Examination of the effects of planned takes by Japanese small-type coastal whaling on 'O' and 'J' stocks common minke whales in the Western North Pacific

Takashi Hakamada[1], Tomio Miyashita[2] and Hiroshi Hatanaka[1]

[1]*The Institute of Cetacean Research 4-5 Toyomi, Chuo-ku, Tokyo, 104-0005 Japan*
[2]*National Research Institute of Far Seas Fisheries, Fukuura 2-12-4, Kanazawa-ku, Yokohama, Kanagawa 236-8648, Japan*

ABSTRACT

This paper provides the scientific basis for support of the proposal for Japanese Small-Type Coastal Whaling (STCW). HITTER-FITTER-based assessments were conducted to examine the effect of combined future catches by the STCW (n=150) and JARPN II (n=70) on 'O' and 'J' stocks common minke whales. This examination was made with the conservation objective for the 'O' stock that 'the population should be allowed to increase under the planned take'; and for the 'J' stock that 'the population trajectories should not be significantly different from the scenario in which total catch is set at zero over a 30 year period'. The stock structure scenario and the abundance estimates used in the assessments are based on updated analyses presented to the recent JARPN II review workshop, and took into consideration the suggestions from the expert panel. The assessment was conducted for the 'best case' as well for 'sensitivity' tests that allowed different assignments of abundance of 'O' and 'J' stocks in the Okhotsk Sea. For comparative purposes the assessments were also conducted for the scenario of no catches. Regarding the 'O' stock, apart from the most conservative scenario (considerable amount of 'J' stock in Okhotsk Sea, *MSYR*(1+)=1% and abundance for this stock at the 90% lower limit), the 'O' stock would increase over the forthcoming decades in all cases examined. Regarding the 'J' stock, results of the assessment suggest that the 'J' stock would increase in all scenarios except in those involving a *MSYR*(1+)=1%, which is considered of low plausibility. The population trajectories of 'J' stock did not differ between the catch and no catch scenario in all cases examined. These results suggest that there is no negative effect on the 'O' and 'J' stock of the combined STCW and JARPN II catches under the established conservation objectives for these stocks.

BACKGROUND

The issue on Japanese small-type coastal whaling was discussed in the Small Working Group (SWG) on the future of the International Whaling Commission (IWC, 2009a) and the SWG instructed the Scientific Committee (SC) to provide advice in relation to Japanese small-type coastal whaling (Annex F of IWC, 2009a).

This paper provides the scientific grounds for supporting the proposal for Japanese small-type coastal whaling. The outline of the proposal, which is essentially the same as previous proposals is as follows:

i) One hundred and fifty common minke whales will be taken in Sub-area 7.
ii) O-stock minke whales will be targeted but some few J-stock animals are expected to be by-caught.
iii) The operations of the small-type coastal catcher boats will be outside 10 nautical miles of the coast in order to minimize the possible takes of J-stock animals.
iv) After the interim period the small-type coastal catcher boats will return to the research activities under the coastal component of JARPN II unless otherwise determined.
v) The user objective will be "to fulfill the needs of small coastal whaling communities".
vi) The conservation objective for O-stock will be that "the population should be allowed to increase under the planned take by Japanese small-type coastal whaling".
vii) The conservation objective for J-stock will be that "the population trajectories should not be significantly

different from the scenario in which total catch is set at zero over a 30 years period". This is because the majority of the anthropogenic takes of J-stock are due to incidental catch by coastal fishing gear and because the status of the stock is not well known.

The present paper evaluates the effect of the planned catches on O and J stocks common minke whales in the context of the updated information on stock structure and abundance. Data used in this evaluation and assessments will be provided on request, under the SC data access Procedure A.

EXAMINATION OF THE EFFECTS OF FUTURE CATCHES ON 'O' STOCK COMMON MINKE WHALES

Stock structure scenario

The IWC SC adopted four stock structure hypotheses of the common minke whale during the *Implementation Simulation Trials* (*IST*s) completed in 2003, but the SC did not evaluate the plausibility of these scenarios. Recent results of genetic and non-genetic studies based on JARPN and JARPN II surveys (Kanda *et al*., 2009a; Goto *et al.*, 2009a; Hakamada and Bando, 2009a) provided support for the single O stock scenario in sub-areas 7, 8, 9, 11 and 12 (stock structure under Scenario B in IWC (2004)). These analyses used data from 1994 to 2007. The data corresponding to the period 2003-2007 were not used during the previous *Implementation*.

Appendix I shows the results of an updated genetic analysis in sub-areas 7, 8 and 9. Appendix II presents the results of an updated CPUE analysis using data from the past commercial whaling in coastal areas of Japan. Results of these analyses support the single O stock scenario (Scenario B in IWC (2004)), and are inconsistent with the multiple O stock scenarios proposed by stock scenarios C and D in IWC (2004).

Kanda *et al* (2009b), Goto *et al*. (2009b) and Hakamada and Bando (2009b) conducted additional analyses on stock structure that considered several of the recommendations from the JARPN II review workshop (IWC, 2009b). Results of these analyses were consistent with those presented originally to the workshop, which support the stock structure scenario B of a single O stock in sub-areas 7, 8 and 9.

Based on the results of these updated analyses, it is concluded that the single O stock scenario (scenario B) has a higher plausibility. Therefore, this is the only scenario considered for the examination of the effect on the stocks of future catches.

The numbers of historical and future catches from O stock

The numbers of commercial and research catches

The past commercial and research catches listed in IWC (2004) were used in this examination. Future annual catches of 70 and 150 by JARPN II and community-based whaling, respectively for the first 5 years, and 220 by JARPN II for the following 25 years, are assumed. It is assumed that the number of samples during JARPN II were in averaged proportion of abundance estimate in sub-areas 7, 8 and 9 over early and late seasons in Hakamada *et al*. (2009).

The numbers of incidental catches

Incidental catches off Japan until 2000 were the same as in option (Jii) in IWC (2004). From 2001 to 2007 the reported incidental catches listed in the Japan Progress Reports were used. It should be remembered that the new regulation for incidental catches were applied from the second half of 2001. It was assumed that the future annual incidental catches off Japan correspond to an average of those from 2001 to 2007.

Proportion of the J stock in the catches

Proportion of the J stock in the commercial catches is assumed to be the same as those in the *IST*. Proportion of the J stock in the past and future incidental catches were assumed to be the average mixing rate by sub-area and sex in the catches after the change of regulation (2001-2007), based on the microsatellite analyses by Kanda *et al*. (2009a) (Table 1). Proportion of the J stock in past JARPN and JARPNII surveys in sub-area 7 were also estimated by using microsatellite analyses by Kanda *et al*. (2009a) (Table 2; see Appendix III for details). The proportion of the J stock in whales taken by future community-based and research whaling in sub-area 7 was assumed to be the proportion of J stock in waters 10 n. miles or more distant from the coast i.e. 10% (see Appendix III).

Sex ratio of males

For the past commercial catches, the ratio in IWC (2004) was used. For past scientific whaling catches the ratio obtained from the JARPN and JARPNII surveys was used. For past incidental catches until 2000, the ratio of (Jii) option in IWC (2004) was used and those from 2001 to 2007, the ratio presented in the Japan Progress Reports for 2001-2007 was used. For future research catches the average ratio from offshore component of JARPN II during 2002-2007 was assumed. For future community-based whaling catches the average ratio from costal component of JARPN II during 2002-2007 was assumed. For future incidental catches the average ratio for the incidental catches in the period 2001 to 2007 was assumed. By using past catch statistics by sub-areas and estimates of mixing rate of J stock and sex ratio of males described above, the past and future annual sex-disaggregated incidental catches from 'O' stock are estimated (Table 3). The past and future annual sex-disaggregated catches of this stock are shown in Table 4.

Abundance estimate

Abundance estimates in sub-areas 7, 8 and 9 were derived from the data collected by the dedicated sighting survey vessel (KS2) during 2006 and 2007 JARPN II surveys in July and August (Hakamada *et al*., 2009). As for sub-areas 11 and 12, the estimates in 2003 and 2006 (Miyashita, 2009) were used. See Appendix IV for details. In this analysis, abundance estimate of 30,932 (CV=0.167) for the O stock were assumed in the base case. Abundances of 20,028 (CV=0.301) and 31,512 (CV=0.169) are assumed in sensitivity 1 and 2, respectively. For more details of the abundance estimate of the O stock, see Appendix IV.

Proportion of J-stock animals in Okhotsk Sea

It was assumed that the proportions of the J-stock in Okhotsk Sea by sub-area are same as in IWC (2004) as a base case. Because mixing rate of the J stock in Okhotsk Sea is unknown, two alternative assumptions were made to divide the Okhotsk Sea abundance estimates: (1) 50% of the whales in sub-area 11 and 25% of those in sub-area 12 belonged to the J stock, and (2) 5% and 0% respectively for these allocations. Table 5 shows proportion of J-stock animal in Okhotsk Sea in base case and these sensitivities.

***g*(0)**

Okamura *et al*., (2008) estimated *g*(0)=0.732 (CV=0.309). By applying this g(0) to the abundance estimate mentioned in the previous paragraph, 42,257 (CV=0.351), 27,360 (CV=0.431) and 43,049 (CV=0.352) were obtained for the base case, sensitivity 1 and sensitivity 2, respectively.

***MSYR*(1+)**

Butterworth *et al*., (2007) argued that *MSYR*(1+) in most baleen whale cases lay in the 2-6% range. For the present examination calculation was made for *MSYR*(1+) = 1-5%.

Biological parameters

In the HITTER computations the parameter values adopted by the *Implementation Simulation Trials* (IWC, 2004), were used:

Age at recruitment (same for both sexes): 4 (50%) and 7.53 (95%)
Age at maturity (same for both sexes): 7 (50%) and 10.53 (95%)
Natural mortality (age-dependent and independent of sex):

0.085 if $a \le 4$

$0.0775 + 0.001875\, a$ if $4 < a < 20$

0.115 if $a \ge 20$

where a is age.

MSY level (*MSYL*): 60% (of *K*)

The following years were chosen for the examination; 2009 (current year), 2014, 2019, 2029 and 2039. Population trajectories were calculated by using HITTER-FITTER program provided by IWC Secretariat without modification of the program.

Results and discussions

Table 6 show the results for HITTER runs for abundance estimates without and with catches for both the best estimate and its lower 5%-ile in the base case. Tables 7 and 8 show the results for the sensitivities 1 and 2, respectively. All runs are for *MSYR* (1+) = 1%, 2%, 3%, 4% and 5%. Except in the most conservative scenario for O stock (e.g. assuming that there is a considerable amount of J-stock whales in Okhotsk Sea, *MSYR*(1+)=1% and abundance for the O stock in the 90% lower limit), the minke whale O stock would increase over the forthcoming decades in all cases examined. Figures 1, 2 and 3 show the projection of depletion for 1+ component assuming abundance estimates without and with the future catch extrapolation and for both the best estimate and its lower 5%-ile, respectively. In the case that *MSYR*(1+)=1%, the population trajectory of the O stock would change but there is no adverse effect on this stock of the future catches. In the case that *MSYR*(1+)=4%, the population trajectories of 1+ component weren't different substantially between the case that the community-based whaling and JARPN II survey catch are 220 and the case that the catch is zero for 30 years. From these tables and figures, it is suggested that there will be no adverse impact on O stock of catches under the proposed community-based whaling and JARPNII, and that the conservation objective would be attained under proposed community-based whaling and JARPNII.

EXAMINATION OF THE EFFECTS OF FUTURE CATCHES ON 'J' STOCK COMMON MINKE WHALES

The stock structure scenario, the numbers of historical and future catches of common mike whales (J and O stocks) and the Proportion of the J stock in the catches are the same as in the previous section.

The numbers of incidental catches of J stock

Incidental catches off Japan until 2000 were the same as in option (Jii) in IWC (2004). From 2001 to 2007 the reported incidental catches listed in the Japan Progress Reports were used. It should be remembered that the new regulation for incidental catches were applied from the second half of 2001. It was assumed that the future annual incidental catches off Japan correspond to an average of those from 2001 to 2007. The numbers of the incidental catches off Japan from the J stock are shown in Table 9. For the incidental catches off Korea, the number of the incidental catches until 2001 provided in IWC (2004) was used. For the period 2002-2007, the numbers were as those reported in the Republic of Korea Progress Report on Cetacean Research presented to the IWC SC. For the incidental catches until 2001, average sex ratio of male during 1996-1997 of 25.7% was assumed (IWC, 2004). For incidental catches whose sex was unknown during 2002-2007, sex ratio of male using samples whose sex in known in each year was assumed. For future incidental catches, average sex ratio of male (59.1%) and the average number during 2002-2007 were assumed. The numbers of past and assumed future incidental catches off Korea from 'J' stock are shown in Table 10.

Sex ratio of males

For the past commercial catches, the ratio in IWC (2004) was used. For past scientific whaling catches the ratio obtained from the JARPN and JARPNII surveys was used. For past incidental catches until 2000, the ratio of (Jii) option in IWC (2004) was used and those from 2001 to 2007, the ratio presented in the Japan Progress Reports for 2001-2007 was used. For future research catches the average ratio from the offshore component of JARPN II during 2002-2007 was assumed. For future community-based whaling catches the average ratio from the costal component of JARPN II during 2002-2007 was assumed. For future incidental catches the average ratio for the incidental catches in the period 2001 to 2007 was assumed. By using past catch statistics by sub-areas and estimates of mixing rate of J stock and sex ratio of males described above, the past and future annual sex-disaggregated incidental catches from 'J' stock are estimated. The past and future annual sex-disaggregated catches of this stock are shown in Table 11.

Abundance estimate

Abundance estimates in sub-areas 7, 8 and 9 were derived from the data collected by the dedicated sighting survey vessel (KS2) during 2006 and 2007 JARPNII surveys in July and August (Hakamada *et al*., 2009). As for sub-areas 11 and 12, the estimates in 2003 and 2006 (Miyashita, 2009) were used. Abundance estimates in sub-areas 5, 6 and 10 used in this analysis are based on Miyashita (2005), Miyashita and Okamura (2007) and Park *et al*. (2006). For more details, see Appendix IV. In this analysis, abundance estimate of 12,920 (CV=0.164) in the J stock were assumed. Abundances of 19,749 (CV=0.128) and 12,340 (CV=0.169) are assumed for sensitivity 1 and 2, respectively. For more details of the abundance estimate of the J stock, see Appendix IV.

***g*(0)**

Okamura *et al*. (2008) estimated g(0)=0.732 (CV=0.309) . By applying this g(0) to the abundance estimate mentioned in the previous paragraph, 17,651 (CV=0.350), 26,979 (CV=0.335) and 16,858 (CV=0.352) were obtained for base case, sensitivity 1 and sensitivity 2, respectively.

***MSYR*(1+)**

Butterworth et al. (2007) argued that *MSYR*(1+) in most baleen whale cases lay in the 2-6% range. For the present examination calculation was made for *MSYR*(1+) = 1-5%.

Biological parameters

In these HITTER computations the parameter values adopted by the *Implementation Simulation Trials* (IWC, 2004), were used:

Age at recruitment (same for both sexes): 4 (50%) and 7.53 (95%)
Age at maturity (same for both sexes): 7 (50%) and 10.53 (95%)
Natural mortality (age-dependent and independent of sex):

0.085 if $a \leq 4$
$0.0775 + 0.001875\, a$ if $4 < a < 20$
0.115 if $a \geq 20$

where a is age.
MSY level (*MSYL*): 60% (of *K*)

The following years were chosen for the examination; 2009 (current year), 2014, 2019, 2029 and 2039. Population trajectories were calculated by using HITTER-FITTER program provided by IWC Secretariat without modification of the program. We also did the calculation for the case that quota of community based whaling and JARPN II catches are zero.

