	0.111	2.677	0.115	22.916	**6,187**	**0.202**	4,185	9,148
	Total	560,837			780.4	8736.9								**40,961**	**0.175**	29,131	57,594

(Table 1-a continued)

Year	Stratum	area	period	TL	n	L	n/L*100	CV	esw	CV	E(s)	CV	D*100	P	CV	95% CI LL	95% CI UL
2001/02	NW	178,729	12/26-1/10	TL1	28.4	802.1	3.536	1.521	0.728	0.180	1.400	0.069	0.034	6,081	1.534	704.4105	52492.9
				TL2	18.5	751.8	2.458	0.832	0.728	0.180	1.400	0.069	0.024	4,226	0.854	990.2698	18034.59
				TL3	20.8	793	2.626	2.354	0.728	0.180	1.400	0.069	0.025	4,516	2.362	306.5252	66534.62
				combined	67.7	2346.9	0.029	0.992	0.728	0.180	1.400	0.069	0.028	**4,958**	**0.998**	971.9094	25291.5
	NE	207,211	1/11-26	TL1	51.4	768.7	6.687	1.129	0.854	0.107	1.443	0.048	0.057	11,709	1.135	1967.31	69693.91
				TL2	40.2	735.1	5.472	1.343	0.854	0.107	1.443	0.048	0.046	9,582	1.349	1303.071	70454.15
				TL3	39.5	746.3	5.288	1.234	0.854	0.107	1.443	0.048	0.045	9,258	1.240	1397.105	61352.75
				combined	131.1	2250.1	0.058	0.710	0.854	0.107	1.443	0.048	0.049	**10,201**	**0.713**	2902.49	35854.06
	SW	86,737	2/12-22	TL1	37.5	438.9	8.537	0.240	0.742	0.155	1.390	0.051	0.080	6,934	0.290	3969.609	12113.68
				TL2	27.2	530.7	5.130	0.266	0.742	0.155	1.390	0.051	0.048	4,167	0.313	2290.459	7580.282
				TL3	31.0	500.9	6.194	0.192	0.742	0.155	1.390	0.051	0.058	5,032	0.252	3091.926	8188.087
				combined	95.7	1470.5	0.065	0.136	0.742	0.155	1.390	0.051	0.061	**5,287**	**0.166**	3828.181	7302.958
	SE	82,153	1/27-2/11	TL1	87.7	642.8	13.646	0.178	0.812	0.090	1.992	0.060	0.167	13,757	0.208	9196.292	20579.36
				TL2	73.7	699	10.543	0.305	0.812	0.090	1.992	0.060	0.129	10,629	0.324	5725.446	19732.24
				TL3	85.4	709.8	12.026	0.258	0.812	0.090	1.992	0.060	0.148	12,124	0.280	7076.034	20771.87
				combined	246.8	2051.6	0.120	0.142	0.812	0.090	1.992	0.060	0.148	**12,126**	**0.155**	8957.167	16416.29
	PB	27,984	2/23-27	TL1	55.9	142.4	39.284	0.130	0.496	0.199	2.116	0.063	0.838	23,453	0.246	14592.19	37694.38
				TL2	67.5	279.5	24.155	0.294	0.496	0.199	2.116	0.063	0.515	14,421	0.360	7269.879	28605.77
				TL3	59.8	146.2	40.899	0.177	0.496	0.199	2.116	0.063	0.873	24,417	0.274	14414.4	41360
				combined	183.2	568.1	0.323	0.129	0.496	0.199	2.116	0.063	0.688	**19,257**	**0.177**	13655.23	27157.6
	Total	404,085			656.8	5843.4								**46,872**	**0.206**	31,426	69,910
2003/04	NW	279,634	12/27-1/11	TL1	14.0	794.0	1.763	0.331	0.752	0.129	1.230	0.055	1.442	4,033	0.359	2,037	7,987
				TL2	22.0	744.3	2.956	0.272	0.752	0.129	1.230	0.055	2.418	6,761	0.306	3,760	12,157
				TL3	16.0	854.0	1.874	0.287	0.752	0.129	1.230	0.055	1.533	4,286	0.319	2,327	7,893
				combined	52.0	2392.3	2.174	0.170	0.752	0.129	1.230	0.032	1.778	**4,972**	**0.189**	3,443	7,181
	NE	247,970	1/12-24	TL1	13.0	831.7	1.563	0.315	0.874	0.262	1.318	0.064	1.179	2,922	0.415	1,339	6,380
				TL2	14.0	906.5	1.544	0.403	0.874	0.262	1.318	0.064	1.164	2,887	0.485	1,173	7,106
				TL3	16.2	861.4	1.877	0.344	0.874	0.262	1.318	0.064	1.415	3,509	0.437	1,546	7,965
				combined	43.2	2599.6	1.661	0.207	0.874	0.262	1.318	0.037	1.252	**3,105**	**0.259**	1,884	5,117
	SW	46,122	2/12-28	TL1	62.3	318.3	19.561	0.487	0.832	0.081	2.371	0.056	27.862	12,851	0.497	5,119	32,258
				TL2	87.4	574.4	15.209	0.621	0.832	0.081	2.371	0.056	21.662	9,991	0.628	3,226	30,942
				TL3	56.7	396.2	14.314	0.726	0.832	0.081	2.371	0.056	20.388	9,403	0.733	2,601	33,990
				combined	206.3	1288.9	16.009	0.361	0.832	0.081	2.371	0.033	22.802	**10,517**	**0.366**	5,251	21,062
	SE	51,093	1/25-2/11	TL1	38.3	823.8	4.653	1.015	0.522	0.189	1.828	0.082	8.140	4,159	1.036	780	22,166
				TL2	34.4	875.7	3.924	2.272	0.522	0.189	1.828	0.082	6.864	3,507	2.281	248	49,529
				TL3	23.6	899.0	2.628	1.751	0.522	0.189	1.828	0.082	4.597	2,349	1.763	229	24,142
				combined	96.3	2598.5	3.707	1.002	0.522	0.189	1.828	0.047	6.484	**3,313**	**1.010**	641	17,129
	PB	34,940	2/29-3/1	TL1	3.0	4.1	73.171	2.204	0.712	0.525	1.952	0.109	100.292	35,042	2.268	2,498	491,492
				TL2	9.7	12.1	80.158	1.369	0.712	0.525	1.952	0.109	109.869	38,388	1.470	4,688	314,376
				TL3	7.4	13.8	53.841	0.004	0.712	0.525	1.952	0.109	73.798	25,785	0.536	9,630	69,041
				combined	20.1	30.0	67.097	0.737	0.712	0.525	1.952	0.068	91.968	**32,134**	**0.810**	7,992	129,193
	Total	659,759			417.9	8909.3								**54,040**	**0.491**	21,732	134,379

Table 1-b. SSV in Area V

Year	Stratum	area	period	TL	n	L	n/L*100	CV	esw	CV	E(s)	CV	D*100	P	CV	95% CI LL	95% CI UL
1990/91	FNW	232,898	1/21-31	TL1	42.0	887	4.735	0.327	0.328	0.186	1.38	0.116	0.099	23,133	0.394	10,991	48,690
				TL2	56.4	951.4	5.930	0.299	0.328	0.186	1.59	0.092	0.143	33,383	0.364	16,729	66,618
				TL3	50.0	888.4	5.628	0.371	0.328	0.186	1.71	0.141	0.147	34,204	0.438	15,039	77,792
				combined	148.4	2726.8	5.443	0.193	0.328	0.186	1.55	0.065	0.130	**30,316**	**0.235**	19,259	47,723
	SNE	347,440	2/16-26	TL1	25.3	681.1	3.710	0.237	0.260	0.477	1.37	0.155	0.098	33,914	0.554	12,297	93,531
				TL2	20.0	893.2	2.239	0.274	0.260	0.477	1.48	0.163	0.064	22,143	0.574	7,784	62,985
				TL3	16.8	924.6	1.814	0.531	0.260	0.477	2.17	0.159	0.076	26,290	0.731	7,291	94,793
				combined	62.0	2498.9	2.483	0.194	0.260	0.477	1.57	0.091	0.077	**26,885**	**0.367**	13,391	53,977
	FSW	62,355	1/11-20	TL1	32.4	556.1	5.824	0.214	0.564	0.204	1.96	0.155	0.101	6,326	0.334	3,346	11,960
				TL2	37.7	470.3	8.016	0.276	0.564	0.204	1.99	0.128	0.141	8,823	0.366	4,403	17,678
				TL3	38.7	608.6	6.352	0.371	0.564	0.204	1.63	0.107	0.092	5,710	0.437	2,518	12,946
				combined	108.7	1635	6.651	0.175	0.564	0.204	1.83	0.071	0.109	**6,815**	**0.220**	4,454	10,427
	SSE	208,511	2/5-14	TL1	55.5	589	9.423	0.164	0.549	0.149	1.84	0.113	0.158	32,972	0.247	20,473	53,104
				TL2	76.0	576.3	13.185	0.288	0.549	0.149	1.83	0.099	0.220	45,890	0.341	23,938	87,973
				TL3	80.6	504.7	15.960	0.222	0.549	0.149	2.03	0.101	0.294	61,375	0.283	35,610	105,784
				combined	212.0	1670	12.697	0.140	0.549	0.149	1.82	0.055	0.221	**46,014**	**0.175**	32,719	64,710
	Total	851,204			531.2	8530.7								**110,031**	**0.133**	84,819	142,736
1992/93	NW	332,682	1/25-2/5	TL1	22.0	712.3	3.089	0.585	0.447	0.147	1.31	0.085	0.045	15,043	0.610	4,998	45,271
				TL3	18.0	664.0	2.711	0.515	0.447	0.147	1.63	0.124	0.049	16,396	0.550	5,991	44,876
				combined	40.0	1376.3	2.906	0.397	0.447	0.147	1.50	0.074	0.047	**15,696**	**0.410**	7,248	33,989
	NE	290,526	12/30-1/11	TL1	14.6	481.2	3.028	0.553	0.681	0.221	1.53	0.190	0.034	9,908	0.625	3,214	30,549
				TL3	19.7	463.0	4.254	0.353	0.681	0.221	1.31	0.099	0.041	11,918	0.428	5,332	26,641
				combined	34.3	944.2	3.629	0.311	0.681	0.221	1.53	0.100	0.037	**10,894**	**0.370**	5,400	21,978
	SW	43,572	1/15-24	TL1	36.3	468.2	7.758	0.452	0.959	0.138	3.15	0.142	0.128	5,557	0.494	2,224	13,883
			2/8-13	TL3	36.2	434.5	8.339	0.586	0.959	0.138	2.44	0.153	0.106	4,623	0.621	1,509	14,166
				combined	72.6	902.7	8.038	0.370	0.959	0.138	2.76	0.103	0.117	**5,107**	**0.389**	2,449	10,650
	SE	180,745	2/14-3/6	TL1	60.8	640.8	9.493	0.689	0.647	0.227	1.84	0.098	0.135	24,393	0.732	6,753	88,109
				TL3	54.0	564.8	9.558	0.406	0.647	0.227	2.11	0.091	0.156	28,196	0.474	11,673	68,104
				combined	57.4	1205.6	4.762	0.824	0.647	0.227	2.01	0.066	0.145	**26,175**	**0.434**	11,587	59,130
	Total	847,525			204.2	4428.8								**57,872**	**0.239**	36,480	91,807
1994/95	NW	194,879	1/4-19	TL1	24.0	1003.4	2.387	0.670	0.748	0.157	2.56	0.176	0.041	7,966	0.710	2,276	27,879
				TL3	30.6	1059.1	2.892	0.473	0.748	0.157	2.19	0.139	0.042	8,268	0.517	3,184	21,469
				combined	54.6	2062.5	2.646	0.396	0.748	0.157	2.36	0.111	0.042	**8,121**	**0.434**	3,600	18,319
	NE	303,617	1/20-2/5	TL1	28.5	847.1	3.366	0.373	0.656	0.178	1.52	0.116	0.039	11,823	0.429	5,284	26,454
			2/13-18	TL3	33.9	720.9	4.708	0.579	0.656	0.178	1.51	0.093	0.054	16,416	0.613	5,426	49,665
				combined	62.5	1568	3.983	0.358	0.656	0.178	1.41	0.058	0.046	**13,935**	**0.386**	6,714	28,921
	SW	40,116	12/18-1/3	TL1	45.8	801.7	5.707	0.411	0.817	0.208	1.92	0.097	0.067	2,697	0.471	1,121	6,485
				TL3	38.7	782.6	4.949	0.457	0.817	0.208	3.13	0.160	0.095	3,796	0.527	1,439	10,015
				combined	84.5	1584.3	5.333	0.306	0.817	0.208	2.26	0.082	0.081	**3,240**	**0.364**	1,623	6,466
	SE	175,421	2/8-9	TL1	72.4	263	27.515	0.524	0.874	0.101	2.40	0.095	0.377	66,204	0.542	24,476	179,076
			2/23-3/11	TL3	71.8	343.6	20.901	0.654	0.874	0.101	2.30	0.091	0.275	48,221	0.668	14,671	158,491
				combined	144.2	606.6	23.769	0.419	0.874	0.101	2.28	0.065	0.319	**56,018**	**0.428**	25,075	125,144
	Total	714,033			345.7	5821.4								**81,313**	**0.306**	45,272	146,048
1996/97	NW	305,819	2/5-20	TL1	15.0	731.0	2.052	0.774	0.552	0.314	1.71	0.143	0.032	9,744	0.847	2,305	41,180
				TL2	13.8	773.4	1.779	0.610	0.552	0.314	1.42	0.142	0.023	6,986	0.700	2,025	24,102
				TL3	23.5	568.6	4.135	0.573	0.552	0.314	1.68	0.127	0.063	19,239	0.665	5,873	63,028
				combined	52.3	2073	2.521	0.376	0.552	0.314	1.52	0.074	0.037	**11,319**	**0.434**	5,015	25,551
	NE	363,668	1/5-20	TL1	35.3	735.0	4.800	0.309	0.654	0.230	1.28	0.092	0.047	17,107	0.396	8,103	36,116
				TL2	34.1	773.8	4.412	0.342	0.654	0.230	1.58	0.103	0.053	19,342	0.425	8,709	42,956
				TL3	32.1	818.5	3.917	0.513	0.654	0.230	2.03	0.106	0.061	22,126	0.572	7,796	62,791
				combined	101.5	2327.3	4.361	0.226	0.654	0.230	1.58	0.057	0.054	**19,615**	**0.288**	11,286	34,090
	SW	40,130	1/21-2/4	TL1	36.9	846.1	4.356	0.611	0.646	0.232	2.44	0.125	0.082	3,299	0.666	1,006	10,813
				TL2	33.5	784.2	4.273	0.814	0.646	0.232	1.55	0.121	0.051	2,054	0.855	481	8,776
				TL3	39.6	801.7	4.936	0.472	0.646	0.232	2.18	0.146	0.083	3,342	0.546	1,229	9,091
				combined	109.9	2432	4.520	0.364	0.646	0.232	2.10	0.075	0.073	**2,912**	**0.386**	1,401	6,050
	SE	208,224	2/21-3/12	TL1	45.9	495.1	9.277	0.552	0.613	0.205	2.80	0.095	0.212	44,144	0.596	14,979	130,100
				TL2	48.3	411.2	11.741	0.583	0.613	0.205	4.46	0.288	0.427	88,953	0.682	26,483	298,778
				TL3	52.6	415.5	12.656	0.189	0.613	0.205	2.51	0.156	0.259	53,970	0.319	29,296	99,425
				combined	146.8	1321.8	11.105	0.267	0.613	0.205	3.24	0.141	0.294	**61,172**	**0.359**	30,903	121,092
	Total	917,841			286.7	8154.1								**95,019**	**0.245**	59,241	152,405