Results and discussions

Results for HITTER runs for abundance estimates without and with catches and for both the best estimate and its lower 5%-ile, are given in Table 12, 13 and 14, respectively for *MSYR*(1+) = 1%, 2%, 3%, 4% and 5%. These tables show that population of the J stock would not decrease except in the case that *MSYR*(1+)=1%. Butterworth *et al*. (2007) argued that *MSYR*(1+) in most baleen whale cases lay in the 2-6% range. *MSYR*(1+)=2.5% was assumed as base case at the trials for B-C-B bowhead whales (IWC, 2008) and *MSYR*(1+)=3.5% was assumed as base case at the trials for Eastern Gray Whales (IWC, 2005). Therefore, *MSYR*(1+)=1% is a less plausible assumption.

The yearly change of the number of incidental catches (assumed to be J stock) per one set net (CPUE) ('large size' and 'salmon' nets) during the period 2001-2005 are shown in Figure 4. We selected this period to examine CPUE because a new regulation was implemented in 2001 and it brought better reporting of incidental catch to local governments. No apparent trend is observed, which suggests that the abundance of this stock has been kept stable and therefore, no adverse effect of the incidental catches and special permit catches on the J stock can be reasonably postulated.

Figures 5, 6 and 7 show the projection of depletion for 1+ component assuming abundance estimates without and with the future catches and for both the best estimate and its lower 5%-ile, respectively. The population trajectories of 1+ component did not differ substantially between the cases in which the community-based whaling and JARPN II survey catch are 220 and the case that the catch is zero for 30 years, in all cases examined. These comparisons suggested that the effect of future catches have a negligible effect on the population trajectory of the J stock. The conservation objective of the 'J' stock under proposed community-based whaling and JARPNII survey is attained.

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Table 1. Assumed mixing rates of J stock common minke whales by sub-areas for incidental catches, which was the proportions of J stock animals by sub-areas identified by microsatellite analysis using incidental catches (Kanda *et al*., 2009a).

sub-areas	2	6	7	10	11
prop. of J	0.859	0.990	0.502	1.000	1.000

Table 2. Assumed mixing rates of J stock by sub-areas for research takes, which was the proportions of J stock common minke whales by sub-areas identified by microsatellite analysis using samples collected during JARPN and JARPN II surveys (Kanda *et al*., 2009a).CK7 and CS7 are samples from JARPN II coastal component in Kushiro region and in Sanriku region, respectively.

sub-areas	11	CK7	CS7	7W	7E	8W	8E	9W	9E
prop. of J	0.319	0.167	0.200	0.065	0.000	0.000	0.000	0.008	0.000

Table 3. Historical and future incidental catch off Japan for the O stock of minke whales in the North Pacific from 1900.

year	male	female
1900-2000	5	7
2001	7	8
2002	10	10
2003	9	11
2004	6	11
2005	8	12
2006	11	13
2007	8	16
2008+	9	12

Table 4. Historical and future catches including incidental catches from the O stock by sex.

O stock			O stock (continued)		
year	male	female	year	male	female
1900-1929	5	7	1971	135	114
1930	12	13	1972	117	178
1931	12	13	1973	256	226
1932	12	13	1974	173	179
1933	12	13	1975	179	143
1934	19	17	1976	142	172
1935	19	17	1977	158	86
1936	19	17	1978	248	154
1937	37	32	1979	265	124
1938	43	37	1980	196	160
1939	43	37	1981	214	133
1940	50	41	1982	171	133
1941	37	32	1983	143	136
1942	43	37	1984	199	158
1943	62	51	1985	194	120
1944	50	41	1986	180	129
1945	43	37	1987	184	115
1946	49	50	1988	5	7
1947	57	59	1989	5	7
1948	80	74	1990	5	7
1949	79	62	1991	5	7
1950	128	78	1992	5	7
1951	116	102	1993	5	7
1952	118	156	1994	23	10
1953	115	109	1995	96	16
1954	110	136	1996	61	20
1955	164	182	1997	92	20
1956	227	204	1998	94	18
1957	160	188	1999	48	14
1958	214	259	2000	39	12
1959	121	144	2001	98	15
1960	110	132	2002	119	39
1961	140	171	2003	118	42
1962	99	123	2004	134	30
1963	94	114	2005	148	68
1964	127	150	2006	143	56
1965	119	168	2007	134	72
1966	154	183	2008	149	65
1967	107	144			
1968	78	132	Future catch		
1969	75	125	2009-2013	146	78
1970	156	147	2014+	149	65

Table 5. Proportion of the J stock applied to abundance in Okhotsk Sea by sub-area.

	SA11	SA12SW	SA12NE
Base case	0.225	0.046	0.000
Sensitivity 1	0.500	0.250	0.250
Sensitivity 2	0.050	0.000	0.000

Table 6. Depletions of the 'O' stock in 2009, 2014, 2019, 2029 and 2039 for the mature female component for the base case without and with the community based whaling and research catches under the stock scenario B, taking the incidental catch into account.

a) Hit 2005 total (1+) population of 42,257 (best estimate) with the future catches.

Statistic	MSYR (1+) (%)				
	1	2	3	4	5
K (1+)	48,103	44,790	43,528	43,019	42,787
Depletion - 2009	86.6%	93.0%	95.9%	97.2%	97.8%
Depletion - 2014	86.4%	92.8%	95.4%	96.4%	96.9%
Depletion - 2019	86.7%	93.1%	95.5%	96.5%	97.0%
Depletion - 2029	87.2%	93.6%	95.8%	96.7%	97.2%
Depletion - 2039	87.6%	94.0%	96.0%	96.9%	97.4%
RY - 2009	210	209	189	178	174
MSY (+1)	289	537	784	1,032	1,284

b) Hit 2005 total (1+) population of 42,257 (best estimate) without the future catches.

Statistic	MSYR (1+) (%)				
	1	2	3	4	5
K (1+)	48,103	44,790	43,528	43,019	42,787
Depletion - 2009	86.6%	93.0%	95.9%	97.2%	97.8%
Depletion - 2014	88.2%	94.7%	97.3%	98.4%	98.9%
Depletion - 2019	89.4%	96.0%	98.3%	99.2%	99.7%
Depletion - 2029	91.5%	97.4%	99.0%	99.4%	99.6%
Depletion - 2039	93.6%	98.6%	99.6%	99.8%	99.9%
RY - 2009	210	209	189	178	174
MSY (+1)	289	537	784	1,032	1,284

c) Hit 2005 total (1+) population of 24,117 (90% lower limit) with the future catches.

Statistic	MSYR (1+) (%)				
	1	2	3	4	5
K (1+)	30,782	27,169	25,609	24,964	24,682
Depletion - 2009	76.4%	86.4%	92.0%	94.7%	95.9%
Depletion - 2015	76.1%	86.4%	91.4%	93.6%	94.6%
Depletion - 2021	76.5%	87.1%	91.8%	93.7%	94.7%
Depletion - 2029	76.9%	88.2%	92.4%	94.1%	95.1%
Depletion - 2039	77.4%	89.0%	92.8%	94.5%	95.4%
RY - 2009	204	218	198	182	176
MSY (+1)	185	326	461	599	740

d) Hit 2005 total (1+) population of 24,117 (90% lower limit) without the future catches.

Statistic	MSYR (1+) (%)				
	1	2	3	4	5
K (1+)	30,782	27,169	25,609	24,964	24,682
Depletion - 2009	76.4%	86.4%	92.0%	94.7%	95.9%
Depletion - 2015	78.8%	89.4%	94.7%	96.9%	97.9%
Depletion - 2021	80.7%	91.8%	96.6%	98.5%	99.3%
Depletion - 2029	84.0%	94.6%	98.0%	99.0%	99.3%
Depletion - 2039	87.5%	97.0%	99.2%	99.7%	99.9%
RY - 2009	204	218	198	182	176
MSY (+1)	185	326	461	599	740

Table 7. Depletions of the 'O' stock in 2009, 2014, 2019, 2029 and 2039 for the mature female component for the sensitivity 1 without and with the community based whaling and research catches under the stock scenario B, taking the incidental catch into account.

a) Hit 2005 total (1+) population of 27,360 (best estimate) with the future catches.

Statistic	MSYR (1+) (%)				
	1	2	3	4	5
K (1+)	33,807	30,258	28,783	28,180	27,914
Depletion - 2009	79.2%	88.4%	93.2%	95.4%	96.5%
Depletion - 2015	78.9%	88.3%	92.6%	94.4%	95.2%
Depletion - 2021	79.3%	88.9%	92.8%	94.5%	95.3%
Depletion - 2029	79.8%	89.7%	93.3%	94.8%	95.7%
Depletion - 2039	80.2%	90.4%	93.7%	95.1%	96.0%
RY - 2009	206	215	195	181	175
MSY (+1)	203	363	518	676	837

b) Hit 2005 total (1+) population of 27,360 (best estimate) without the future catches.

Statistic	MSYR (1+) (%)				
	1	2	3	4	5
K (1+)	33,807	30,258	28,783	28,180	27,914
Depletion - 2009	79.2%	88.4%	93.2%	95.4%	96.5%
Depletion - 2015	81.4%	91.0%	95.5%	97.3%	98.2%
Depletion - 2021	83.1%	93.0%	97.1%	98.7%	99.4%
Depletion - 2029	86.1%	95.5%	98.3%	99.1%	99.4%
Depletion - 2039	89.2%	97.5%	99.3%	99.7%	99.9%
RY - 2009	206	215	195	181	175
MSY (+1)	203	363	518	676	837

c) Hit 2005 total (1+) population of 13,868 (90% lower limit) with the future catches.

Statistic	MSYR (1+) (%)				
	1	2	3	4	5
K (1+)	21,680	17,995	15,962	14,972	14,534
Depletion - 2009	61.5%	73.4%	83.0%	89.0%	92.2%
Depletion - 2015	60.6%	73.7%	82.9%	88.0%	90.3%
Depletion - 2021	60.6%	75.1%	84.1%	88.5%	90.6%
Depletion - 2029	60.3%	77.3%	85.9%	89.6%	91.4%
Depletion - 2039	60.1%	79.1%	87.1%	90.3%	92.0%
RY - 2009	188	228	218	196	182
MSY (+1)	130	216	287	359	436

d) Hit 2005 total (1+) population of 13,868 (90% lower limit) without the future catches.

Statistic	MSYR (1+) (%)				
	1	2	3	4	5
K (1+)	21,680	17,995	15,962	14,972	14,534
Depletion - 2009	61.5%	73.4%	83.0%	89.0%	92.2%
Depletion - 2015	64.4%	78.3%	88.0%	93.4%	95.9%
Depletion - 2021	66.7%	82.2%	91.9%	96.5%	98.5%
Depletion - 2029	71.0%	88.0%	95.5%	98.0%	98.8%
Depletion - 2039	76.1%	92.9%	98.2%	99.4%	99.8%
RY - 2009	188	228	218	196	182
MSY (+1)	130	216	287	359	436

Table 8. Depletions of the 'O' stock in 2009, 2014, 2019, 2029 and 2039 for the mature female component for the sensitivity 1 without and with the community based whaling and research catches under the stock scenario B, taking the incidental catch into account.

a) Hit 2005 total (1+) population of 43,049 (best estimate) with the future catches.

Statistic	MSYR (1+) (%)				
	1	2	3	4	5
K (1+)	48,874	45,571	44,316	43,809	43,578
Depletion - 2009	86.8%	93.1%	96.0%	97.2%	97.8%
Depletion - 2015	86.7%	93.0%	95.5%	96.5%	97.0%
Depletion - 2021	87.0%	93.3%	95.6%	96.5%	97.0%
Depletion - 2029	87.4%	93.7%	95.8%	96.7%	97.3%
Depletion - 2039	87.8%	94.1%	96.0%	96.9%	97.4%
RY - 2009	210	208	189	178	174
MSY (+1)	293	547	798	1,051	1,307

b) Hit 2005 total (1+) population of 43,049 (best estimate) without the future catches.

Statistic	MSYR (1+) (%)				
	1	2	3	4	5
K (1+)	48,874	45,571	44,316	43,809	43,578
Depletion - 2009	86.8%	93.1%	96.0%	97.2%	97.8%
Depletion - 2015	88.4%	94.8%	97.3%	98.4%	98.9%
Depletion - 2021	89.7%	96.1%	98.4%	99.2%	99.7%
Depletion - 2029	91.7%	97.4%	99.0%	99.4%	99.6%
Depletion - 2039	93.7%	98.6%	99.6%	99.8%	99.9%
RY - 2009	210	208	189	178	174
MSY (+1)	293	547	798	1,051	1,307

c) Hit 2005 total (1+) population of 24,526 (90% lower limit) with the future catches.

Statistic	MSYR (1+) (%)				
	1	2	3	4	5
K (1+)	31,161	27,556	26,007	25,369	25,089
Depletion - 2009	76.8%	86.7%	92.2%	94.8%	96.0%
Depletion - 2015	76.5%	86.7%	91.6%	93.7%	94.7%
Depletion - 2021	76.8%	87.3%	91.9%	93.8%	94.7%
Depletion - 2029	77.3%	88.4%	92.5%	94.2%	95.2%
Depletion - 2039	77.8%	89.2%	92.9%	94.6%	95.5%
RY - 2009	204	218	197	182	176
MSY (+1)	187	331	468	609	753

d) Hit 2005 total (1+) population of 24,526 (90% lower limit) without the future catches.

Statistic	MSYR (1+) (%)				
	1	2	3	4	5
K (1+)	31,161	27,556	26,007	25,369	25,089
Depletion - 2009	76.8%	86.7%	92.2%	94.8%	96.0%
Depletion - 2015	79.2%	89.7%	94.8%	97.0%	98.0%
Depletion - 2021	81.0%	92.0%	96.6%	98.5%	99.4%
Depletion - 2029	84.3%	94.7%	98.0%	99.0%	99.3%
Depletion - 2039	87.7%	97.1%	99.2%	99.7%	99.9%
RY - 2009	204	218	197	182	176
MSY (+1)	187	331	468	609	753

Table 9. Historical and future incidental catch off Japan for the J stock of minke whales in the North Pacific from 1900 by sex. The numbers of future incidental catches are assumed to be average over 2001 – 2007.

year	male	female
1900-2000	38	50
2001	45	48
2002	41	48
2003	44	59
2004	44	54
2005	45	62
2006	55	68
2007	59	72
2008+	47	59

Table 10. Historical and future incidental catch off Korea for the J stock of minke whales in the North Pacific from 1988 by sex. The numbers of future incidental catches are assumed to be average over 2002 – 2007.

year	male	female
1989	3	8
1990	6	17
1991	9	25
1992	11	33
1993	14	41
1994	17	50
1995	20	58
1996	33	96
1997	20	58
1998	9	36
1999	17	39
2000	20	57
2001	38	110
2002	48	41
2003	60	32
2004	40	29
2005	59	50
2006	53	27
2007	47	33
2008+	51	35

Table 11. Historical and future catches including incidental catches from the J stock by sex.