(Table 1-b continue)

Year	Stratum	area		TL	n	L	n/L*100	CV	esw	CV	E(s)	CV	D*100	P	CV	95% CI LL	95% CI UL
1998/99	NW	321,375	1/30-2/3	TL1	14.0	268.1	5.222	0.469	0.424	0.249	2.14	0.161	0.132	42,369	0.555	15,335	117,061
				TL2	17.9	311.1	5.747	0.472	0.424	0.249	1.94	0.135	0.132	42,313	0.550	15,443	115,935
				TL3	19.0	254.4	7.469	0.369	0.424	0.249	1.47	0.109	0.130	41,674	0.458	17,715	98,036
				combined	50.9	833.6	6.104	0.251	0.424	0.249	1.82	0.081	0.131	**42,136**	**0.306**	23,423	75,798
	NE	311,050	1/24-29	TL1	12.0	194.9	6.157	0.375	0.489	0.206	1.92	0.261	0.121	37,504	0.501	14,826	94,869
				TL2	16.0	204.9	7.804	0.460	0.489	0.206	2.17	0.180	0.173	53,876	0.536	20,132	144,181
				TL3	18.0	174.3	10.327	0.253	0.489	0.206	2.56	0.133	0.271	84,148	0.353	43,021	164,589
				combined	46.0	574.1	8.011	0.212	0.489	0.206	2.23	0.104	0.185	**57,509**	**0.263**	34,671	95,388
	SW	42,583	2/4-25	TL1	67.0	548.2	12.229	0.431	0.536	0.165	2.429	0.068	0.277	11,809	0.466	4,950	28,177
				TL2	68.7	522.2	13.162	0.352	0.536	0.165	2.429	0.068	0.298	12,710	0.395	6,024	26,816
				TL3	60.4	488.6	12.353	0.319	0.536	0.165	2.429	0.068	0.280	11,929	0.366	5,954	23,898
				combined	196.1	1559.0	0.126	0.216	0.536	0.165	2.429	0.068	0.285	**12,148**	**0.239**	7,649	19,294
	SE	52,553	2/26-3/15	TL1	35.0	425.2	8.231	0.746	0.527	0.144	2.49	0.105	0.194	10,205	0.767	2,690	38,705
				TL2	45.0	370.9	12.131	1.053	0.527	0.144	1.94	0.096	0.224	11,746	1.067	2,127	64,869
				TL3	36.0	387.6	9.288	0.737	0.527	0.144	1.67	0.113	0.147	7,733	0.759	2,061	29,014
				combined	116.0	1183.7	9.799	0.519	0.527	0.144	1.98	0.061	0.188	**9,878**	**0.526**	3,748	26,034
	Total	727,561			310.5	3179.3								**121,671**	**0.169**	87,606	168,983
2000/01	NW	269,652	2/10-25	TL1	19.9	843.7	2.358	0.964	0.618	0.349	1.898	0.137	0.036	9,773	1.034	1,838	51,975
				TL2	16.5	914.4	1.805	0.842	0.618	0.349	1.898	0.137	0.028	7,479	0.921	1,609	34,766
				TL3	11.0	930.6	1.182	1.019	0.618	0.349	1.898	0.137	0.018	4,898	1.086	868	27,627
				combined	47.4	2688.7	0.018	0.553	0.618	0.349	1.898	0.137	0.027	**7,305**	**0.596**	2,481	21,512
	NE	334,377	1/2-23	TL1	69.3	888.1	7.807	0.394	0.626	0.164	1.74	0.080	0.108	36,245	0.434	16,049	81,857
				TL2	75.8	898.0	8.437	0.354	0.626	0.164	1.92	0.138	0.130	43,323	0.414	19,871	94,453
				TL3	81.5	918.7	8.869	0.416	0.626	0.164	1.82	0.086	0.129	43,106	0.455	18,415	100,903
				combined	226.6	2704.8	8.377	0.226	0.626	0.164	1.70	0.043	0.122	**40,925**	**0.252**	25,152	66,589
	SW	64,854	2/27-3/19	TL1	64.2	769.7	8.336	0.408	0.741	0.165	1.38	0.064	0.078	5,027	0.445	2,186	11,560
				TL2	64.5	770.9	8.362	0.344	0.741	0.165	1.48	0.070	0.083	5,408	0.388	2,596	11,265
				TL3	68.8	727.1	9.463	0.276	0.741	0.165	1.72	0.080	0.110	7,128	0.332	3,784	13,429
				combined	197.4	2267.7	8.706	0.199	0.741	0.165	1.43	0.036	0.090	**5,830**	**0.221**	3,800	8,944
	SE	150,364	1/24-2/9	TL1	81.1	404.5	20.051	0.298	0.734	0.154	2.636	0.062	0.360	54,116	0.342	28,219	103,777
				TL2	74.6	515.5	14.463	0.438	0.734	0.154	2.636	0.062	0.260	39,034	0.468	16,306	93,442
				TL3	72.7	388.6	18.713	0.384	0.734	0.154	2.636	0.062	0.336	50,504	0.418	22,991	110,944
				combined	228.4	1308.6	0.175	0.216	0.734	0.154	2.636	0.062	0.313	**47,102**	**0.236**	29,829	74,379
	Total	819,247			699.8	7863.5								**101,163**	**0.103**	82,740	123,688
2002/03	NW	281,117	2/11-21	TL1	24.0	615.2	3.897	0.427	0.750	0.100	2.029	0.067	0.053	14,811	0.444	6,450	34,009
				TL2	38.0	571.9	6.645	0.522	0.750	0.100	2.029	0.067	0.090	25,253	0.536	9,437	67,579
				TL3	42.0	650.5	6.455	0.367	0.750	0.100	2.029	0.067	0.087	24,533	0.387	11,807	50,976
				combined	104.0	1837.6	0.057	0.261	0.750	0.100	2.029	0.067	0.076	**21,502**	**0.271**	12,773	36,199
	NE	352,391	1/4-26	TL1	44.8	1219.2	3.673	0.240	0.811	0.198	1.637	0.054	0.037	13,058	0.316	7,137	23,891
				TL2	48.0	1181.8	4.060	0.275	0.811	0.198	1.637	0.054	0.041	14,435	0.343	7,507	27,758
				TL3	35.3	1172.0	3.011	0.382	0.811	0.198	1.637	0.054	0.030	10,706	0.434	4,745	24,155
				combined	128.1	3573.0	0.036	0.169	0.811	0.198	1.637	0.054	0.036	**12,742**	**0.207**	8,523	19,050
	SW	75,414	2/26-3/8	TL1	42.6	302.8	14.060	0.705	0.376	0.277	1.897	0.074	0.355	26,742	0.761	7,107	100,615
				TL2	47.0	231.1	20.322	0.776	0.376	0.277	1.897	0.074	0.513	38,653	0.827	9,386	159,183
				TL3	34.6	230.2	15.023	0.661	0.376	0.277	1.897	0.074	0.379	28,575	0.721	8,043	101,519
				combined	124.1	764.1	0.162	0.423	0.376	0.277	1.897	0.074	0.410	**30,896**	**0.454**	13,216	72,230
	SE	76,792	1/27-2/9	TL1	156.7	234.4	66.847	0.382	0.695	0.080	2.614	0.044	1.256	96,459	0.392	45,950	202,489
				TL2	166.8	202.3	82.442	0.399	0.695	0.080	2.614	0.044	1.549	118,962	0.409	55,057	257,040
				TL3	190.3	298.2	63.810	0.411	0.695	0.080	2.614	0.044	1.199	92,076	0.421	41,719	203,216
				combined	513.8	734.9	0.699	0.231	0.695	0.080	2.614	0.044	1.314	**100,875**	**0.237**	63,780	159,544

Table 1-c. SSV in the eastern part of Area III.