J stock			J stock (continued)		
year	male	female	year	male	female
1900-1929	38	50	1971	448	517
1930	38	50	1972	464	549
1931	38	50	1973	526	594
1932	38	50	1974	365	427
1933	38	51	1975	386	429
1934	38	50	1976	334	406
1935	38	50	1977	587	650
1936	38	50	1978	580	611
1937	38	50	1979	523	621
1938	38	50	1980	523	525
1939	38	50	1981	444	443
1940	91	92	1982	407	454
1941	134	136	1983	285	302
1942	164	164	1984	241	263
1943	134	136	1985	109	126
1944	127	129	1986	92	79
1945	48	50	1987	41	64
1946	40	57	1988	38	50
1947	40	59	1989	41	58
1948	103	108	1990	44	67
1949	64	91	1991	47	75
1950	72	67	1992	50	83
1951	109	116	1993	52	91
1952	192	124	1994	55	100
1953	171	119	1995	58	108
1954	110	115	1996	78	147
1955	88	113	1997	58	108
1956	119	115	1998	47	86
1957	226	221	1999	55	89
1958	190	249	2000	59	108
1959	204	262	2001	86	158
1960	180	263	2002	97	93
1961	126	206	2003	109	97
1962	147	227	2004	93	85
1963	219	278	2005	118	122
1964	275	313	2006	120	103
1965	197	224	2007	120	116
1966	220	305	2008	114	104
1967	241	328			
1968	234	311	Future catch		
1969	277	357	2009-2013	110	100
1970	437	506	2014+	114	104

Table 12. Depletions of the 'J' stock in 2009, 2014, 2019, 2029 and 2039 for the mature female component for the base case without and with the community based whaling and research catches under the stock scenario B, taking the incidental catch into account.

a) Hit 2004 total (1+) population of 17,651 (best estimate) with the future catches.

Statistic	MSYR (1+) (%)				
	1	2	3	4	5
K (1+)	38,677	31,783	27,273	24,148	21,952
Depletion - 2009	40.7%	48.8%	56.4%	63.4%	69.9%
Depletion - 2014	40.6%	51.1%	60.7%	68.9%	75.3%
Depletion - 2019	40.3%	53.2%	64.6%	73.3%	79.2%
Depletion - 2029	39.9%	57.6%	71.5%	79.7%	83.7%
Depletion - 2039	39.4%	61.9%	76.7%	83.2%	85.6%
RY - 2009	180	300	370	386	362
MSY (+1)	232	381	491	580	659

b) Hit 2004 total (1+) population of 17,651 (best estimate) without the future catches.

Statistic	MSYR (1+) (%)				
	1	2	3	4	5
K (1+)	38,677	31,783	27,273	24,148	21,952
Depletion - 2009	40.7%	48.8%	56.4%	63.4%	69.9%
Depletion - 2014	40.8%	51.3%	60.9%	69.2%	75.7%
Depletion - 2019	40.8%	53.8%	65.2%	74.1%	80.0%
Depletion - 2029	40.9%	58.8%	72.7%	80.9%	84.9%
Depletion - 2039	41.0%	63.6%	78.3%	84.5%	86.8%
RY - 2009	180	300	370	386	362
MSY (+1)	232	381	491	580	659

c) Hit 2004 total (1+) population of 10,096 (90% lower limit) with the future catches.

Statistic	MSYR (1+) (%)				
	1	2	3	4	5
K (1+)	33,117	27,340	23,495	20,732	18,652
Depletion - 2009	25.0%	29.8%	34.1%	38.1%	41.8%
Depletion - 2015	23.8%	30.3%	36.9%	43.3%	49.3%
Depletion - 2021	22.3%	30.8%	39.8%	48.6%	56.7%
Depletion - 2029	19.2%	31.8%	46.4%	59.8%	69.7%
Depletion - 2039	15.6%	33.1%	53.7%	69.5%	77.9%
RY - 2009	120	211	294	362	411
MSY (+1)	199	328	423	498	560

d) Hit 2004 total (1+) population of 10,096 (90% lower limit) without the future catches.

Statistic	MSYR (1+) (%)				
	1	2	3	4	5
K (1+)	33,117	27,340	23,495	20,732	18,652
Depletion - 2009	25.0%	29.8%	34.1%	38.1%	41.8%
Depletion - 2015	24.0%	30.6%	37.2%	43.6%	49.7%
Depletion - 2021	22.9%	31.4%	40.5%	49.5%	57.6%
Depletion - 2029	20.4%	33.3%	48.1%	61.6%	71.4%
Depletion - 2039	17.6%	35.6%	56.3%	71.7%	79.7%
RY - 2009	120	211	294	362	411
MSY (+1)	199	328	423	498	560

Table 13. Depletions of the 'J' stock in 2009, 2014, 2019, 2029 and 2039 for the mature female component for the sensitivity 1 without and with the community based whaling and research catches under the stock scenario B, taking the incidental catch into account.

a) Hit 2004 total (1+) population of 26,979 (best estimate) with the future catches.

Statistic	MSYR (1+) (%)				
	1	2	3	4	5
K (1+)	46,132	38,463	33,824	31,043	29,474
Depletion - 2009	54.1%	64.3%	73.0%	79.7%	84.2%
Depletion - 2015	54.7%	66.9%	76.4%	82.7%	86.5%
Depletion - 2021	55.2%	69.2%	79.1%	84.9%	87.9%
Depletion - 2029	56.2%	73.4%	83.1%	87.4%	89.3%
Depletion - 2039	57.2%	76.8%	85.5%	88.6%	89.9%
RY - 2009	229	340	359	324	280
MSY (+1)	277	462	609	745	884

b) Hit 2004 total (1+) population of 26,979 (best estimate) without the future catches.

Statistic	MSYR (1+) (%)				
	1	2	3	4	5
K (1+)	46,132	38,463	33,824	31,043	29,474
Depletion - 2009	54.1%	64.3%	73.0%	79.7%	84.2%
Depletion - 2015	54.8%	67.1%	76.6%	83.0%	86.7%
Depletion - 2021	55.6%	69.7%	79.6%	85.4%	88.5%
Depletion - 2029	57.0%	74.3%	84.0%	88.3%	90.1%
Depletion - 2039	58.4%	78.0%	86.5%	89.5%	90.7%
RY - 2009	229	340	359	324	280
MSY (+1)	277	462	609	745	884

c) Hit 2004 total (1+) population of 15,787 (90% lower limit) with the future catches.

Statistic	MSYR (1+) (%)				
	1	2	3	4	5
K (1+)	37,263	30,603	26,211	23,118	20,871
Depletion - 2009	37.3%	44.7%	51.6%	58.2%	64.4%
Depletion - 2015	37.0%	46.7%	55.9%	64.0%	70.8%
Depletion - 2021	36.5%	48.6%	59.9%	69.1%	75.7%
Depletion - 2029	35.5%	52.7%	67.3%	76.8%	81.8%
Depletion - 2039	34.5%	56.8%	73.4%	81.3%	84.3%
RY - 2009	167	284	362	394	387
MSY (+1)	224	367	472	555	626

d) Hit 2004 total (1+) population of 15,787 (90% lower limit) without the future catches.

Statistic	MSYR (1+) (%)				
	1	2	3	4	5
K (1+)	37,263	30,603	26,211	23,118	20,871
Depletion - 2009	37.3%	44.7%	51.6%	58.2%	64.4%
Depletion - 2015	37.2%	47.0%	56.1%	64.3%	71.2%
Depletion - 2021	37.0%	49.2%	60.5%	69.8%	76.6%
Depletion - 2029	36.6%	53.9%	68.7%	78.1%	83.0%
Depletion - 2039	36.2%	58.7%	75.1%	82.8%	85.7%
RY - 2009	167	284	362	394	387
MSY (+1)	224	367	472	555	626

Table 14. Depletions of the 'J' stock in 2009, 2014, 2019, 2029 and 2039 for the mature female component for the sensitivity 2 without and with the community based whaling and research catches under the stock scenario B, taking the incidental catch into account.

a) Hit 2004 total (1+) population of 16,858 (best estimate) with the future catches.

Statistic	MSYR (1+) (%)				
	1	2	3	4	5
K (1+)	38,080	31,281	26,816	23,699	21,475
Depletion - 2009	39.3%	47.1%	54.5%	61.3%	67.7%
Depletion - 2015	39.1%	49.3%	58.7%	66.9%	73.6%
Depletion - 2021	38.8%	51.3%	62.7%	71.7%	77.9%
Depletion - 2029	38.1%	55.6%	69.9%	78.6%	83.0%
Depletion - 2039	37.4%	59.9%	75.4%	82.5%	85.1%
RY - 2009	174	293	367	390	372
MSY (+1)	228	375	483	569	644

b) Hit 2004 total (1+) population of 16,858 (best estimate) without the future catches.

Statistic	MSYR (1+) (%)				
	1	2	3	4	5
K (1+)	38,080	31,281	26,816	23,699	21,475
Depletion - 2009	39.3%	47.1%	54.5%	61.3%	67.7%
Depletion - 2015	39.3%	49.5%	59.0%	67.2%	73.9%
Depletion - 2021	39.2%	51.9%	63.4%	72.4%	78.7%
Depletion - 2029	39.1%	56.8%	71.2%	79.8%	84.2%
Depletion - 2039	39.0%	61.7%	77.1%	83.9%	86.3%
RY - 2009	174	293	367	390	372
MSY (+1)	228	375	483	569	644

c) Hit 2004 total (1+) population of 10,096 (90% lower limit) with the future catches.

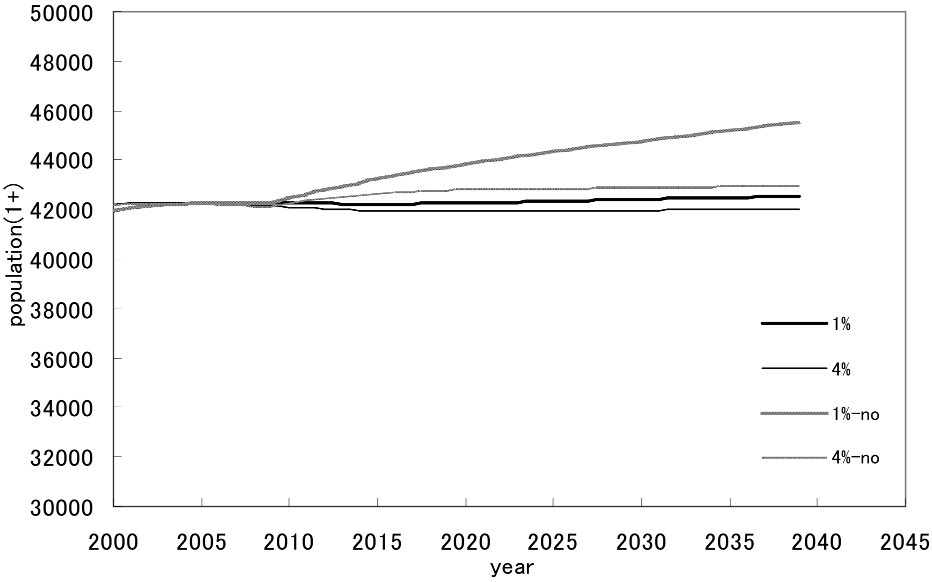
Statistic	MSYR (1+) (%)				
	1	2	3	4	5
K (1+)	32,773	27,082	23,294	20,572	18,520
Depletion - 2009	23.8%	28.3%	32.4%	36.1%	39.6%
Depletion - 2015	22.5%	28.7%	34.9%	41.0%	46.8%
Depletion - 2021	20.9%	28.9%	37.6%	46.2%	54.2%
Depletion - 2029	17.5%	29.5%	43.8%	57.4%	67.8%
Depletion - 2039	13.7%	30.3%	50.8%	67.5%	76.8%
RY - 2009	115	203	284	353	406
MSY (+1)	197	325	419	494	556

d) Hit 2004 total (1+) population of 10,096 (90% lower limit) without the future catches.

Statistic	MSYR (1+) (%)				
	1	2	3	4	5
K (1+)	32,773	27,082	23,294	20,572	18,520
Depletion - 2009	23.8%	28.3%	32.4%	36.1%	39.6%
Depletion - 2015	22.7%	29.0%	35.2%	41.4%	47.2%
Depletion - 2021	21.5%	29.6%	38.3%	47.1%	55.2%
Depletion - 2029	18.8%	31.1%	45.5%	59.2%	69.6%
Depletion - 2039	15.7%	32.9%	53.5%	69.8%	78.7%
RY - 2009	115	203	284	353	406
MSY (+1)	197	325	419	494	556

Fig. 1. Population trajectories of the O stock without and with the future catches under the community based whaling and JARPN II for base case.

a) Hit 2005 total (1+) population of 42,257 (best estimate) without and with the future catches for *MSYR*(1+)=1% and 4%



b) Hit 2005 total (1+) population of 24,117 (90% lower limit) without and with the future catches for *MSYR*(1+)=1% and 4%

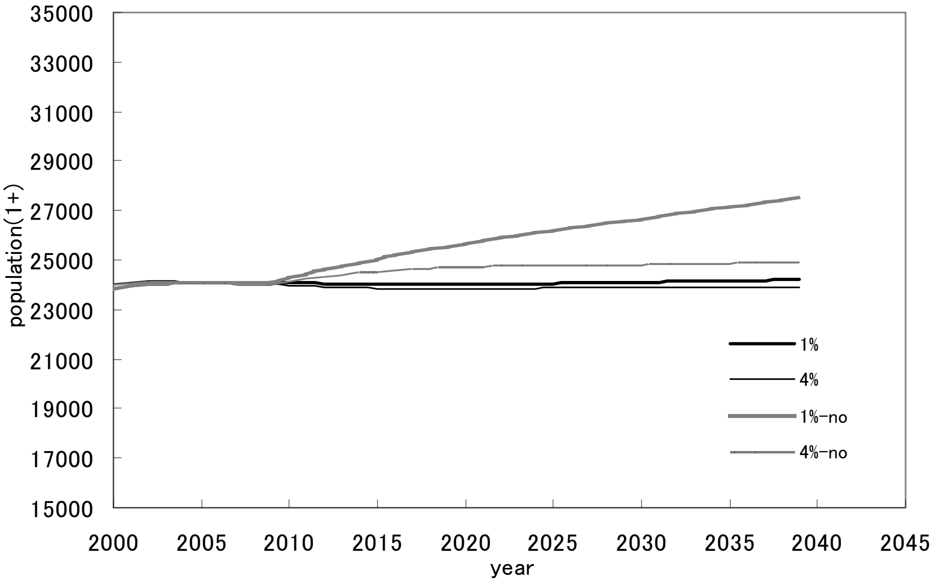
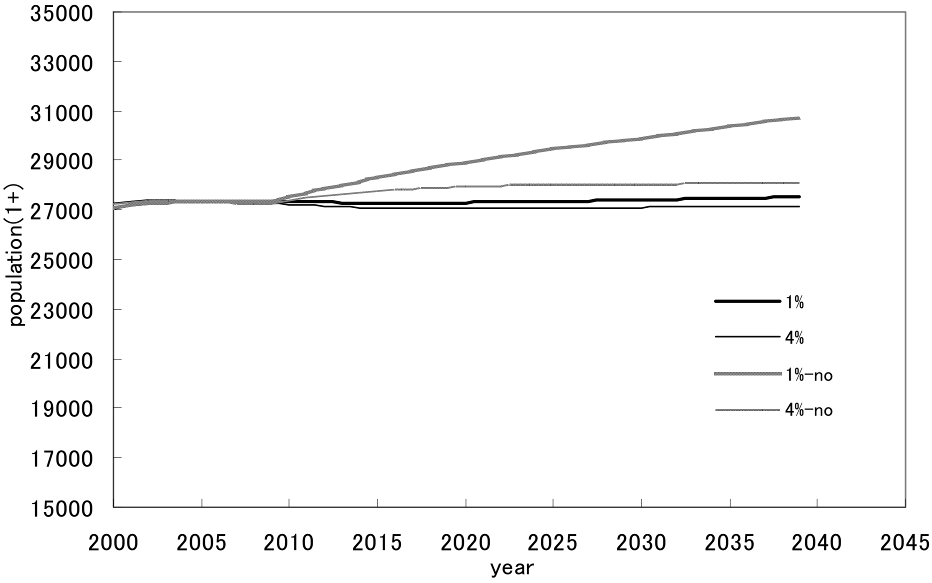


Fig. 2 Population trajectories of the O stock without and with the future catches under the community based whaling and JARPN II for sensitivity 1.

a) Hit 2005 total (1+) population of 27,360 (best estimate) without and with the future catches for *MSYR*(1+)=1% and 4%



b) Hit 2005 total (1+) population of 13,868 (90% lower limit) without and with the future catches for *MSYR*(1+)=1% and 4%

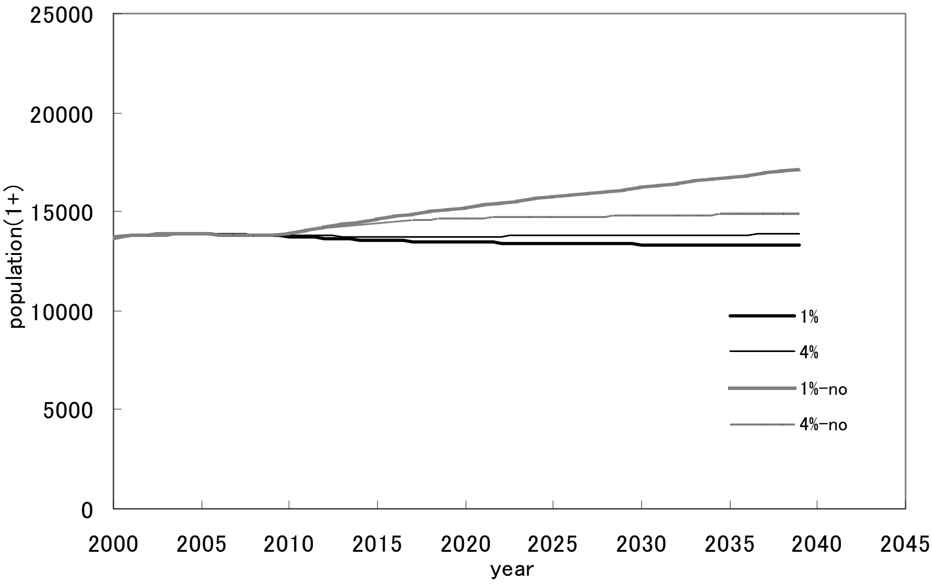
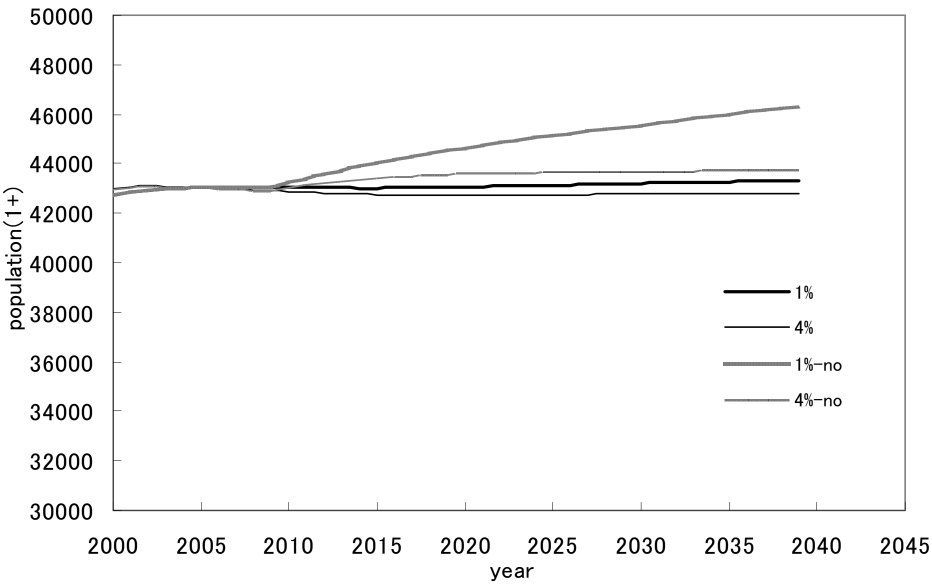
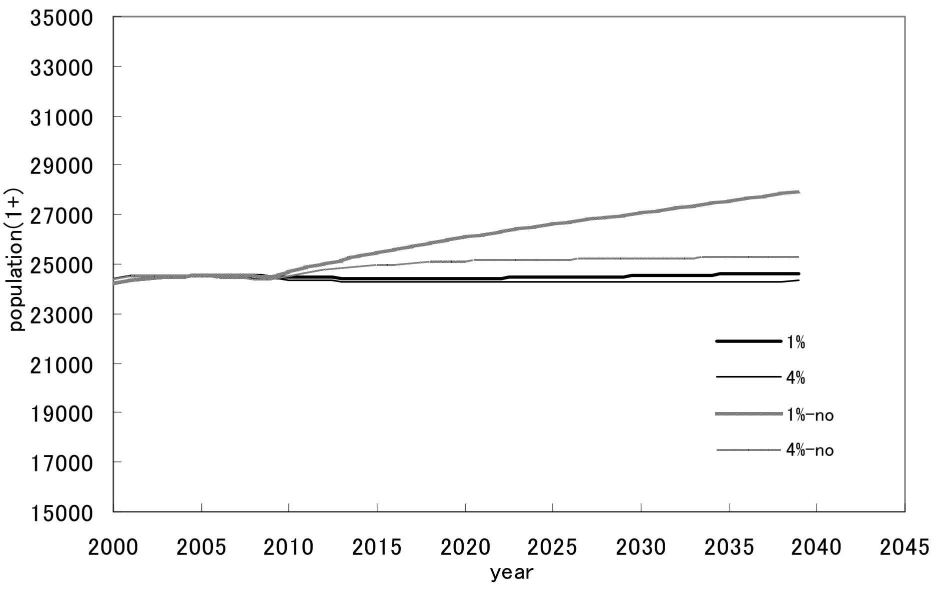


Fig. 3 Population trajectories of the O stock without and with the future catches under the community based whaling and JARPN II for sensitivity 2.

a) Hit 2005 total (1+) population of 43,049 (best estimate) without and with the future catches for *MSYR*(1+)=1% and 4%



b) Hit 2005 total (1+) population of 24,526 (90% lower limit) without and with the future catches for *MSYR*(1+)=1% and 4%



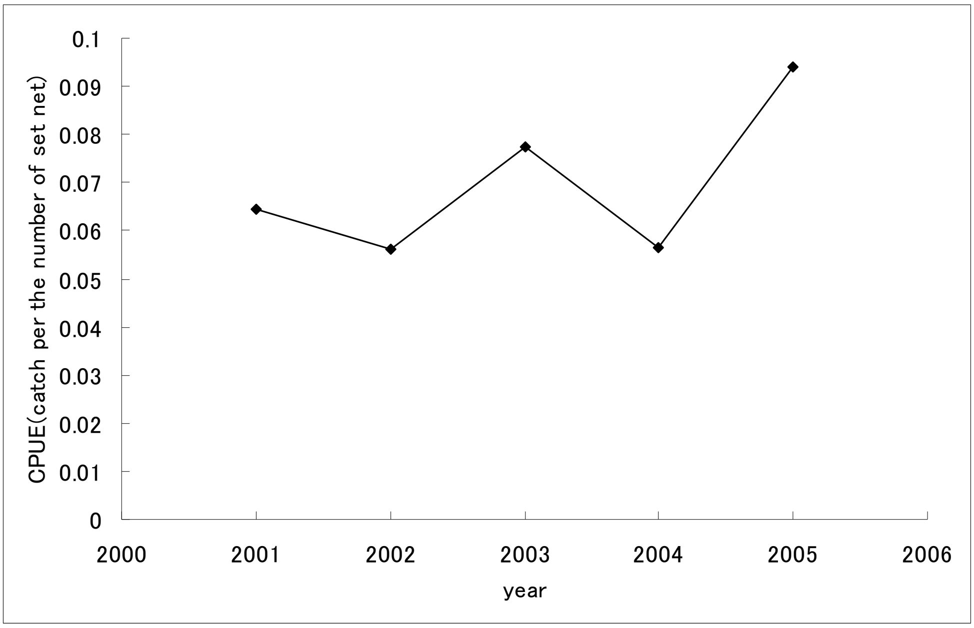
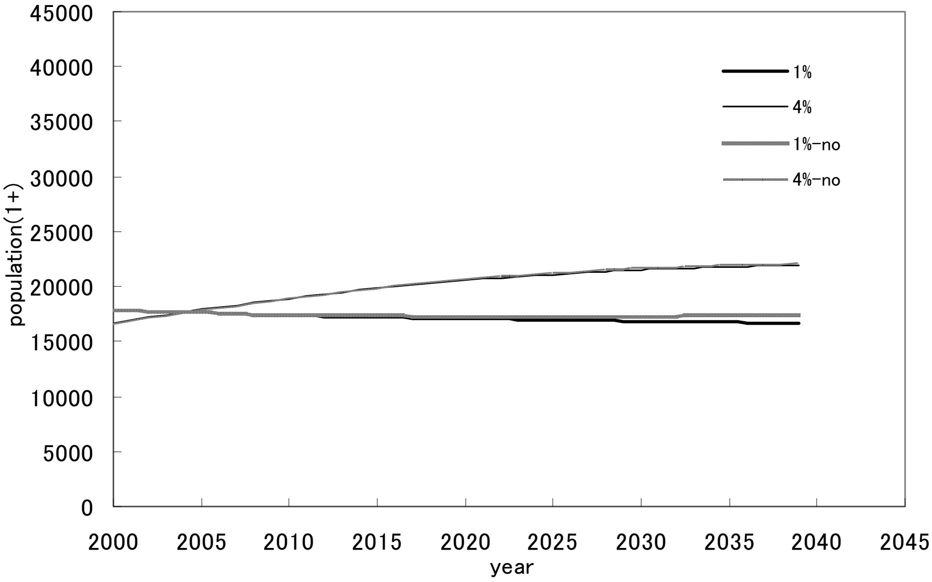


Fig. 4 The number of incidental catch per the number of the 'large-size' and 'salmon' set net in the period 2001-2005.

Fig. 5. Population trajectories of the J stock without and with the future catches under the community based whaling and JARPN II for base case.

a) Hit 2004 total (1+) population of 17,651 (best estimate) without and with the future catches for *MSYR*(1+)=1% and 4%



b) Hit 2004 total (1+) population of 10,096 (90% lower limit) without and with the future catches for *MSYR*(1+)=1% and 4%

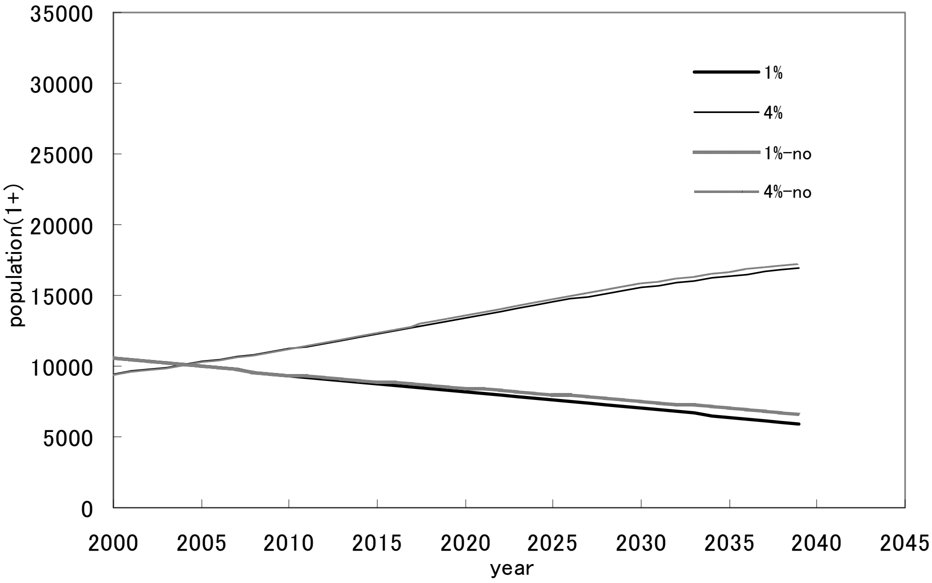
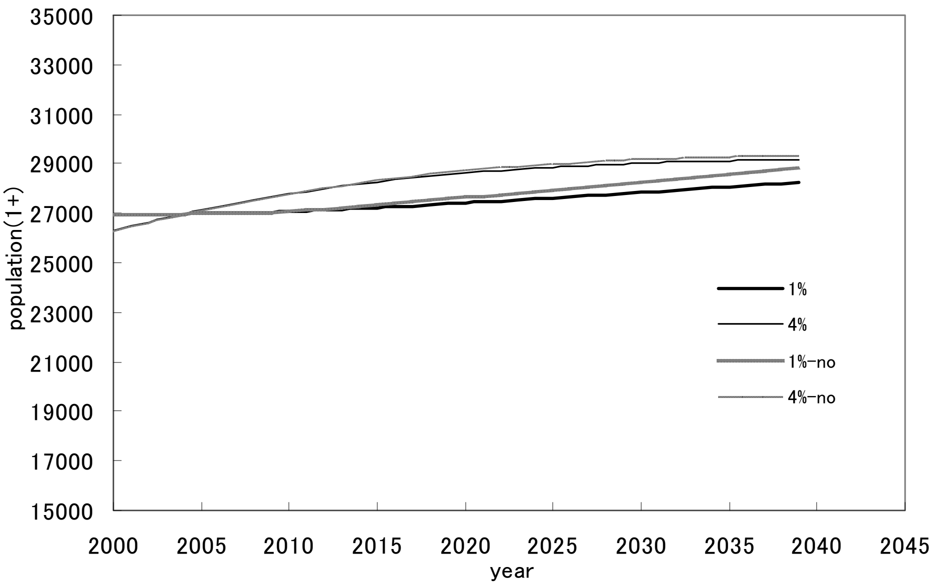


Fig. 6 Population trajectories of the J stock without and with the future catches under the community based whaling and JARPN II for sensitivity 1.

a) Hit 2004 total (1+) population of 26,979 (best estimate) without and with the future catches for *MSYR*(1+)=1% and 4%



b) Hit 2004 total (1+) population of 15,787 (90% lower limit) without and with the future catches for *MSYR*(1+)=1% and 4%