Year	Stratum	area	period	TL	n	L	n/L*100	CV	esw	CV	E(s)	CV	D	P	CV	95% CI LL	95% CI UL
1995/96	FIIIE	253,343	12/8-22	TL1	26.8	804.0	3.336	0.330	0.444	0.189	1.298	0.054	0.049	12,356	0.384	5,977	25,543
				TL2	22.8	798.4	2.855	0.259	0.444	0.189	1.298	0.054	0.042	10,575	0.325	5,687	19,665
				TL3	19.6	828.8	2.366	0.398	0.444	0.189	1.298	0.054	0.035	8,761	0.444	3,818	20,106
				combined	69.2	2431.2	0.028	0.190	0.444	0.189	1.298	0.054	0.042	**10,546**	**0.222**	6,860	16,211
1997/98	FIIIE	250,985	12/16-31	TL1	22.0	949.6	2.321	0.485	0.761	0.239	1.649	0.072	0.025	6,310	0.545	2,322	17,146
				TL2	31.7	1092.8	2.898	0.520	0.761	0.239	1.649	0.072	0.031	7,876	0.577	2,754	22,530
				TL3	22.9	1195.7	1.919	0.642	0.761	0.239	1.649	0.072	0.021	5,217	0.689	1,539	17,687
				combined	76.7	3238.1	0.024	0.320	0.761	0.239	1.649	0.072	0.026	**6,435**	**0.352**	3,293	12,574
1999/00	FIIIE	357358	12/15-26	TL1	25.9	490.0	5.287	0.793	0.765	0.155	1.679	0.070	0.058	20,736	0.811	5,145	83,571
				TL2	34.3	402.8	8.528	0.460	0.765	0.155	1.679	0.070	0.094	33,446	0.490	13,463	83,086
				TL3	35.2	363.2	9.680	1.092	0.765	0.155	1.679	0.070	0.106	37,965	1.105	6,593	218,610
				combined	95.4	1256.0	0.076	0.485	0.765	0.155	1.679	0.070	0.083	**29,794**	**0.495**	11,895	74,629
2001/02	FIIIE	355282	12/9-25	TL1	39.7	772.2	5.137	1.174	0.696	0.162	2.770	0.136	0.102	36,308	1.193	5,742	229,573
				TL2	50.4	741.2	6.802	0.749	0.696	0.162	2.770	0.136	0.135	48,077	0.779	12,472	185,321
				TL3	33.2	689.4	4.817	0.970	0.696	0.162	2.770	0.136	0.096	34,044	0.993	6,713	172,664
				combined	123.3	2202.8	0.056	0.552	0.696	0.162	2.770	0.136	0.111	**39,560**	**0.566**	14,078	111,161
2003/04	FIIIE	324,032	11/30-12/23	TL1	48.9	1129.4	4.328	0.404	0.835	0.148	2.083	0.059	5.401	17,501	0.434	7,758	39,480
				TL2	53.0	1115.4	4.749	0.516	0.835	0.148	2.083	0.059	5.926	19,201	0.540	7,125	51,745
				TL3	44.5	1132.9	3.930	0.874	0.835	0.148	2.083	0.059	4.904	15,890	0.889	3,562	70,882
				combined	146.4	3377.7	4.333	0.352	0.752	0.129	2.083	0.034	5.407	**17,522**	**0.364**	8,783	34,957

Table 1-d. SSV in the western part of Area VI

Year	Stratum	area	period	TL	n	L	n/L*100	CV	esw	CV	E(s)	CV	D	P	CV	95% CI LL	95% CI UL
1996/97	FVIW	205,180	12/15-1/4	TL1	24.0	831.8	2.887	0.227	0.744	0.162	1.785	0.078	0.035	7,110	0.290	4,075	12,407
				TL2	31.6	905.1	3.496	0.274	0.744	0.162	1.785	0.078	0.042	8,608	0.328	4,600	16,107
				TL3	21.1	888.6	2.376	0.507	0.744	0.162	1.785	0.078	0.029	5,852	0.538	2,177	15,728
				combined	76.8	2625.5	0.029	0.193	0.744	0.162	1.785	0.078	0.035	**7,201**	**0.220**	4,702	11,027
1998/99	SVIW	316,727	3/16-31	TL1	25.0	175.8	14.217	0.406	0.788	0.149	1.235	0.051	0.111	35,304	0.435	15,608	79,854
				TL2	20.7	239.4	8.662	0.721	0.788	0.149	1.235	0.051	0.068	21,511	0.738	5,907	78,336
				TL3	23.9	157.3	15.180	0.516	0.788	0.149	1.235	0.051	0.119	37,696	0.540	13,991	101,567
				combined	69.6	572.5	0.122	0.314	0.788	0.149	1.235	0.051	0.095	**30,194**	**0.327**	16,161	56,411
2000/01	FVIW	290,908	12/11-31	TL1	40.5	903.2	4.489	0.365	0.654	0.161	1.422	0.058	0.049	14,202	0.403	6,642	30,364
				TL2	34.2	999.5	3.417	0.349	0.654	0.161	1.422	0.058	0.037	10,811	0.389	5,181	22,560
				TL3	38.1	994.8	3.830	0.369	0.654	0.161	1.422	0.058	0.042	12,118	0.407	5,627	26,094
				combined	112.8	2897.5	0.039	0.210	0.654	0.161	1.422	0.058	0.042	**12,317**	**0.232**	7,867	19,283
2002/03	FVIW	329,256	12/2-1/1	TL1	34.5	1576.2	2.187	0.238	0.510	0.139	1.209	0.038	0.026	8,533	0.278	5,002	14,557
				TL2	45.0	1426.3	3.155	0.290	0.510	0.139	1.209	0.038	0.037	12,307	0.324	6,625	22,861
				TL3	38.8	1395.8	2.777	0.474	0.510	0.139	1.209	0.038	0.033	10,831	0.495	4,323	27,133
				combined	118.2	4398.3	0.027	0.203	0.510	0.139	1.209	0.038	0.032	**10,486**	**0.219**	6,855	16,039

1-e. SV (closing mode) in Areas IV and V.

Year	Stratum	area	period	n	L	n/L*100	CV	esw	CV	E(s)	CV	D*100	P	CV	95% CI LL	95% CI UL
1991/92	SW	34,259	1/26-2/6	48.9	1038.1	4.713	0.271	0.378	0.339	2.258	0.122	14.088	4,826	0.450	2,079	11,206
	SE	34,871	1/16-24	28.5	924.0	3.082	0.142	0.969	0.132	2.181	0.167	3.470	1,210	0.259	735	1,993
	PB	27,733	2/9-14	79.1	237.1	33.380	0.485	0.762	0.203	4.466	0.495	97.832	27,132	0.690	7,982	92,225
1993/94	NW	232,782	2/15-3/3	26.0	1667.4	1.559	0.317	0.295	0.255	1.280	0.106	3.378	7,863	0.416	3,597	17,190
	NE	171,281	1/5-20	22.4	1250.4	1.788	0.224	0.408	0.534	1.650	0.166	3.614	6,190	0.598	2,095	18,290
	SW	33,394	1/22-30	40.2	1024.8	3.926	0.262	0.643	0.281	1.760	0.132	5.373	1,794	0.404	837	3,845
	SE	30,908	12/21-1/4	60.0	839.8	7.145	0.717	0.479	0.353	2.214	0.111	16.516	5,105	0.807	1,274	20,446
	PB	35,196	2/6-14	27.0	477.7	5.652	0.415	0.350	0.300	1.369	0.096	11.060	3,893	0.518	1,497	10,120
	total	503,561		175.6	5260.1	3.338							**24,845**	**0.273**	14,697	41,999
1995/96	NW	217,044	1/10-26	15.0	793.6	1.890	0.437	0.251	0.829	2.267	0.169	8.526	18,505	0.940	3,888	88,074
	NE	228,383	2/10-18	17.6	856.2	2.055	0.594	0.183	0.489	2.222	0.220	12.498	28,542	0.800	7,189	113,321
	SW	33,433	12/22-1/9	41.0	714.2	5.741	0.410	0.460	0.224	2.737	0.121	17.066	5,706	0.482	2,331	13,966
	SE	29,932	2/19-29	53.9	578.4	9.316	0.206	0.475	0.176	2.362	0.127	23.152	6,930	0.300	3,901	12,311
	PB	27,929	1/27-2/5	25.0	475.2	5.261	0.144	0.351	0.347	1.379	0.134	10.339	2,887	0.399	1,359	6,133
	total	536,721		152.5	3417.6	4.461							**62,570**	**0.463**	26,397	148,315
1997/98	NW	214,265	12/31-1/14	20.6	551.5	3.736	1.182	0.978	0.201	2.215	0.158	0.042	9,067	1.210	1,410	58,296
	NE	220,630	1/30-2/12	10.0	702.6	1.416	0.329	0.576	0.657	1.556	0.156	0.019	4,222	0.751	1,138	15,654
	SW	44,188	2/13-27	10.3	530.7	1.940	0.422	0.280	1.159	1.800	0.181	0.062	2,760	1.247	413	18,420
	SE	40,371	1/15-29	18.0	602.9	2.986	0.343	0.513	0.389	1.556	0.093	0.045	1,826	0.527	692	4,817
	PB	6,865	3/2-4	2.8	88.6	3.143	0.716	0.409	1.768	2.333	0.286	0.090	615	1.929	54	7,068
	total	526,319		61.6	2476.3	2.489							**18,490**	**0.650**	5,775	59,204
1999/2000	NW	241,290	12/27-1/11	2.0	325.5	0.614	0.564	1.500	0.000	1.500	0.333	0.003	741	0.655	230	2,391
	NE	230,745	1/11-26	25.0	345.5	7.236	0.410	0.329	0.248	1.421	0.135	0.156	36,019	0.498	14,329	90,540
	SW	42,090	2/18-3/1,3/6-9	22.6	171.9	13.164	0.544	0.708	0.234	1.878	0.147	0.175	7,352	0.610	2,440	22,155
	SE	37,035	1/28-2/18	93.1	582.3	15.980	0.319	0.674	0.168	4.008	0.147	0.475	17,591	0.389	8,424	36,733
	PB	22,324	3/1-6	10.1	101.4	10.008	1.403	0.496	0.845	2.180	0.311	0.220	4,907	1.667	512	47,023
	total	573,484		152.8	1526.6	10.011							**66,610**	**0.320**	36,098	122,912
2001/02	NW	178,743	12/25-1/8	7.3	189.5	3.862	0.488	0.433	0.709	1.071	0.219	0.048	8,545	0.888	1,917	38,092
	NE	207,240	1/9-25	2.0	211.0	0.948	1.089	1.500	0.000	1.000	0.000	0.003	655	1.089	116	3,705
	SW	86,141	2/10-21,27	9.0	198.5	4.534	0.475	0.551	0.216	1.420	0.167	0.058	5,035	0.548	1,845	13,737
	SE	83,193	1/26-2/8	14.9	197.1	7.559	0.435	0.385	0.480	1.143	0.085	0.112	9,323	0.654	2,896	30,010
	PB	27,984	2/22-26	40.1	133.7	29.972	0.277	0.864	0.182	1.605	0.082	0.279	7,794	0.341	4,067	14,937
	total	583,301		73.3	929.8	7.882							**31,352**	**0.334**	16,562	59,348
2003/04	NW	273,397	12/26-1/10	5.0	257.1	1.945	0.374	0.427	0.307	1.667	0.200	0.038	10,372	0.524	3,953	27,219
	NE	249,833	1/11-24	6.0	329.1	1.823	0.425	1.088	0.144	1.000		0.008	2,094	0.449	904	4,849
	SW	44,810	2/7-25	4.4	257.0	1.711	1.013	0.766	0.751	2.400	0.486	0.027	1,200	1.351	163	8,845
	SE	46,942	1/25-2/7	16.0	242.9	6.596	1.126	0.345	0.666	3.108	0.354	0.297	13,931	1.355	1,883	103,042
	PB	34,830	2/26-3/2	7.5	235.5	3.177	0.298	0.586	0.922	1.571	0.129	0.043	1,484	0.977	298	7,383
	Total	614,982		38.9	1321.6								**29,081**	**0.680**	8,683	97,402

1-f. SV (closing mode) in Areas V.

Year	Stratum	area	period	n	L	n/L*100	CV	esw	CV	E(s)	CV	D*100	P	CV	95% CI LL	95% CI UL
1992/93	NW	332,682	1/25-2/5	47.0	923.0	5.092	0.464	0.451	0.170	1.565	0.076	8.834	29,388	0.500	11,634	74,235
	NE	290,526	12/30-1/11	15.0	717.3	2.091	0.638	0.460	0.194	2.581	0.317	5.867	17,045	0.738	4,680	62,080
	SW	43,572	1/15-24,2/8-13	106.0	1004.7	10.546	0.241	0.484	0.264	2.914	0.102	31.766	13,841	0.372	6,835	28,027
	SE	180,745	2/14-3/6	173.7	1050.7	16.530	0.332	0.478	0.144	1.913	0.071	33.087	59,803	0.369	29,715	120,359
	Total	847,525		341.6	3695.7	9.244							**120,077**	**0.248**	74,387	193,829
1994/95	NW	194,879	1/4-19	48.3	1166.9	4.137	0.756	0.464	0.399	1.423	0.144	6.350	12,375	0.867	2,853	53,681
	NE	303,617	1/20-2/14	29.8	1194.7	2.497	0.272	0.565	0.270	1.759	0.127	3.890	11,812	0.404	5,514	25,305
	SW	40,116	12/18-1/3	88.4	884.7	9.996	0.328	0.776	0.146	3.918	0.109	25.235	10,123	0.375	4,971	20,615
	SE	175,421	2/15-3/13	193.6	686.4	28.209	0.368	0.823	0.098	4.091	0.102	70.089	122,950	0.394	58,394	258,874
	Total	714,033		360.2	3932.7								**157,260**	**0.318**	85,609	288,881
1996/97	NW	305,819	2-4/20	14.8	711.6	2.082	0.279	0.542	0.257	4.077	0.538	7.833	23,956	0.658	7,392	77,636
	NE	363,668	1-3/20	16.0	806.1	1.985	0.426	0.243	0.277	1.568	0.180	6.413	23,321	0.539	8,668	62,745
	SW	40,130	1/21-2/3	20.4	692.4	2.942	0.655	0.766	0.395	2.739	0.325	5.257	2,110	0.831	510	8,735
	SE	208,224	2/20-3/12	107.1	790.1	13.550	0.642	0.709	0.151	3.700	0.106	35.337	73,581	0.668	22,377	241,954
	Total	917,841		158.2	3000.2								**122,968**	**0.432**	54,642	276,733
1998/99	NW	327,187	1/14-2/2	8.5	185.4	4.609	0.883	1.186	0.255	3.500	0.235	0.068	22,259	0.949	4,630	107,013
	NE	318,104	1/13-23	15.8	652.8	2.418	0.369	0.389	0.522	1.533	0.167	0.048	15,164	0.661	4,663	49,319
	SW	42,583	2/3-21	13.1	86.9	15.082	1.101	0.224	0.565	3.182	0.371	1.070	45,584	1.292	6,538	317,829
	SE	44,024	2/24-3/12	1.5	116.5	1.330	1.235	1.500	0.000	5.000	0.200	0.022	976	1.251	146	6,543
	Total	731,898		38.98	1041.6								**83,983**	**0.755**	22,530	313,052
2000/01	NW	269,652	2/10-23	2.0	254.9	0.785	0.626	0.211	0.883	1.000	0.000	0.019	5,022	1.082	894	28,216
	NE	354,068	1/1-23	12.6	333.9	3.769	0.618	0.211	0.883	6.546	0.580	0.586	207,356	1.224	31,797	1,352,195
	SW	89,617	2/25-3/18	10.0	210.8	4.744	1.321	0.264	0.728	1.889	0.299	0.170	15,217	1.537	1,757	131,774
	SE	150,364	1/24-2/7	17.9	225.0	7.958	0.646	0.264	0.728	1.658	0.129	0.250	37,602	0.982	7,515	188,143
	Total	863,701		42.49	1024.6								**265,197**	**0.971**	53,683	1,310,086
2002/03	NW	274,012	2/11-20,3/5-7	15.6	183.3	8.529	0.611	0.413	0.373	2.231	0.177	0.230	63,059	0.737	17,337	229,364
	NE	352,403	1/5-25	15.4	408.3	3.775	0.404	0.451	0.456	1.636	0.149	0.068	24,125	0.627	7,802	74,601
	SW	82,548	2/21-3/4	27.0	203.0	13.286	0.361	1.075	0.131	2.000	0.147	0.124	10,206	0.411	4,706	22,134
	SE	74,348	1/27-2/9	26.3	148.3	17.754	0.362	0.686	0.314	1.800	0.128	0.233	17,311	0.495	6,910	43,365
	Total	783,311		84.35	942.9								**114,701**	**0.434**	50,788	259,044

1-g. SV (closing mode) in the eastern part of Area III and in the western part of Area VI.

Year	Stratum	area	period	n	L	n/L*100	CV	esw	CV	E(s)	CV	D	P	CV	95% CI LL	95% CI UL
1995/96	FIIIE	253,343	12/8-22	5.0	733.9	0.681	0.486	0.178	0.561	1.000	0.000	0.019	4,843	0.742	1,322	17,742
1997/98	FIIIE	250,985	12/16-30	6.0	697.0	0.861	0.440	0.372	0.984	1.000	0.000	0.012	2,902	1.078	519	16,219
1999/00	FIIIE	356,046	12/5-13,21-26	4.0	188.1	2.127	1.296	0.428	0.422	1.667	0.400	0.041	14,749	1.420	1,880	115,697
2001/02	FIIIE	354,965	12/9-24	20.0	257.9	7.755	0.548	0.384	0.265	3.889	0.249	0.392	139,277	0.658	43,018	450,931
2003/04	FIIIF	324,032	11/30-12/24	31.1	373.2	8.346	0.599	0.355	0.573	1.807	0.1112	0.212	68,853	0.836	16,534	286,735
1996/97	FVIW	206,490	12/14-1/1	29.6	1015.7	2.913	0.236	0.410	0.442	2.044	0.193	0.073	14,994	0.537	5,589	40,228
1998/99	FVIW	316,727	3/12-31	0.0	116.7	0.000	-	-	-	-	-	0.000	0	-	-	-
2000/01	FVIW	290,908	12/11-29	30.0	660.6	4.547	0.280	0.835	0.189	2.071	0.143	0.056	16,403	0.367	8,178	32,901
2002/03	FVIW	309,998	12/3-30	8.0	354.7	2.255	0.523	0.466	0.286	1.500	0.333	0.036	11,260	0.683	3,349	37,863

1-h. SV in passing mode in Area IV.

Year	Stratum	area	period	n	L	n/L*100	CV	esw	CV	E(s)	CV	D	P	CV	95% CI LL	95% CI UL
1997/98	NW	214,265	12/31-1/14	4.4	199.4	2.230	0.632	1.482	0.178	2.215	0.158	0.017	3,569	0.675	1,074	11,858
	SW	44,188	2/13-27	8.0	256.4	3.120	0.680	0.969	0.215	1.800	0.181	0.029	1,280	0.736	353	4,649
	SE	40,371	1/15-29	5.9	222.6	2.642	0.649	0.992	0.841	1.556	0.093	0.021	836	1.067	151	4,617
	PB	6,865	3/2-4	20.4	46.5	43.800	0.093	0.634	0.543	2.333	0.286	0.805	5,529	0.621	1,806	16,927
1999/00	NW	241,290	12/27-1/11	4.0	673.6	0.594	0.449	0.441	0.472	1.500	0.333	0.010	2,439	0.732	676	8,803
	NE	230,745	1/11-26	31.4	698.2	4.501	0.495	0.582	0.199	1.421	0.135	0.055	12,689	0.550	4,633	34,750
	SW	42,090	2/18-29,3/6-	84.1	498.9	16.864	0.360	1.016	0.110	1.878	0.147	0.156	6,559	0.404	3,062	14,052
	SE	37,035	1/28-2/18	50.6	237.2	21.331	0.303	0.976	0.130	4.008	0.147	0.438	16,228	0.361	8,178	32,203
	PB	22,324	3/1-6	33.0	290.4	11.375	0.410	1.051	0.343	2.180	0.311	0.118	2,633	0.619	863	8,036
	Total	551,160		203.2	2398.3								**40,548**	**0.241**	25,434	64,645
2001/02	NW	178,743	12/25-1/8	7.0	507.2	1.387	0.749	0.733	0.879	1.071	0.219	0.010	1,810	1.175	292	11,233
	NE	207,240	1/9-25	41.9	810.5	5.173	0.813	0.309	0.197	1.000	0.000	0.084	17,353	0.836	4,163	72,321
	SW	86,141	2/10-21,27	116.1	652.8	17.785	0.439	0.878	0.065	1.420	0.167	0.144	12,385	0.474	5,126	29,925
	SE	83,193	1/26-2/8	175.3	636.5	27.540	0.212	0.518	0.091	1.143	0.085	0.304	25,251	0.246	15,709	40,589
	PB	27,984	2/22-26	173.6	331.9	52.299	0.308	0.624	0.131	1.605	0.082	0.673	18,832	0.345	9,769	36,304
	Total	555,317		513.9	2938.9								**75,631**	**0.240**	47,538	120,325
2003/04	NW	273,397	12/26-1/10	23.4	587.2	3.982	0.589	0.334	0.538	1.667	0.200	0.099	27,143	0.822	6,635	111,037
	NE	249,833	1/11-24	8.7	809.8	1.071	0.289	0.672	0.816	1.000		0.008	1,990	0.866	460	8,618
	SW	44,810	2/7-25	75.6	729.3	10.366	0.393	0.941	0.149	2.400	0.486	0.132	5,922	0.643	1,871	18,744
	SE	46,942	1/25-2/7	13.0	791.8	1.636	0.391	0.597	0.234	3.108	0.354	0.043	2,000	0.577	699	5,720
	PB	34,830	2/26-3/2	34.3	243.0	14.103	0.557	0.949	0.223	1.571	0.129	0.117	4,068	0.614	1,342	12,325
	Total	614,982		154.9	3161.1								**41,123**	**0.556**	14,863	113,778

1-i. SV in passing mode in Area V.