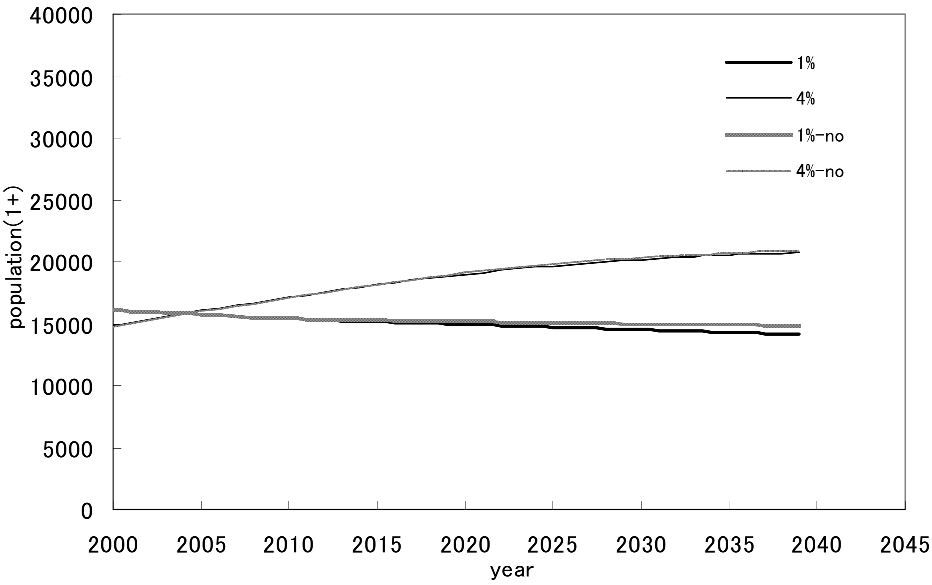
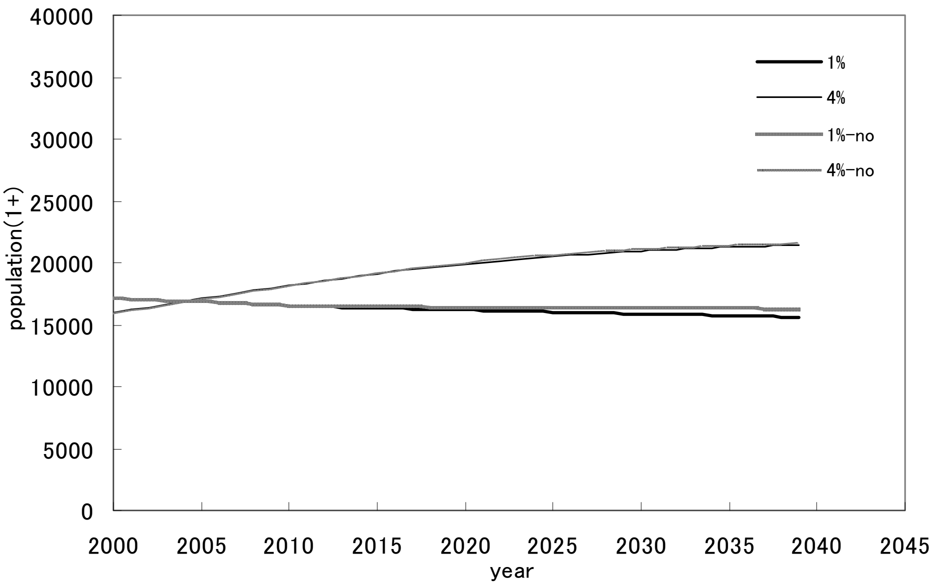
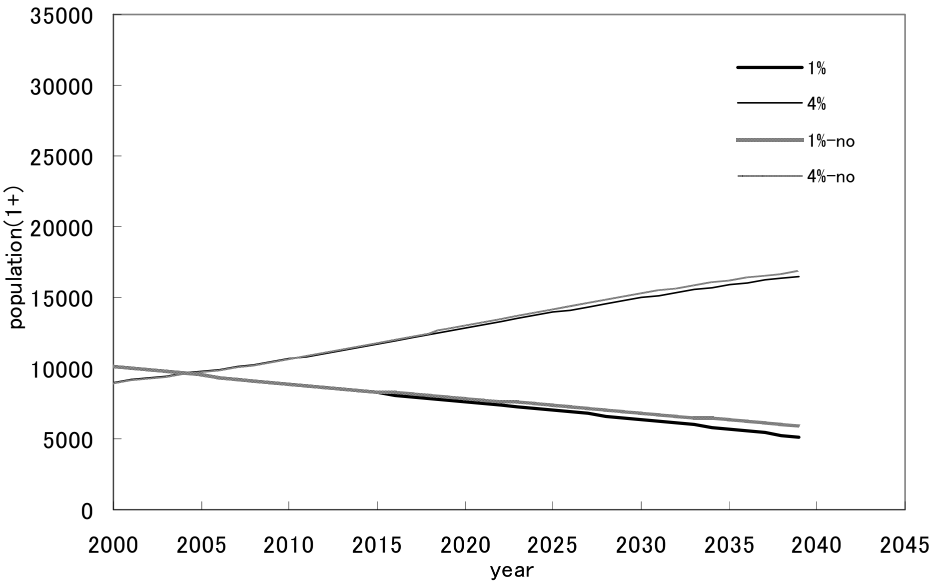


Fig. 7 Population trajectories of the J stock without and with the future catches under the community based whaling and JARPN II for sensitivity 2.

a) Hit 2004 total (1+) population of 16,858 (best estimate) without and with the future catches for *MSYR*(1+)=1% and 4%



b) Hit 2004 total (1+) population of 9,606 (90% lower limit) without and with the future catches for *MSYR*(1+)=1% and 4%



Appendix I

Genetic stock structure of common minke whales from the SA7 to SA9

Mutsuo Goto and Naohisa Kanda

Institute of Cetacean Research, 4-5 Toyomi-cho, Chuo-ku, Tokyo, 104-0005 Japan

Common minke whales, *Balaenoptera acutorostrata*, are the smallest and the most abundant baleen whale species inhabiting major open oceans world-wide with spatial and temporal separations among populations, and around the ocean off the Japanese coast, at least two different stocks of common minke whales are known to exist: one stock is distributed in the western North Pacific and the other in the Sea of Japan (Pastene *et al*., 2007).

The IWC Scientific Committee (SC) completed the RMP *Implementation* for the western North Pacific common minke whales during the 2003 Annual Meeting. At the final stage of the *Implementation* process, the SC adopted the following stock scenarios in the western North Pacific (IWC, 2004).

(1) Baseline A: three-stock scenario (J, O, W) with the W stock found only in part of sub-area 9 and only sporadically.
(2) Baseline B: two stock scenario (J and O) with no W stock as a limiting case of Baseline A.
(3) Baseline C : four-stock scenario overall, with O_W, O_E and W to the east of Japan. Boundaries are fixed at 147°E and 157°E and there is no mixing between the stocks.
(4) Baseline D ： three-stock scenario (J, O, W), with O and W mixing over 147°E and 162°E, O being dominant to the west and W to the east.

The SC did not examine the plausibility of each baseline scenario because it was afraid that any conclusions would not have been accepted by all. Consequently, the SC rated all of the scenarios the same 'high' plausibility.

The genetic studies looking at the genetic variation at control region of the mitochondrial DNA and nuclear microsatellite loci have examined the plausibility of these four stock baseline scenarios by analyzing samples of common minke whales collected during JARPNII as well as JARPN conducted from 1994 to 2007 (Goto *et al*. 2009; Kanda *et al*. 2009b).

MATERIALS AND METHODS

Common minke whales samples used were collected from the JARPN and JARPNII offshore component surveys conducted in the SA 7 to 9 from 1994 to 2007 and the JARPNII coastal component survey conducted at Sanriku (spring of 2003, 2005, 2006, and 2007) and Kushiro (fall of 2002, 2004, 2005, 2006, and 2007) from 2002 to 2007. Eighteen sub-areas were set for management purpose of the western North Pacific common minke whale during the *Implementation* Specification conducted in 2003, and sub-areas 7, 8, and 9 were further divided into western and eastern strata for analyses, respectively: 7W (140.01°E -147.00°E), 7E (147.01°E -150.00°E), 8W (150.01°E -153.00°E), 8E (153.01°E -157.00°E), 9W (157.01°E -162.00°E), and 9E (162.01°E -170.00°E). Table 1 shows the number of individuals used in the present microsatellite analysis by year, sub-area and the offshore/coastal components, and Fig. 1 shows sighting positions of the collected individuals.

Genetic variation at 487bp of the control region sequences of mtDNA and 16 microsatellite loci was analyzed. Conventional hypothesis testing procedure was conducted using heterogeneity test in mtDNA haplotype and microsatellite allele frequencies among the samples, respectively. Our null hypothesis to be tested is that the samples came from a genetically same group of minke whales. If a statistically significant allele frequencies differences exist, then it could indicate these samples came from genetically different stocks of minke whales. Details of the laboratory procedures and data analysis can be found in Goto *et al*. (2009) and Kanda *et al*. (2009b).

RESULTS AND DISCUSSION

The genetic studies (Goto *et al*. 2009; Kanda *et al*. 2009b) substantially improved our knowledge of the stock structure of minke whales in the western North Pacific and were quite informative for effective management of this species. An additional 923 minke whales were collected after the 2003 *Implementation* process and used for the current study, and our samples spatially covered the survey areas quite well as shown in the Fig. 1. These facts allowed us to look for evidence of distribution of the individuals from the J and W stocks, if they exist, in our survey area.

Examination was undertaken to determine if there was any evidence of genetic differences between the coastal and offshore samples collected in the same year from the 7W, among the samples collected in the different years from the same sub-area, and among the samples divided and compared on the basis of proposed stock divisions from each of the four baseline scenarios. The SC has recommended that the suspected J stock individuals should be excluded from the analyses of the North Pacific minke whales because they could have large effects on the analyses. We thus conducted heterogeneity tests with three different kinds of sample groups: 1) one that included all the analyzed individuals, 2) one that excluded the suspected J stock individuals (samples contained individuals of unknown origin and the O stock) and 3) one that used only the suspected O stock individuals (samples excluded individuals of unknown origin and the J stock). Individual genetic identification was according to Kanda *et al*. (2009a).

Statistical significance was found in the heterogeneity test between the 7W and other offshore (east of 7E) samples, but it disappeared when the suspected J stock individuals were excluded from the samples. The heterogeneity caused by the SA9 samples, but it was not clear enough to convince the existence of the W stock. The genetic studies thus showed 1) whales from the J stock existed in the 7W with low but large enough number to cause genetic heterogeneity observed in the 7W samples as well as between the 7W and other samples, 2) except the J stock whales, the survey area was mainly occupied by O stock, 3) the baselines C and D were not supported because no other genetically distinct stock was observed in the survey area, and 4) We should await results from more detailed genetic analysis (e.g., look for the pair of individuals that are related), from other independent studies conducted on the same samples (e.g., morphometric study) as well as from continued monitoring of minke whales migrating to the SA9 in order to better understand migration pattern of the W stock under the baseline A.

Following same recommendations for the JARPN II Review workshop an update of the genetic analyses were conducted and results are presented in Documents SC/61/JR5, SC/61/JR7 and SC/61/JR8 in this meeting. Results of those additional analyses were consistent with those presented to the JARPN II Review workshop.

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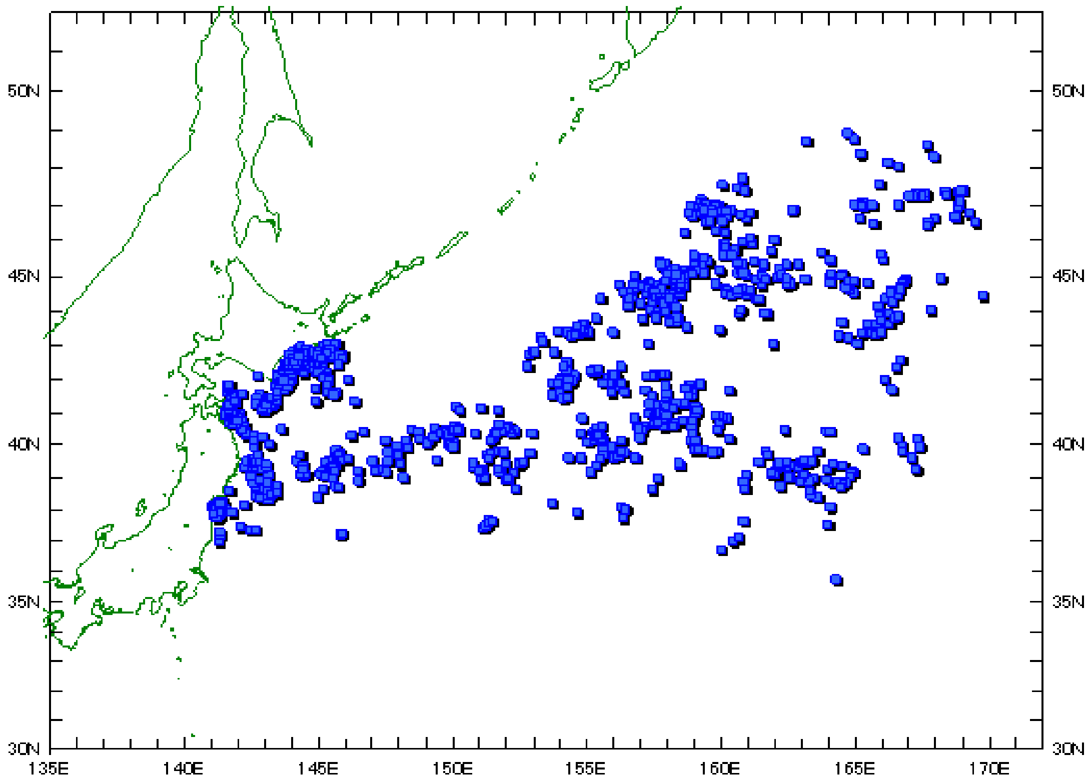

Fig. 1. Locations of the collected minke whales during the JARPN and JARPNII surveys. Both the offshore and coastal component samples are included.

Table 1. Samples used for the microsatellite analyses.

	Survey area							
	Coastal	Offshore						
Year	7W	7W	7E	8W	8E	9W	9E	Total
1994						7	14	21
1995						78	22	100
1996		31		1	15			47
1997		2		1	30	19	48	100
1998		25	31	44				100
1999		50						50
2000		24				16		40
2001		43	7		21	29		100
2002	50	60			8	32		150
2003	50	17	7	21	17	24	14	150
2004	58	15				42	41	156
2005	120	32		7	7	19	30	215
2006	95	36	2	10	28	23	1	195
2007	107	79		2	13	2	4	207
Total	480	414	47	86	139	291	174	1631

Appendix II

An Assessment of Plausibility of Sub-Stock Scenarios on Western North Pacific Minke Whales Using the Historical CPUE series

Hiroshi Okamura
National Research Institute of Far Seas Fisheries
2-12-4 Fukuura, Kanazawa-ku, Yokohama-shi, Kanagawa 236-8648, Japan
Contact email: okamura@fra.affrc.go.jp

ABSTRACT

The aim of this article is to investigate the plausibility of different stock structure scenarios on western North Pacific minke whales proposed in *Implementation Simulation Trials* (*IST*) of *Revised Management Procedure* (RMP). To provide an independent assessment of the plausibility, we used CPUE time series data, which were not used in *IST*. Using a simple Bayesian population dynamics model, we showed that the posterior confidence interval (CI) of the depletion rate contained that of initial depletion statistics of Stock Scenario A wholly. On the other hand, the confidence intervals of Stock Scenarios C and D were not included in the CI derived from the model. As a result, we conclude that the plausibility of Stock Scenarios C and D is much lower than that of Stock Scenario A on the assumption that CPUE is proportional to population abundance. The conclusion is supported even under square root nonlinearity of the relationship between CPUE and abundance.

1. INTRODUCTION

Implementation Simulation Trials (*IST*) of western North Pacific minke whales have four 'baseline' trials based on different stock structure scenarios, in which Baselines A and B have fewer stocks or simpler stock structure than Baselines C and D. Baseline A is the scenario with three stocks, J, O, and W, in which W-stock occurs sporadically in sub-area 9. Baseline A was derived from analysis of mt-DNA data by Japanese scientists. Baseline B is the same as Baseline A with no W-stock. Baseline C is the scenario with four stocks, J, Ow, Oe, and W, where the existence of Ow and Oe stocks was inferred by the boundary rank method. Baseline D is the scenario with three stocks, J, O, and W, where O and W-stocks are mixing among the whole sub-areas of western North Pacific. We hereafter refer to the stock structure scenario associated with each Baseline as 'Hypothesis'. See the details on pages 118-119 of JCRM 6 (Supplement) (IWC, 2004).

Hypotheses C and D predict the considerable decline of O or Ow stock in terms of initial depletion statistics of *IST* (IWC, 2004). For example, in the Cl-Jl O trial, the 90% confidence interval of initial depletion is [0.25, 0.42] with the median value, 0.33. Kawahara (2003) pointed out that plausibility of Hypotheses C and D was lower than that of Hypotheses A and B using the historical catch per unit effort (CPUE) time series data, which were not used in *IST* and the result therefore was an assessment of plausibility of the different stock structure hypotheses independent from *IST*. In this article, we provide a more refined assessment of the CPUE time series data, especially in terms of statistical inference.