Year	Stratum	area	period	n	L	n/L*100	CV	esw	CV	E(s)	CV	D	P	CV	95% CI LL	95% CI UL
1998/99	NW	327,187	1/14-2/2	42.8	811.6	5.269	0.476	0.536	0.240	3.500	0.235	0.172	56,252	0.583	19,500	162,272
	SW	42,583	2/3-21	86.2	560.6	15.384	0.347	0.539	0.271	3.182	0.371	0.454	19,333	0.576	6,772	55,193
	SE	44,024	2/24-3/12	30.0	260.8	11.503	0.504	0.487	0.206	5.000	0.200	0.591	26,019	0.580	9,056	74,757
2000/01	NW	269,652	2/10-23	18.0	651.9	2.761	0.411	0.462	0.247	1.000	0.000	0.030	8,063	0.479	3,306	19,663
	NE	354,068	1/1-23	31.3	902.4	3.468	0.275	0.329	0.556	6.546	0.580	0.345	122,083	0.849	28,803	517,454
	SW	89,617	2/25-3/18	34.0	674.4	5.041	0.436	0.397	0.317	1.889	0.299	0.120	10,760	0.617	3,537	32,731
	SE	150,364	1/24-2/7	152.0	721.3	21.066	0.273	0.945	0.118	1.658	0.129	0.185	27,802	0.325	14,953	51,695
	Total	757,361		265.2	3210.8								**168,708**	**0.618**	55,295	514,738
2002/03	NW	274,012	2/11-20,3/5-	82.3	714.8	11.510	0.409	0.493	0.298	2.231	0.177	0.261	71,390	0.536	26,653	191,219
	NE	352,403	1/5-25	39.8	1065.7	3.736	0.267	0.640	0.236	1.636	0.149	0.048	16,821	0.386	8,099	34,936
	SW	82,548	2/21-3/4	213.4	491.2	43.439	0.251	0.562	0.115	2.000	0.147	0.773	63,824	0.313	35,049	116,225
	SE	74,348	1/27-2/9	334.2	704.0	47.473	0.284	0.525	0.124	1.800	0.128	0.814	60,523	0.336	31,906	114,809
	Total	1,466,324		934.9	6186.5								**212,558**	**0.227**	137,098	329,553

1-j. SV in passing mode in the eastern part of Area III and in the western part of Area VI.

Year	Stratum	area	period	n	L	n/L*100	CV	esw	CV	E(s)	CV	D	P	CV	95% CI LL	95% CI UL
1997/98	FIIIE	250,985	12/16-30	2.0	309.1	0.647	0.908	1.500	0.000	1.000	0.000	0.002	541	0.908	118	2,475
1999/00	FIIIE	356,046	12/5-13,21-2	5.0	527.8	0.947	0.610	0.361	1.415	1.667	0.400	0.022	7,782	1.592	860	70,387
2001/02	FIIIE	354,965	12/9-24	19.1	426.2	4.487	0.465	0.680	0.385	3.889	0.249	0.128	45,569	0.653	14,166	146,585
2003/04	FIIIE	324,032	11/30-12/24	154.5	1490.4	10.363	0.4024	0.7561	0.1815	1.8071	0.1112	12.384	40,128	0.455	17,142	93,938
1998/99	SVIW	316,727	3/12-31	57.0	425.3	13.402	0.329	0.742	0.134	1.222	0.120	0.110	34,941	0.375	17,147	71,197
2000/01	FVIW	290,908	12/11-29	34.4	825.5	4.164	0.406	0.425	0.301	2.071	0.143	0.101	29,494	0.525	11,207	77,622
2002/03	FVIW	309,998	12/3-30	26.9	1140.2	2.358	0.309	0.624	0.351	1.500	0.333	0.028	8,792	0.575	3,087	25,043

Table 2-a. Uncorrected and corrected abundance estimates in Areas IV and V. Correction factors R1=0.812 (CV=0.089) and *R*2=0.689(CV=0.137) are used for the correction.

Area IV

year	SSV	CV	SV-closing	CV	SV-passing	CV	Corrected	CV
1989/90	30,657	0.142					54,539	0.215
1991/92	30,893	0.181	33,647*1	0.567			54,959	0.243
1993/94	26,887	0.187	24,845	0.273			41,943	0.215
1995/96	22,848	0.159	62,523	0.463			42,134	0.220
1997/98	18,962	0.205	18,490	0.650	11,215*2	0.391	32,656	0.252
1999/00	40,961	0.175	66,611	0.320	40,548	0.241	49,867	0.169
2001/02	51,830	0.186	31,352	0.334	75,631	0.240	68,503	0.167
2003/04	54,040	0.491	29,081	0.680	41,123	0.556	47,858	0.358

Area V

year	SSV	CV	SV-closing	CV	SV-passing	CV	Corrected	CV
1990/91	110,031	0.133					195,743	0.210
1992/93	57,872	0.239	120,077	0.248			122,048	0.229
1994/95	81,313	0.306	157,260	0.318			168,566	0.268
1996/97	95,019	0.245	122,968	0.432			171,332	0.261
1998/99	120,068	0.171	83,983	0.755	101,603*2	0.372	198,423	0.233
2000/01	101,163	0.157	265,198	0.971	168,708	0.618	179,796	0.210
2002/03	166,016	0.171	114,702	0.434	212,558	0.227	226,884	0.161

*1: SV surveyed in only southern strata. Therefore this estimated was not accounted to estimate combined estimate.

*2: SV was not surveyed in passing mode in Eastern North stratum. Therefore this estimated was not accounted to estimate combined estimate.

Table 2-b. Uncorrected and corrected abundance estimates in eastern part of Area III and western part of Areas VI. Correction factors *R*1=0.812 (CV=0.089) and *R*2=0.689(CV=0.137) are used for the correction. In principle, sighting data in December were used to estimate abundance. In 1998/99, the data in late March were used because survey couldn't be conducted in December due to a fire accident.

Eastern part of Area III

year	SSV	CV	SV-closing	CV	SV-passing	CV	Corrected	CV
1995/96	10,546	0.222	4,843	0.742			13,793	0.282
1997/98	6,435	0.352	2,902	1.078	541	0.908	8,153	0.400
1999/00	8,667	0.787	14,749	1.420	7,782	1.592	12,314	0.686
2001/02	39,560	0.566	139,277	0.658	45,569	0.653	58,302	0.410
2003/04	17,522	0.364	68,853	0.836	40,128	0.455	34,887	0.294

Western part of Area VI

year	SSV	CV	SV-closing	CV	SV-passing	CV	Corrected	CV
1996/97	7,201	0.220	14,994	0.537			13,373	0.259
1998/99	30,194	0.327	0	0.000	34,941	0.375	40,743	0.268
2000/01	12,317	0.232	16,403	0.367	29,494	0.525	23,237	0.224
2002/03	10,388	0.216	11,260	0.683	8,792	0.575	13,807	0.250

Table 3. Corrected abundance estimates of I-stock (see text) in 35-165^{o}E sector. Because the survey weren't conducted in eastern part of Area III before 1994/95, the estimates before 1994/95 are not available. For 2003/04, the estimate doesn't include the estimate in western part of Area V.

year	abundance	CV
1995/96 + 1996/97	82,975	0.165
1997/98 + 1998/99	124,301	0.187
1999/00 + 2000/01	128,110	0.227
2001/02 + 2002/03	228,349	0.142
2003/04	83,947	0.248

Table 4. Comparison of the abundance estimate between JARPA and IDCR in CP II. The bottom column in each table is IDCR abundance estimates referred from Branch and Butterworth (2001).

Area IV

survey	year	abundance	CV	95% CI LL	95% CI UL
JARPA	1989/90	54,539	0.215	35,927	82,791
	1991/92	54,959	0.243	34,363	87,898
	1993/94	41,943	0.215	27,639	63,649
	1995/96	42,134	0.220	27,525	64,497
	1997/98	32,656	0.252	20,088	53,086
	1999/00	49,867	0.169	35,866	69,335
	2001/02	68,503	0.167	49,477	94,845
	2003/04	47,858	0.358	24,243	94,476
IDCR	1988/89	58,170	0.228	37,765	91,271

Area V

survey	year	abundance	CV	95% CI LL	95% CI UL
JARPA	1990/91	195,743	0.210	130,276	294,111
	1992/93	122,048	0.229	78,362	190,089
	1994/95	168,566	0.268	100,586	282,491
	1996/97	171,332	0.261	103,507	283,603
	1998/99	198,423	0.233	126,390	311,509
	2000/01	179,796	0.210	119,548	270,406
	2002/03	226,884	0.161	165,850	310,380
IDCR	1985/86	299,793	0.135	230,371	390,135

Table 5. Comparison of abundance estimate in this study to those derived from spatial modeling (Fernanda *et al*, 2003; Burt *et al*., 2005).

Area IV

year	this paper	CV	spatial	CV
1989/90	54,539	0.215	20,930	0.114
1991/92	54,959	0.243	31,000	0.180
1993/94	41,943	0.215	27,060	0.183
1995/96	42,134	0.220	26,240	0.126
1997/98	32,656	0.252	15,060	0.146
1999/00	49,867	0.169	63,400	0.187

Area V

year	this paper	CV	spatial	CV
1990/91	195,743	0.210	88,939	0.204
1992/93	122,048	0.229	84,110	0.263
1994/95	168,566	0.268	103,645	0.150
1996/97	171,332	0.261	76,047	0.269
1998/99	198,423	0.233	109,804	0.361
2000/01	179,796	0.210	101,320	0.218

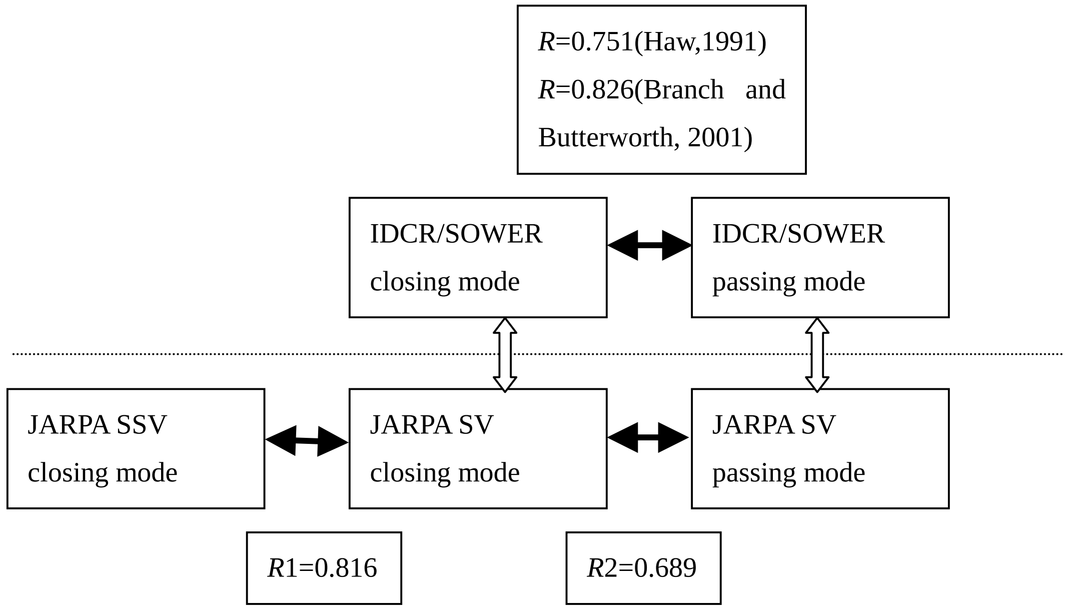


Fig. 1. Illustration of relationship between comparison abundance estimate and correction factor estimated by the method in Haw (1991). Black arrow indicates comparisons that have been conducted. White arrow indicates both estimates are comparable because survey procedure is very similar to each other.

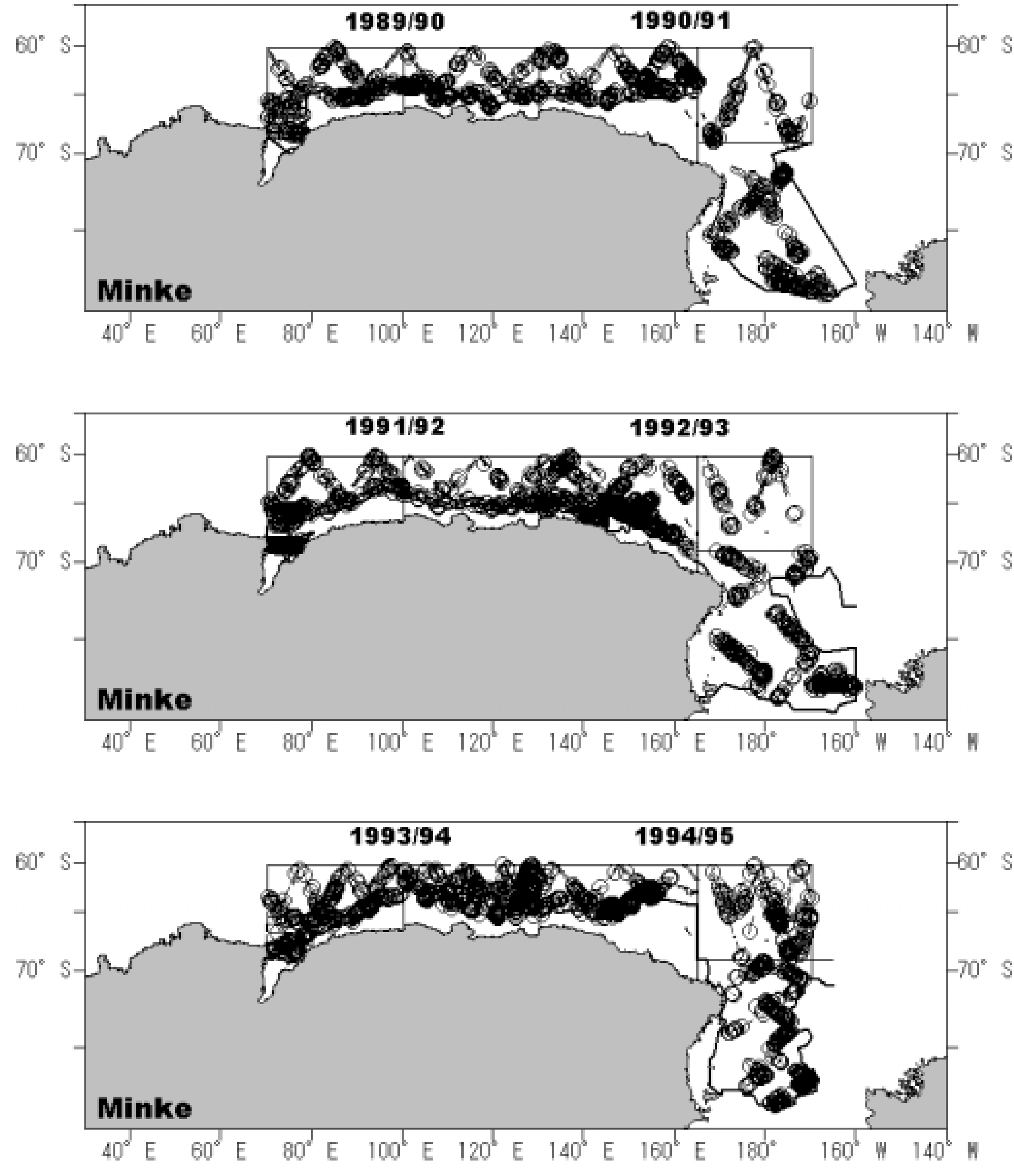
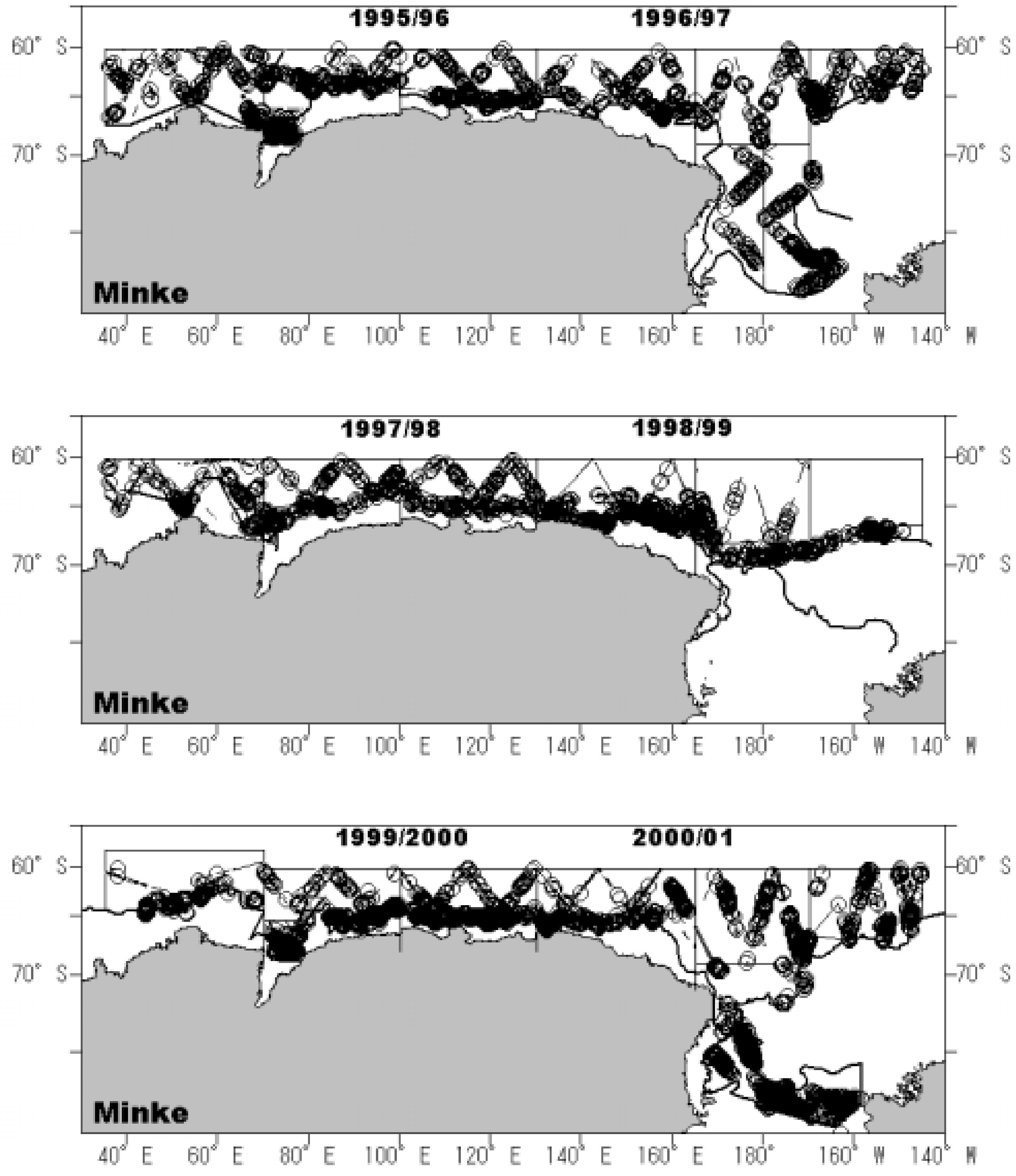
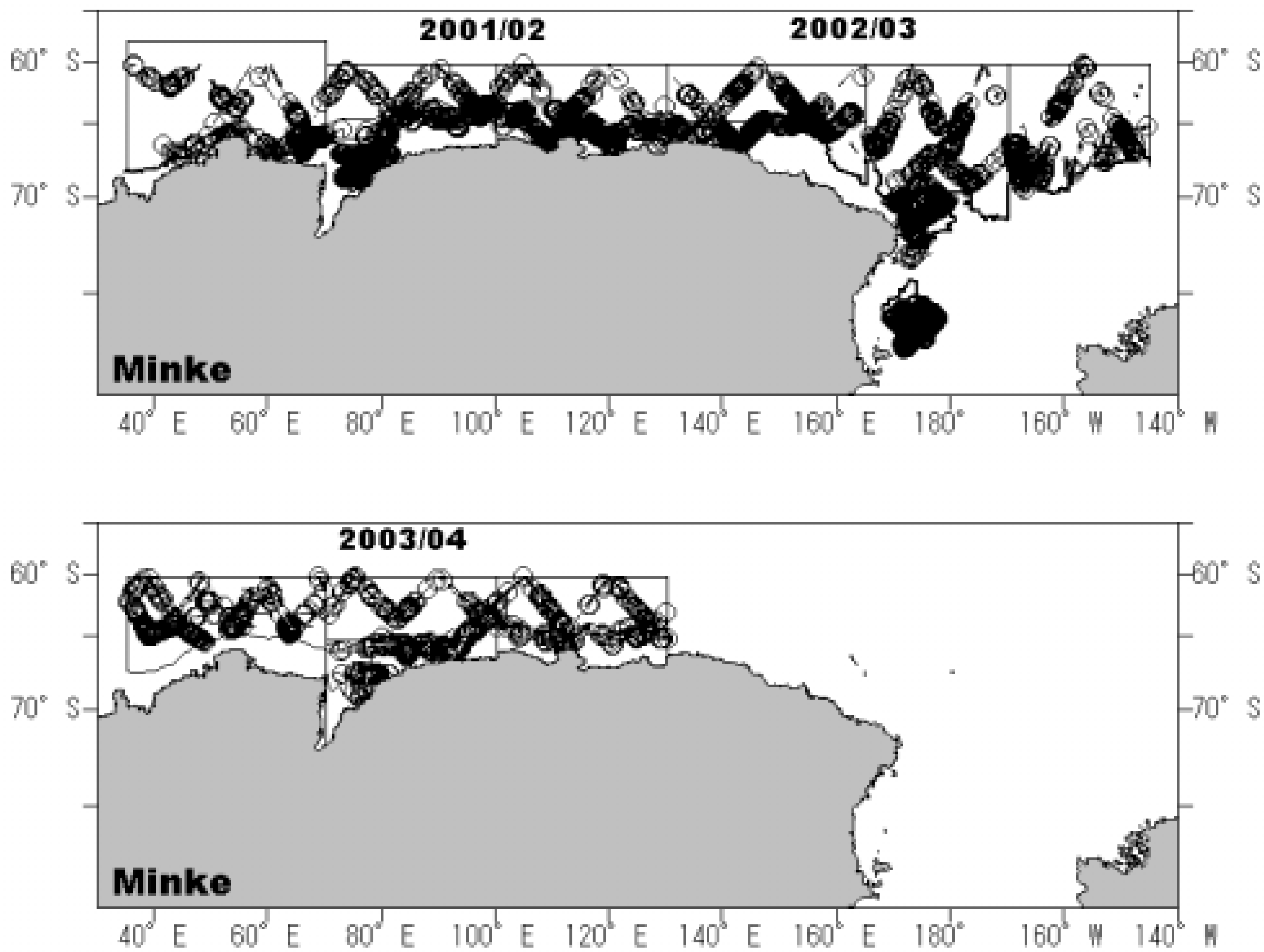


Fig. 2. Distribution of searching effort and primary sighting of the minke whales from 1989/90 to 2003/04. Circles indicate position of primary sightings, bold lines indicates estimated ice edge line and thin lines indicate track lines.