2. MATERIALS AND METHODS

2.1. The Data

Basic datasets are same as Kawahara (2003). Although Kawahara (2003) showed main results using the uncorrected CPUE time series data, we use the CPUE time series data with the effort data corrected for vessel tonnage effects. The corrected effort might overcompensate for the changes in efficiency (Kawahara, 2003). However, for our purpose, overcompensation is less problematic than undercompensation.

As in Kawahara (2003), we use the CPUE series from three periods 1955-1964 (Period 1), 1968-1977 (Period 2), and 1977-1987 (Period 3). Periods 1 and 2 series were corrected for the total vessel tonnage while Period 3 series was not corrected. Because there was no big change in the vessel tonnage between 1977 and 1987, this may be not so much problematic. We use three CPUE time series with Areas 3, 4, and 7 data derived from Anderson and Weaver (1991) as the independent time series data of Period 3. The plots of the CPUE time series data for each Period are shown in Fig. 1.

2.2. Model

A state-space model enables us to deal with natural variability underlying the annual population dynamics transitions (process error) and uncertainty in the observed abundance indices due to measurement and sampling error (observation error) distinguishably (Meyer and Millar, 1999). We use a state-space model to incorporate the intrinsic uncertainty as much as we can appropriately.

For the state equation, we use a population dynamics model with a simple exponential increasing rate:

$$N_{t+1} = N_t \exp(\lambda_t)$$

where $\lambda_t \sim N(\bar{\lambda}, \tau^2)$, in which $\bar{\lambda}$ is the mean increasing rate of population. It is possible to avoid making any extra assumptions using the simple model like this.

The observation equations are given by

$$I_{i,a,t} = q_t N_t \exp(\sigma_{i,a,t})$$

where q_i is the fishing efficiency of Period i, a denotes the corresponding area (a = 3,4,7 for Period 3. If Period is 1 or 2, a is omitted), and $\sigma_{i,a,t} \sim N(0, \nu_{i,a}^2)$

We use a Bayesian approach to infer parameters because the Bayesian approach can easily handle nonlinearities of state and observation equations and realistic distributional assumption of each parameter (Meyer and Millar, 1999).

As prior distributions of each parameter, we use the following ones:

$\log(N_{1955}) \sim U(8,11)$ (This corresponds to $N_{1955} \in [3{,}000, 60{,}000]$),
$\bar{\lambda} \sim N(0,10^6)$,
$\log(q_i) \sim U(-20,20)$,
$1/\nu^2_{i,a} \sim Ga(0.001,0.001)$,
$1/\tau^2 \sim Ga(0.001,0.001)$,

where we use approximately noninformative priors for the parameters except for $\log(N_{1955})$ and uniform distributions for the logarithms of scale parameters according to the custom of Bayesian population dynamics models (Punt and

Hilborn, 1997; McAllister and Kirkwood, 1998). For log(N_{1955}), we use a mildly informative prior distribution to stabilize estimation. The informative prior is set within 3,000 to 60,000 with reference to the existing information (IWC, 2004; Butterworth, 1996; Hakamada, 2004). Note nevertheless that as there is no scale information input to these analyses, because all the CPUE series are treated as relative indices and there are no catches or survey estimates of abundance used, the specific choice of the prior for log(N_{1955}) will hardly affect results.

The inference is carried out using WinBUGS (Spiegelhalter *et al*, 2003), which produces the posterior samples using the Gibbs sampler (Gelfand and Smith, 1990). We use the 5 MCMC sequences with different initial parameter values to diagnose the convergence and the MCMC simulation for each sequence is repeated 35,000 times. We remove the first 5,000 iterations as the burn-in samples.

The posterior distribution of depletion $D_{2000} = N_{2000}/ N_{1955}$ is compared with the initial depletion statistics of *IST*. We use N_{1955} as the initial population size, while *IST* used the catch statistics prior to 1955. However, the catches prior to 1955 would have made little impact on the population abundance, so the comparison would not be much affected by the model not covering the pre-1955 period, as is evident from inspection of *IST* trajectories shown in IWC (2004). We use the results of O trials with $MSYR_{\text{mature}}$ = 1% for comparison, since they are one of Basecase trials of North Pacific minke whales *IST* and have a big impact on the performance statistics for the O stock (IWC, 2004).In addition, we carry out two sensitivity tests, where one is done by removing the Period 1 CPUE dataset, which is considered the least reliable among three periods, and another is done by assuming the CPUE time series is proportional to the square root of population size to take into account the case that the changes in CPUE are proportionally smaller than changes in abundance. We call the former test the 'DR' trial, and the latter test the 'NP' trial (DR = Data Reduction, NP = Non-Proportionality).

3. RESULTS

The trace plots of each parameters indicated the convergence and the $\hat{R}$ statistics of all the parameters was less than 1.1. When $\hat{R}$ is near 1, we can generally think that the analysis is acceptable in terms of convergence of MCMC simulations (Gelman *et al*., 2004). We repeated the analyses with different initial values several times so that we got almost identical results from every run. We therefore judged that we had the converged posterior samples.

The estimated population trend $\bar{\lambda}$ was 0.01 at the median value (90% posterior confidence interval [-0.016, 0.031]). The depletion D_{2000} was estimated to be 1.56 at the median value (90% CI [0.56, 3.31]). The observation errors $\nu_{i,a}$s were within 0.13 and 0.24 and the process error was 0.05 at the median. The summary of estimated main parameters was given in Table 1.

The plots of depletion D_{2000} were shown in Fig. 2 with trajectories of 5%-ile, 25%-ile, and 50%-ile. For comparison, we attached the confidence intervals of initial depletion statistics in the Jl O trials with $MSYR_{\text{mat}}$ = 1% of Hypotheses A, C, and D (IWC, 2004). The 90% confidence intervals of Jl O trials with $MSYR_{\text{mat}}$ = 1% were [0.70, 0.83], [0.25, 0.42], and [0.29, 0.47] for Hypotheses A, C and D, respectively (IWC, 2004). Because the result of Hypothesis B was omitted in *IST* in 2003, we do not mention the result of Hypothesis B. However, as Hypothesis B involves only one stock to the east of Japan, its results will be more optimistic than even those for Hypothesis A. The confidence interval of initial depletion of Hypothesis A was included in the 90% confidence interval of depletion -D_{2000}, while those of Hypotheses C and D were not included in it. It is worth while mentioning that if the full range of C and D robustness trials is considered, only in a very few cases is there slight overlap with 90% confidence interval for depletion $D_{2000.}$

The summary statistics of sensitivity tests was given in Table 2. We can see that the lower limits of depletion of each sensitivity test declined to some extent. The plots from the sensitivity tests were shown in Figs. 3 ('DR' trial) and 4 ('NP' trial). The lower limits of trajectories in two plots were similar. The confidence interval of initial depletion of Hypothesis A was within the confidence intervals of depletion $D_{2000.}$ On the other hand, the lower limits of confidence intervals of depletion D_{2000} slightly overlapped with the upper limits of initial depletion statistics of Hypotheses C and D, while most values of initial depletion statistics of Hypotheses C and D, which included the median values, were still outside the confidence intervals of depletion $D_{2000.}$

4. DISCUSSION

Historically, there was a lot of discussion on the proportional relationship between CPUE and population size in fisheries circles including the International Whaling Commission (Cooke, 1985; IWC, 1989a). We also have to acknowledge our analysis to be of an initial nature. However, we believe that the CPUE series could give us valuable information on the status of stocks if we are sufficiently cautious about uncertainty of relationship between CPUE and stock size.

Cooke (1985) pointed out that proportionality between CPUE and population abundance did not hold giving a number of reasons, mainly on the theoretical basis. Some hold true for North Pacific minke whales but some do not. North Pacific minke whales are very difficult to detect and most of sightings are composed of a single animal. The former may cause variations in catchability and handling time so that CPUE is not proportional to stock size, while the latter removes some important impacts such as schooling effects. We incorporated observation and process errors into our model to deal with uncertainty as reasonably as we can. In addition, we carried out the sensitivity test in which CPUE is proportional to the square root of abundance. Although there is a degree of arbitrariness in choosing the square root dependence for the sensitivity test, it is worth noting that when CPUE data were included in the early RMP trials (IWC, 1989b), this was the alternative to linear proportionality chosen to be considered by the Scientific Committee, and further that Rose and Kulka (1999) showed that CPUE of northern cod, which might have been considerably hyperstable because of shoaling effects, was approximately proportional to the square root of local density.

We made efforts as many as we can at present to take account of uncertainty. For example, the use of corrected CPUE time series, incorporating observation and process errors, and carrying out a few sensitivity tests. Nevertheless, our analyses gave the impression that the stock decline of Hypotheses C and D is too extreme to be realistic. In addition, we used the exponential trend in our analysis to continue until 2000, whereas in reality catches were reduced substantially after 1987 because of the moratorium of commercial whaling, so that any negative trend the model caused from 1988 to 2000 may well have been overestimated by our approach which used the data up until 1987 only. So, our approach is likely to overestimate the extent of population decline. As a result, we conclude that the plausibility of Hypotheses C and D is much lower than that of Hypothesis A and hence it is unnecessary to consider stock scenarios C and D when accounting for the effect of catches on the O stock.

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Table 1. The 5%-ile, 25%-ile, and 50%-ile of posterior distribution of $\bar{\lambda}$ and D_{2000} under the basecase trial

	5%-ile	25%-ile	50%-ile
$\bar{\lambda}$	-0.016	0.001	0.010
D_{2000}	0.556	1.086	1.563

Table 2. The 5%-ile, 25%-ile, and 50%-ile of posterior distribution of $\bar{\lambda}$ andD_{2000} under the 'DR' trial

	5%-ile	25%-ile	50%-ile
$\bar{\lambda}$	-0.027	-0.004	0.010
D_{2000}	0.405	0. 891	1.538

Table 3. The 5%-ile, 25%-ile, and 50%-ile of posterior distribution of $\bar{\lambda}$ and D_{2000} under the 'NP' trial

	5%-ile	25%-ile	50%-ile
$\bar{\lambda}$	-0.028	0.001	0.018
D_{2000}	0.411	1.165	2.320

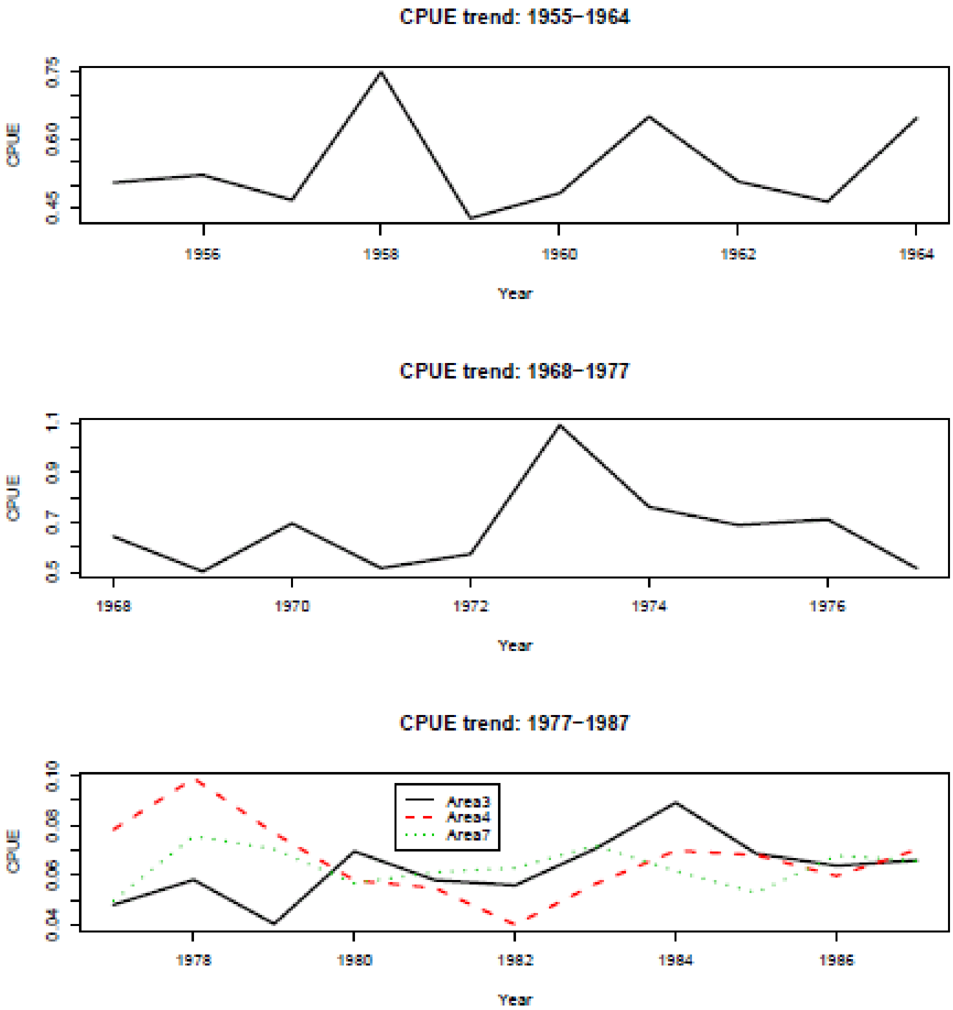

Figure 1. The CPUE time series data corrected for vessel tonnage effects used in the analysis.

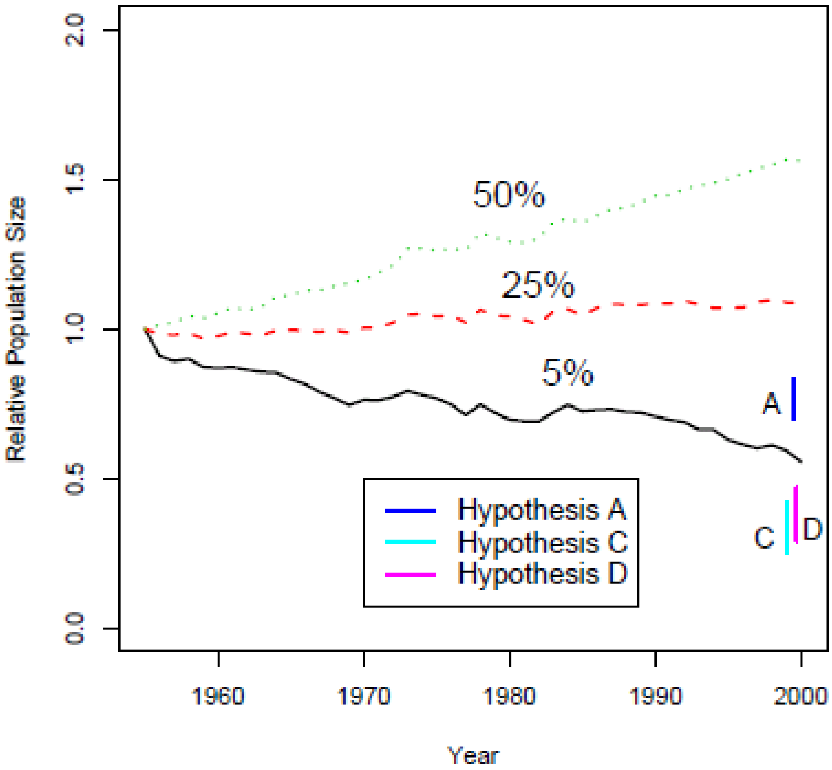

Figure 2. Comparison between 90% CIs of the depletion from the analysis in this article and initial depletion statistics under the Basecase trial for $MSYR_{mat} = 1\%$.