(Fig. 2. continued)



(Fig. 2. continued)

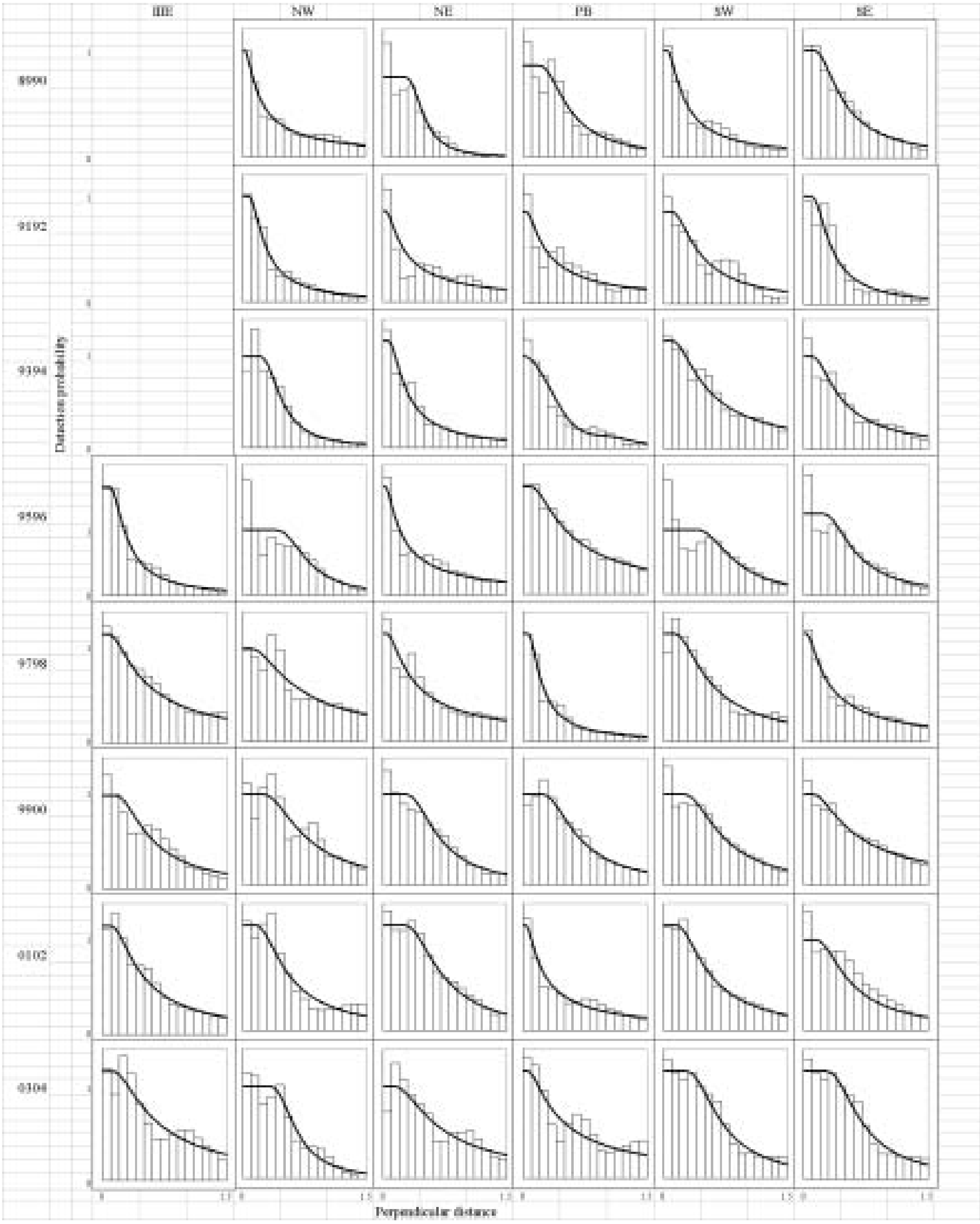
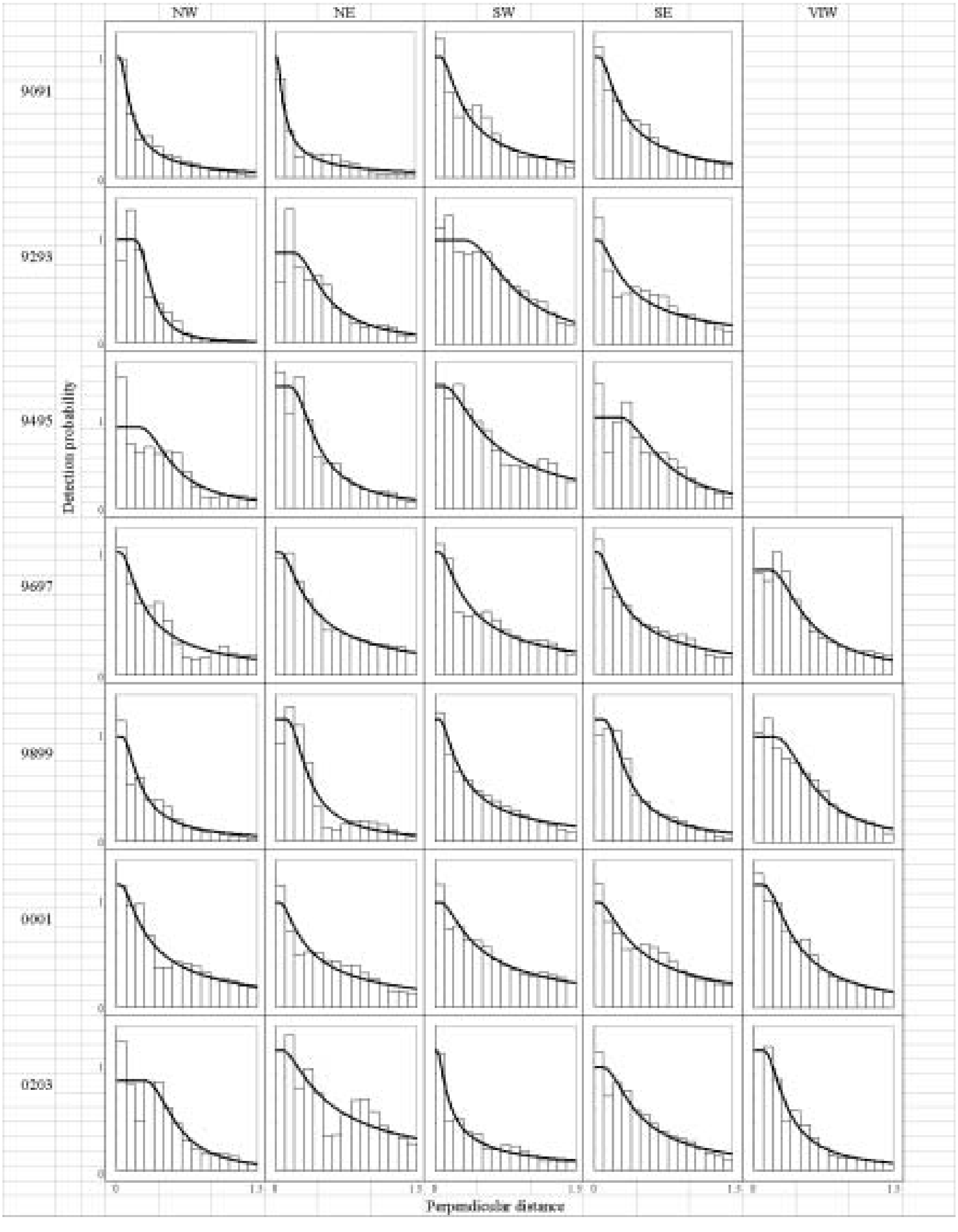
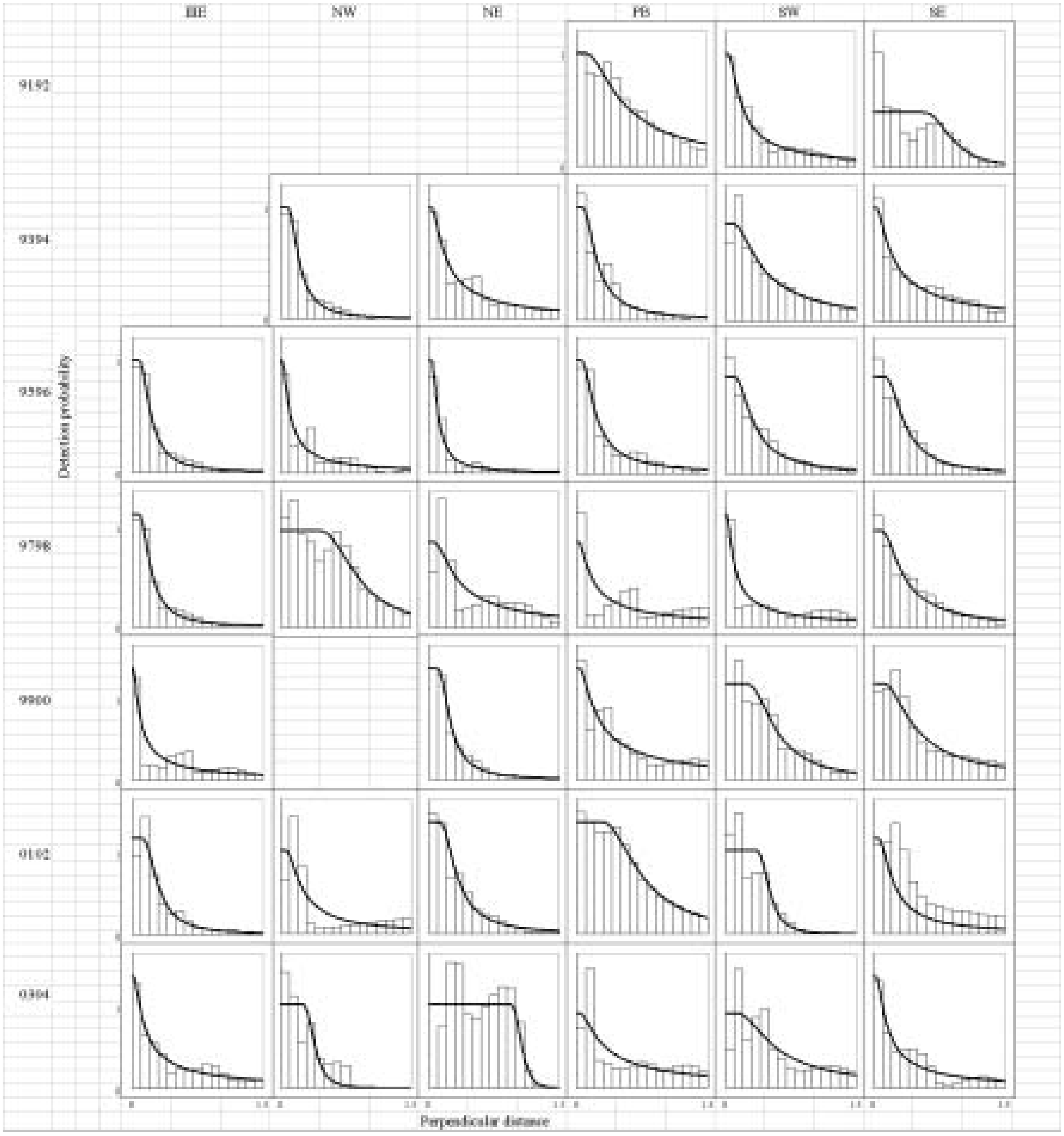


Fig. 3. Detection probability functions of the minke whale for each strata.