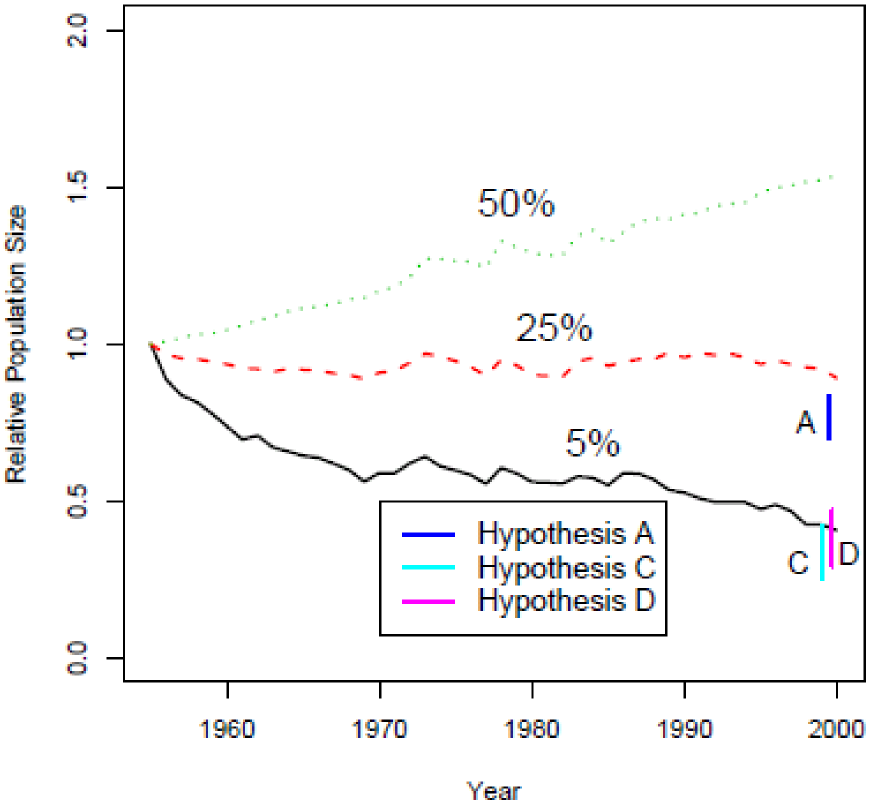

Figure 3. Comparison between 90% CIs of the depletion from the analysis in this article and initial depletion statistics under the 'DR' trial for $MSYR_{mat}$ = 1%.

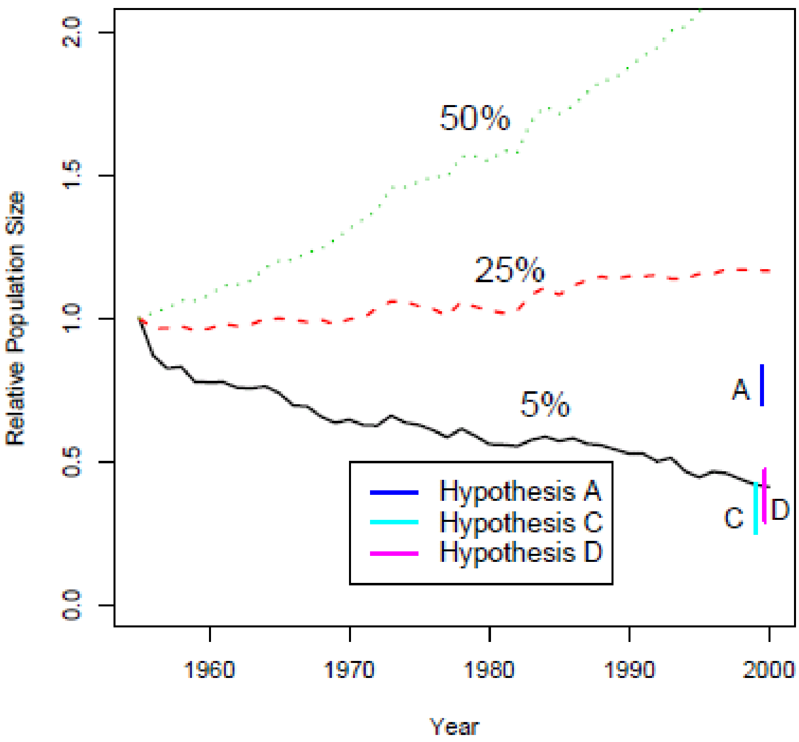

Figure 4. Comparison between 90% CIs of the depletion from the analysis in this article and initial depletion statistics under the 'NP' trial for $MSYR_{mat}$ = 1%.

Appendix III

Genetic basis for limiting whaling operations on O stock common minke whales to waters 10 nautical miles or more from the Japanese Pacific coast

Mutsuo Goto and Naohisa Kanda

Institute of Cetacean Research, 4-5 Toyomi-cho, Chuo-ku, Tokyo, 104-0005 Japan

The mixing proportion of the J-stock common minke whales in the sub-area 7 was investigated using mitochondrial DNA (mtDNA) data obtained from samples of common minke whales from different sources: past coastal commercial whaling, coastal and offshore surveys of JARPN and JARPN II and by-catches. In addition to that, the proportion of the J stock individuals identified using the microsatellite analysis (Kanda *et al*., 2009) was also presented. This analysis was made to restrict the area of operation of future whaling on the O stock in order to minimize the catch of J-stock animals.

MATERIALS AND METHODS

mtDNA

Based on mitochondrial DNA (mtDNA) haplotype frequency data, the mixing proportion of the J stock in the sub-area 7W was estimated for the samples from past coastal commercial whaling from 1983 to 1987 (n=141), coastal and offshore surveys of JARPN and JARPNII from 1996 to 2007 (n=690) and by-catches from 2001 to 2007(n=186). In these estimations, the haplotype composition of samples from Japanese by-catches in sub-area 6 (Sea of Japan) (n=362) during 2001 to 2007 and that of samples from the sub-areas 8 and 9 taken in JARPN and JARPNII surveys (n=690) between 1994 and 2007 were used as representative samples of J and O stocks, respectively. The mixing proportion was estimated using a Bayesian approach (Punt, 2003), which was previously employed during the *Implementation Simulation Trials* (IST) for North Pacific common minke whales and included estimation of the standard deviations.

microsatellite

Microsatellite polymorphisms were analyzed using 16 sets of primers in order to obtain genotypic data from coastal and offshore surveys of JARPN and JARPNII from 1994 to 2007 (n=1711) and by-catches from 2001 to 2007(n=831). The Bayesian clustering approach implemented in the computer program STRUCTURE version 2.0 (Pritchard *et al*., 2000) was used to determine the most likely number of genetically distinct stocks present in our samples. The simulation results then indicated that our samples most likely came from two genetically distinct groups of minke whales. On the basis of the simulation results, we divided the individuals into the two groups and the sampling location information of the individuals indicated that these two groups were the J and O stock, respectively, allowing us to identify origins of the individuals in our samples. See Kanda *et al*., (2009) for more details. In this appendix III, we used the individuals of the JARPN and JARPNII surveys and the bycatches collected from the 7W that were identified as coming from the J and O stock to determine the proportion of the J stock individuals by the distance from coastal line.

RESULTS AND DISCUSSION

Both of the genetic analyses showed very similar results (Table 1). The proportion of the J stock individuals in the samples was decreased by the distance from the coastal line. Although there were approximately 25% of the J stock individuals in the samples collected from the area less than 10 n.m, the proportion became approximately 10 % in the area further than 10 n.m. from the coastal line. The results from the genetic analyses demonstrated that the impact of community-based whaling on the J stock can be kept at a low level by restricting whaling operations to waters 10 n.m. or more from the coast.

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Punt, A.E. 2003. A Bayesian Approach to Estimating 'J'-'O' Mixing Proportions. Annex F. Report of the Workshop on North Pacific Common Minke Whale (*Balaenoptera acutorostrat*a) *Implementation Simulation Trials* (SC/54/Rep1). *J. Cetacean Res. Manage.* (*Suppl*.) 5:482.

Table 1. Mixing proportion of the J stock estimated from the mtDNA analysis and proportion of the J stock individuals estimated from the microsatellite analysis by the distance from the Japanese Pacific coast in sub-area 7W based on samples taken by JARPN-JARPN II from 1996 to 2007 and by-catches (within 3 n.m.) from 2001 to 2007.

Distance from coastal line	mtDNA (s.d.)	microsatellite
Within 3 n.m.	0.528 (0.038)	0.508
Less than 10 n.m.	0.246 (0.036)	0.248
10 n.m. or more	0.096 (0.012)	0.102
20 n.m. or more	0.058 (0.015)	0.051
30 n.m. or more	0.048 (0.017)	0.040
40 n.m. or more	0.063 (0.021)	0.051
50 n.m. or more	0.062 (0.023)	0.054

s.d. = standard deviation

Appendix IV

Available information on abundance estimates of common minke whales in the Russian EEZ in the Sea of Okhotsk, east of Kuril Islands - Kamchatka peninsula, in the Sea of Japan and western North Pacific for assessment of J and O stocks.

Tomio Miyashita [1] and Takashi Hakamada [2]

1: National Research Institute of Far Seas Fisheries

2-12-4 Fukuura, Kanazawa-ku, Yokohama-shi, Kanagawa 236-8648, Japan

2: The Institute of Cetacean Research

4-5 Toyomi Chuo-ku Tokyo 104-0055, Japan

Contact e-mail: miyachan@fra.affrc.go.jp

ABSTRACT

Available information on abundance estimate of the western North Pacific common minke assuming *g*(0)=1 are summarised for the assessment of the effect of the community based whaling and JARPN II catches on the J and O stocks. The abundance estimates used for the assessment were 28,436 (CV=0.185) in the Okhotsk Sea, 972 (CV=0.52) east of the Kuril Islands – Kamchatka peninsula, 12,266 (CV=0.170) in the Sea of Japan and 2,798 (CV=0.409) in the JARPN II area (sub-areas 7, 8 and 9). These values were estimated from the sighting data obtained in August and September during the northward migration. This is reflected in the larger number of animals in the northern area such as the Sea of Okhotsk than the southern area such as the JARPN II survey area.

Abundance estimate in the Russian EEZ in sea of Okhotsk. and east of Kuril Islands-Kamchatka peninsula (Miyashita, 2009)

<u>Survey outline</u>

a. 2003 survey (Miyashita, 2004)

Period: 22 July – 19 September

Area : Sea of Okhotsk. Block (Fig. 1), Pre-determined track line (Fig. 2 and 3)

Research vessel: *Shonan-maru* (SM1) and *Shonan-maru No.2* (SM2)

Scientists onboard:

SM1: T.Saito, T. Hayashi and E.Chvestov (TINRO-centre)

SM2: T.Miyashita, D.Tokuta and A.Vlamidirov (VNIRO)

Research method: IO passing mode

Research distance: 903nmi (SM1), 1,805 nmi (SM2)

Track line traversed with sighting effort: (Fig. 4).

Common minke whale sighting results: (Tables 1 and 2).

SM1: 12 schools with 12 animals as primary sightings

SM2: 69 schools with 78 animals as primary sightings

Sighting positions of common minke whale: (Fig. 4)

b. 2005 survey (Miyashita, 2006)

Period: 29 July – 20 September

Area : East of Kamchatka Peninsula (SM1) and east of Kuril Islands (SM2).

Block (Fig. 5), Pre-determined track line (Fig. 6 and 7)

Research vessel: *Shonan-maru* (SM1) and *Shonan-maru No.2* (SM2)

Scientists onboard:

SM1: T.Miyashita, H.Hiruta and S.Kornev (Kam TINRO)

SM2: T.Saito, S.Noji and P.Gusakov (VNIRO)

Research method: IO passing mode
Research distance: 1,441nmi (SM1), 929nmi (SM2)
Track line traversed with sighting effort: (Fig. 8).
Common minke whale sighting results: (Tables 3 and 4).
SM1: 5 schools with 5 animals as primary sightings
SM2: 6 schools with 6 animals as primary sightings
Sighting positions of common minke whale: (Fig. 8)

Abundance estimate

Method: Traditional line transect method using the program DISTANCE 4.1 (Thomas *et al.*, 2003).

Detection curve fitting: The information of the distance and angle for the first sighing from the top barrel and the IO platform was used for the fitting of detection curve. Because of small sample size but the common vessel type through these cruises, all primary sighting are accumulated and the detection curve was fitted (Fig. 9).

Abundance estimate:

Table 5 showed abundance estimate in the Sea of Okhotsk, abundance of common minke whales was estimated as 28,436 (CV 0.185, 95%C.I. 19,866 – 40,703). East of the Kamchatka Peninsula and the Kuril Island, the abundance was estimated as 972 (CV 0.52, 95%C.I. 373 – 2,534).

Abundance estimate in the Sea of Japan

Table 6 shows abundance estimate in the Sea of Japan. For more details of materials and method of these estimates, see Miyashita (2005), Miyashita and Okamura (2007) and Park *et al.* (2006). For the abundance in the same sub-area, average value mean were calculated and these estimates are extrapolated according to their average coverage (Table 7). Abundance estimate in the Sea of Japan were estimated as 12,266 (CV=0.170).

Abundance estimate in JARPN II survey area.

Fig. 10 shows JARPN II survey area. Fig. 11 shows track line traversed with sighting effort and sighting positions of common minke whale (pink circle) in 2006 and 2007 used for the estimation of abundance in late season. Survey was conducted by line transect in closing mode. More details were described in Kiwada *et al*. (2009). Table 8 show abundance estimate in this area in early and late season using JARPN II survey in 2006 and 2007. The estimates are 6,006 (CV=0.581) and 2,798 (CV=0.409), respectively. More details of materials and survey methods are written in Hakamada *et al*. (2009). To avoid double counting, the estimate in late season when other surveys were conducted was used for the assessment.

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Table 1. Number of sightings of common minke whales by *Shonan-maru* in 2003.

Block	CE					OE					ONW					OSW					Transit		Total		
Mode*	IO-pass		IO-close		NF	IO-pass		IO-close		NF	IO-pass		IO-close		NF	IO-pass		IO-close		NF	Passing				
Distance (nmi)	226.7		222.5			134.9		3.6			9.8		126.2			115.5		64.5			NA		903.7		
Primary/Secondary	Pri.	Sec.	Pri.	Sec.	Sec.	Pri.	Sec.	Pri.	Sec.	Sec.	Pri.	Sec.	Pri.	Sec.	Sec.	Pri.	Sec.	Pri.	Sec.	Sec.	Pri.	Sec.	Pri.	Sec.	Total
Schools	4															4					4	6	12	6	18
Animals	4															4					4	7	12	7	19

* IO-pass: IO passing mode, IO-close: IO but closing after abeam pasing, NF: Non effort, Passing: normal passing.

Table 2. Number of sightings of common minke whales by *Shonan-maru 2* in 2003.

Block	SHA					CNW					CSW					11W					Transit		Total		
Mode*	IO-pass		IO-close		NF	IO-pass		IO-close		NF	IO-pass		IO-close		NF	IO-pass		IO-close		NF	Passing				
Distance (nmi)	114.0		190.2			235.5		339.5			229.1		307.2			62.8		119.7			206.3		1804.3		
Primary/Secondary	Pri.	Sec.	Pri.	Sec.	Sec.	Pri.	Sec.	Pri.	Sec.	Sec.	Pri.	Sec.	Pri.	Sec.	Sec.	Pri.	Sec.	Pri.	Sec.	Sec.	Pri.	Sec.	Pri.	Sec.	Total
Schools	13		16	1	2	1		3		6	3		5		1	16		3			9	6	69	16	85
Animals	17		16	1	2	1		3		7	3		5		1	19		3			11	7	78	18	96

*same as in Table 1.