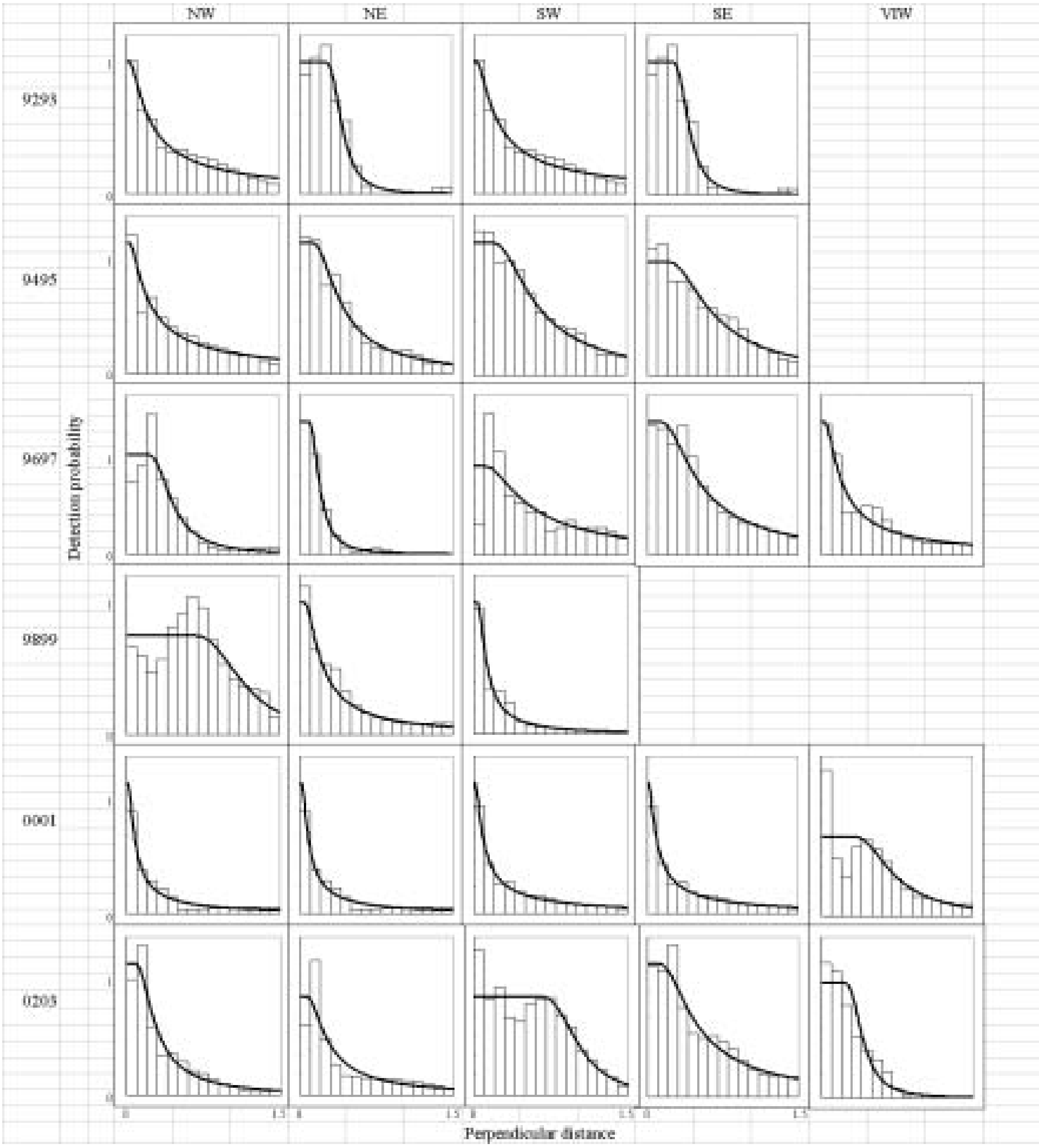
3-a. SSV in Area IV and the eastern part of Area III.



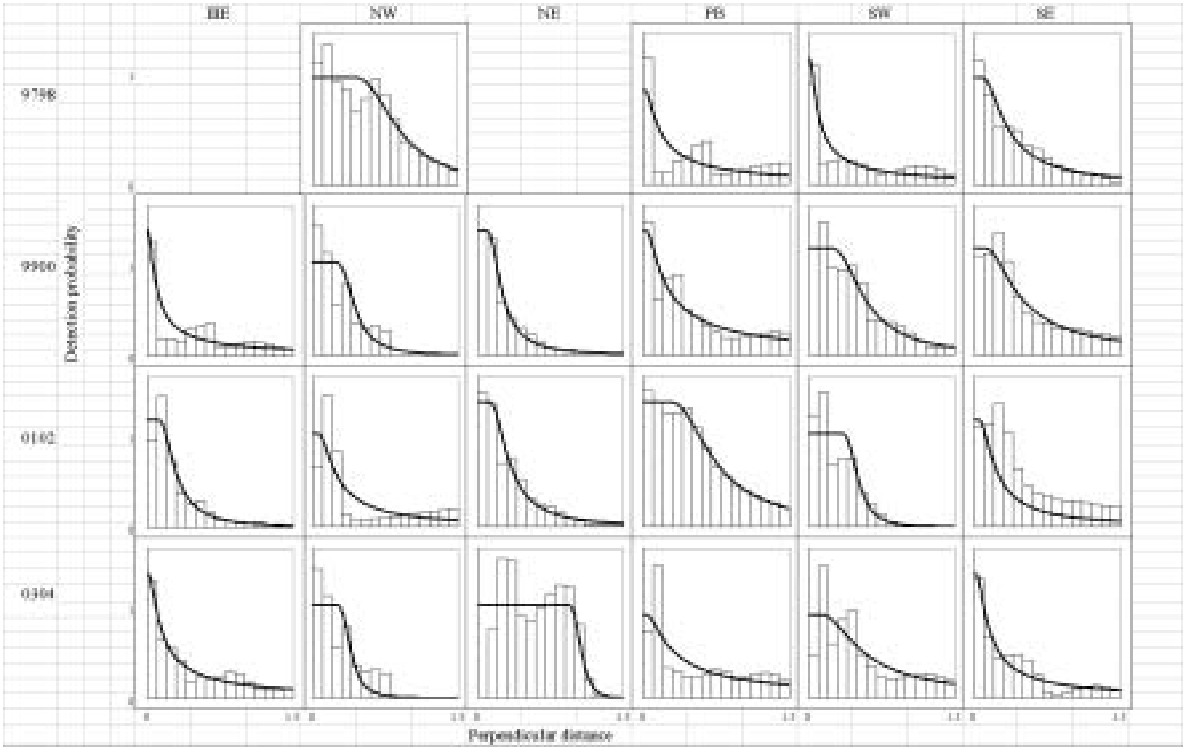
3-b. SSV in Area V and the western part of Area VI.



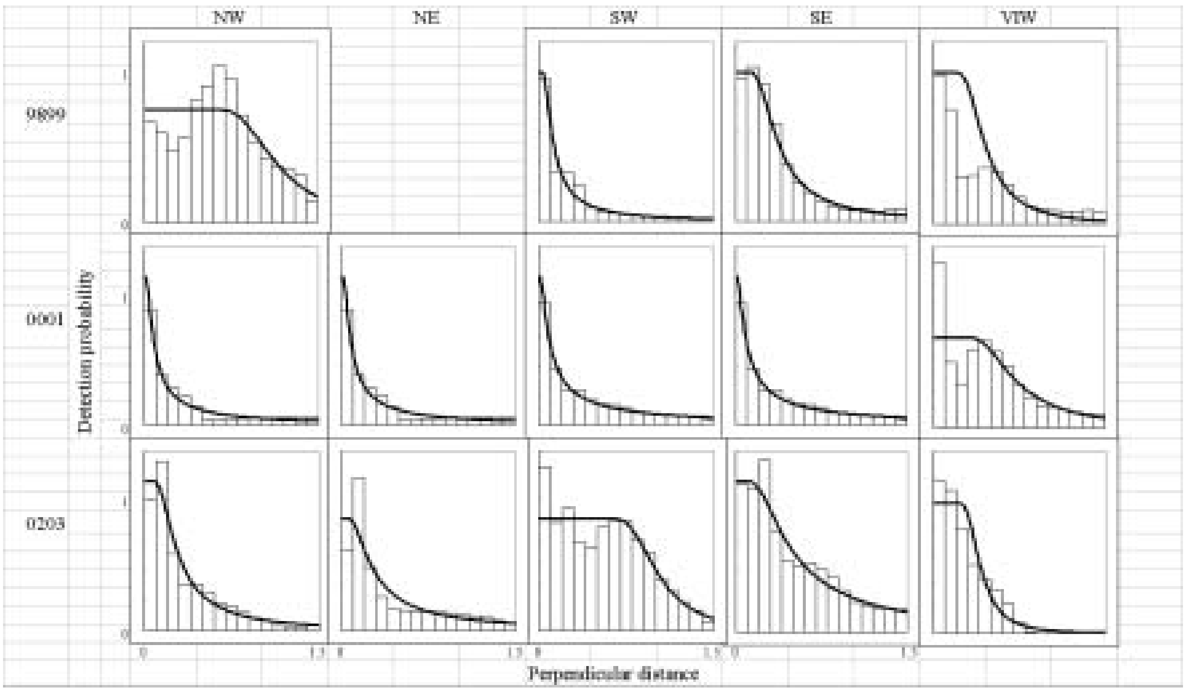
3-c. SV (closing mode) in Area IV and the eastern part of Area III.



3-d. SV (closing mode) in Area V and the western part of Area VI.



3-e. SV (passing mode) in Area IV and the eastern part of Area III.



3-f. SV (passing mode) in Area V and the western part of Area VI.