Table 3. Number of sightings of common minke whales by *Shonan-maru* in 2005.

Block	BEN		BES		KAN		KAS		Transit		Total	
Mode*	IO-pass	NF	IO-pass	NF	IO-pass	NF	O-pass	NF	Passing			
Distance (nmi)	578.1		259.5		418.4		184.9				1441.2	
Primary/secondary	Pri.	Sec.	Pri.	Sec.	Pri.	Sec.	Pri.	Sec.	Pri.	Sec.	Pri.	Sec.
Schools	2	5	2	1	0	0	0	1	1	1	5	8
Animals	2	5	2	1	0	0	0	1	1	1	5	8

*same as in Table 1.

Table 4. Number of sightings of common minke whales by *Shonan-maru No.2* in 2005.

Block	KUL		PAE		PAW		Transit		Total	
Mode*	IO-pass	NF	IO-pass	NF	IO-pass	NF	Passing			
Distance (nmi)	868.2		60.7		0				928.9	
Primary/secondary	Pri.	Sec.	Pri.	Sec.	Pri.	Sec.	Pri.	Sec.	Pri.	Sec.
Schools	6	7	0	0	0	0	2	0	8	7
Animals	6	7	0	0	0	0	2	0	8	7

*same as in Table 1.

Table 5. Abundance estimate of common minke whales in the Russian EEZ assuming $g(0)$=1.

Block	N	CV%	95% C.I.		
Sea of Okhotsk (2003)					
11W	1,496	92.6	320	−	6,994
CSW	2,882	34.1	1,506	−	5,516
OSW	4,035	88.9	904	−	18,002
Subtotal(12SW)	6,917	53.8	2,576	−	18,573
CE	935	49.6	373	−	2,342
CNW	772	36	390	−	1,529
ONW	1,335	36.7	666	−	2,678
SHA	16,981	19.8	11,571	−	24,920
Subtotal(12NE)	20,023	17.2	14,333	−	27,972
Total	28,436	18.5	19,866	−	40,703
East of Kuril Islands − Kamchatka pen. (2005)					
KUL	728	47	303	−	1,747
BEN	244	152.3	29	−	2,088
Total	972	52	373	−	2,534

Table 6. Summary for abundance estimates of common minke whales in sub-areas 5, 6 and 10.

Sub-area	Season	Survey by	EEZ	Area (nm^2)	% covered	Reseaech distance(nm)	No. primary sightings	g(0)=1			
								N	CV	95%LCI	95%UCI
10	2002	Japan	Japan*	28,823	21.4	501.6	12	1,089	0.544	401	2,954
	2003			27,822	20.7	582.8	7	303	0.610	100	913
	2006		Russia**	77,662	57.7	1,422.0	46	3,042	0.220	1,726	5,358
6	2002		Japan*	98,736	54.8	2,314.3	26	1,365	0.503	538	3,460
	2003			90,932	50.5	1,830.9	21	1,081	0.298	609	1,916
	2002	Korea***	Koera	7,074	3.9	1,169.3	30	521	0.426	231	1,176
	2003			8,063	4.5	1,081.6	16	758	0.680	208	2,762
	2005			6,703	3.7	1,144.5	28	1,349	0.524	500	3,640
	2006			14,968	8.3	1,069.8	20	1,645	0.531	593	4,561
5	2002			30,552	25.4	813.2	10	1,965	1.564	189	20,402
	2004			36,084	30.0	1,787.2	18	1,287	0.645	385	4,303

*: Miyashita (2005, SC/57/NMP3), **: Miyashita (2007), ***: Park *et al.* (2006)

Table 7. Summary for extrapolated abundance estimate of common minke whales in sub-areas 5, 6 and 10.

Sub-area	Abundance in surveyed area[1]	CV	95%LCI	95%UCI	%covered[2]	Extrapolated abundance	CV	95%LCI	95%UCI
Case: g(0)=1									
10	3,415	0.203	2,304	5,060	78.7	4,336	0.203	4,609	10,120
6	1,800	0.194	1,236	2,622	57.8	3,117	0.194	2,472	5,244
5	1,333	0.601	449	3,960	27.7	4,812	0.601	898	7,919
Total	6,548	0.170	4,701	9,120		12,266	0.170	9,402	18,240

1: Average weighted by inverse variance for replicated area. 2: Mean %coverage

Table 8. Abundance estimate of the common minke in JARPN II survey areas by sub-areas in early (May-June) and late (July-August) season assuming $g(0)$=1.

period	SA7		SA8N		SA8S		SA9N		SA9S		total	
	P	CV	P	CV	P	CV	P	CV	P	CV	P	CV
early	3,637	0.881	339	0.872	430	0.718	0	0.000	1,600	0.487	6,006	0.581
late	487	0.591	226	0.679	0	0.000	1,776	0.603	310	1.022	2,798	0.409

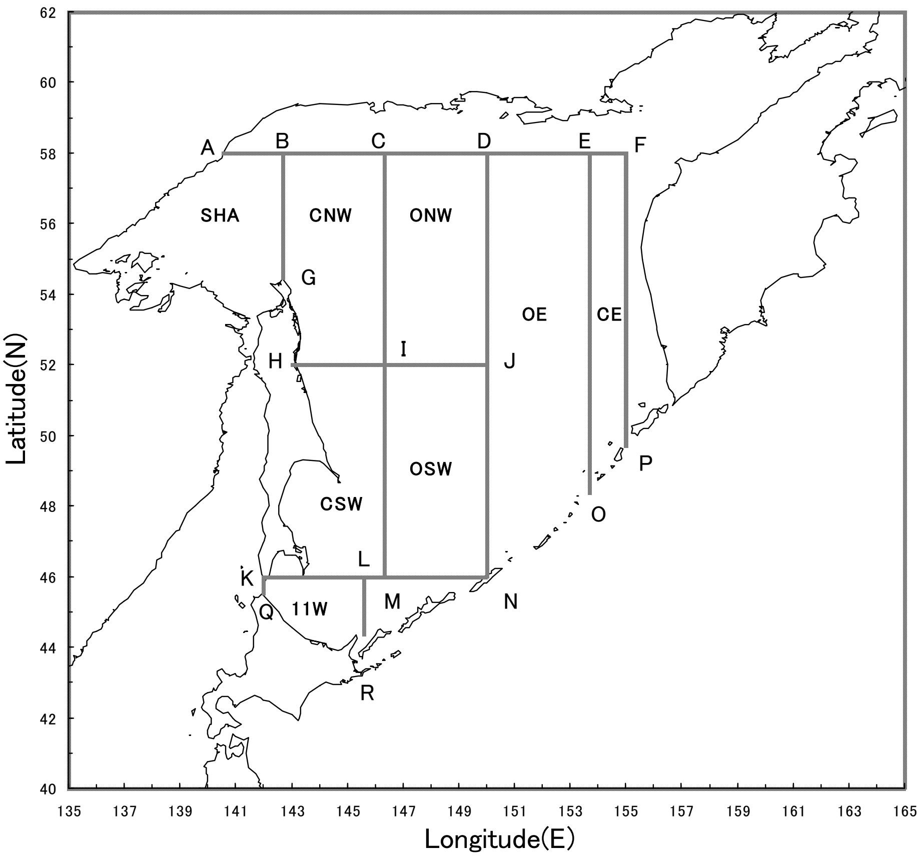

Fig. 1. Definition of block for 2003 sighting survey.

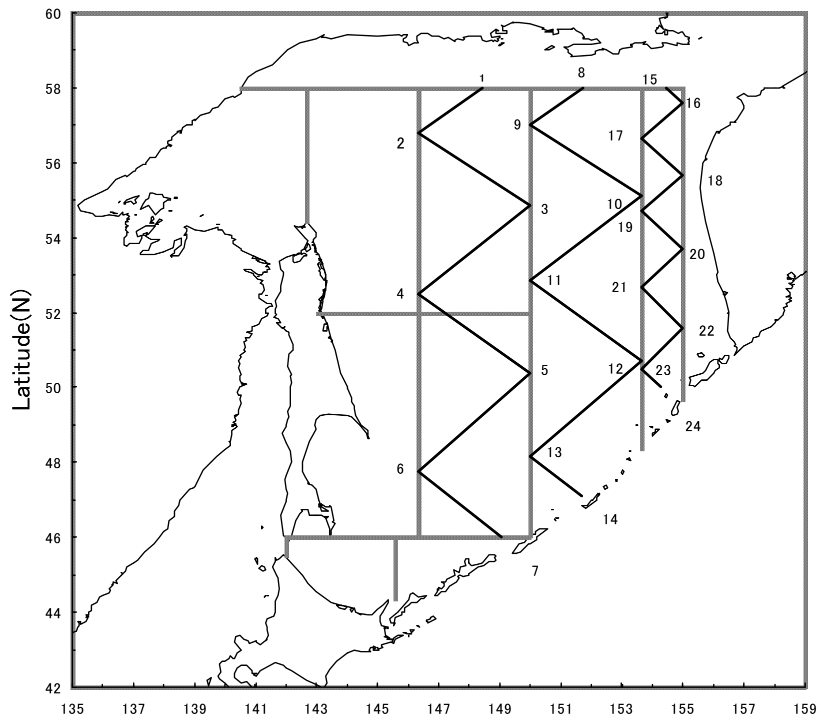

Fig. 2. Pre-determined track line for *Shonan-maru* in 2003.

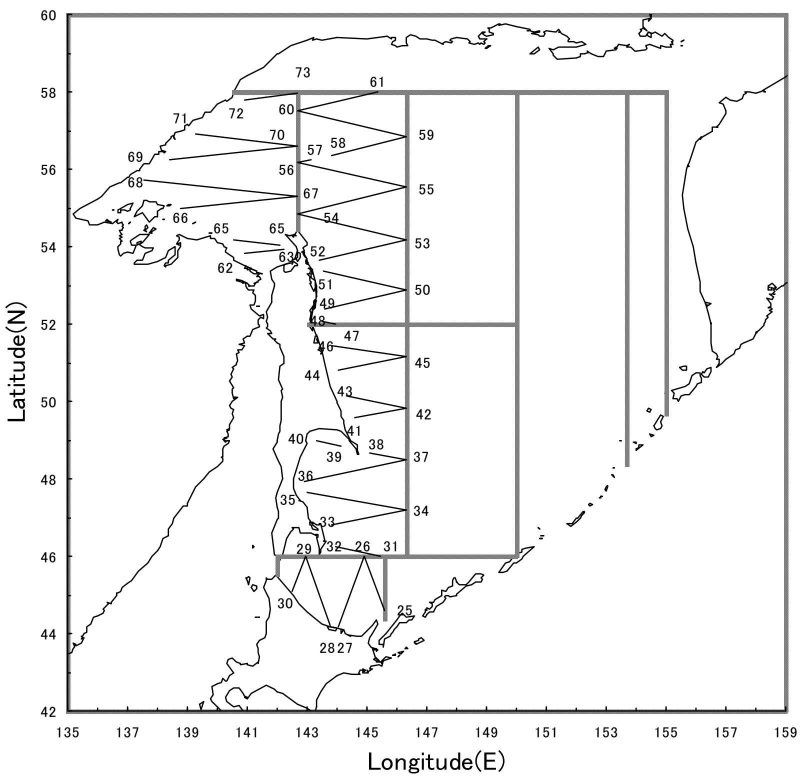

Fig. 3. Pre-determined track line for *Shonan-maru No.2* in 2003.

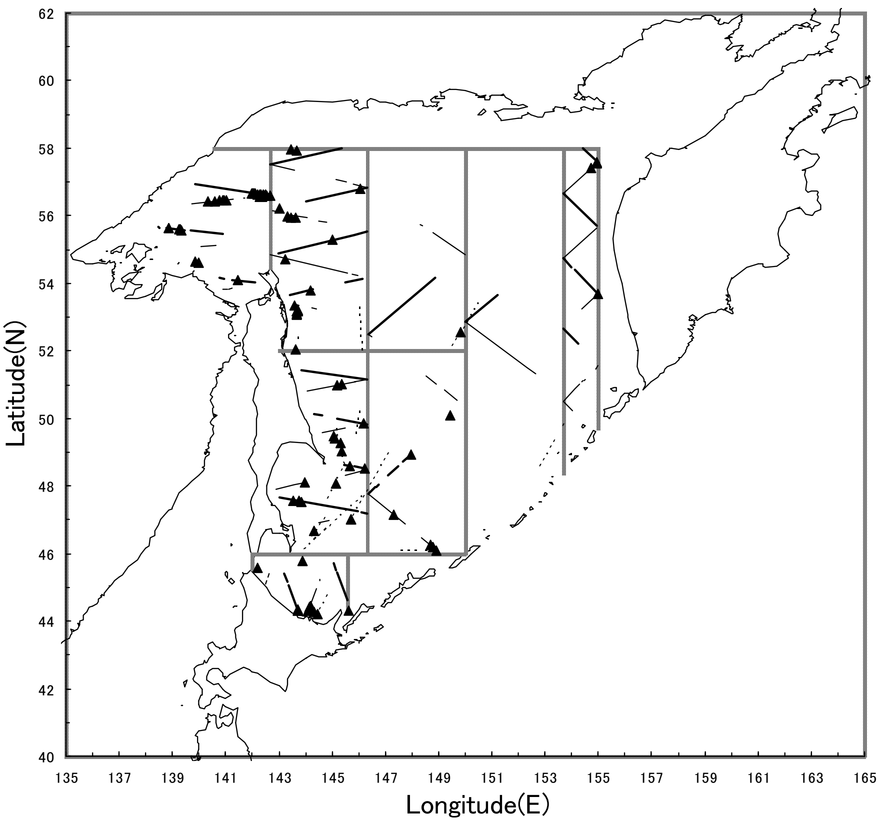

Fig. 4. Track line traversed with sighting effort and sighting position of common minke whale school (black triangle) in 2003.

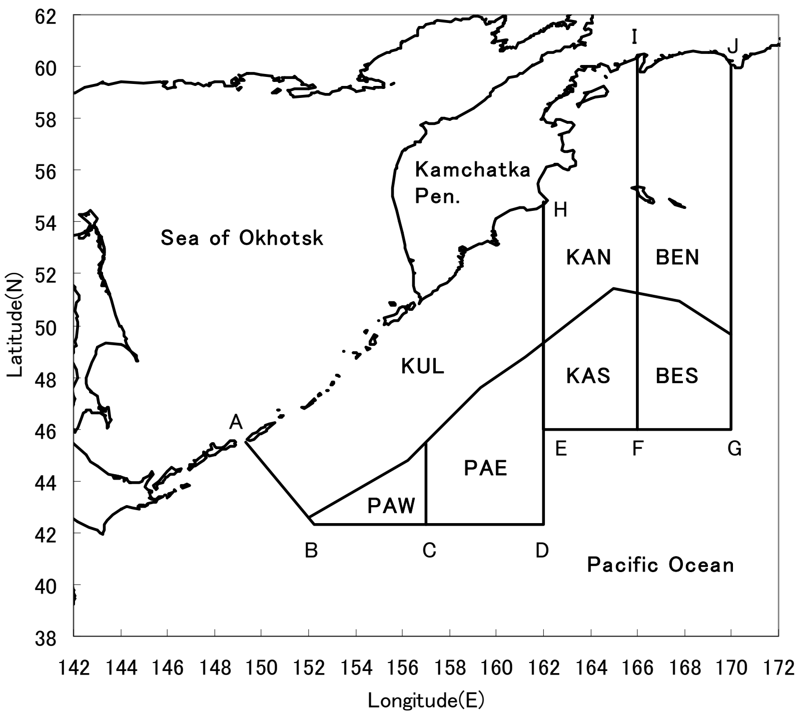

Fig. 5. Definition of block for 2005 sighting survey.

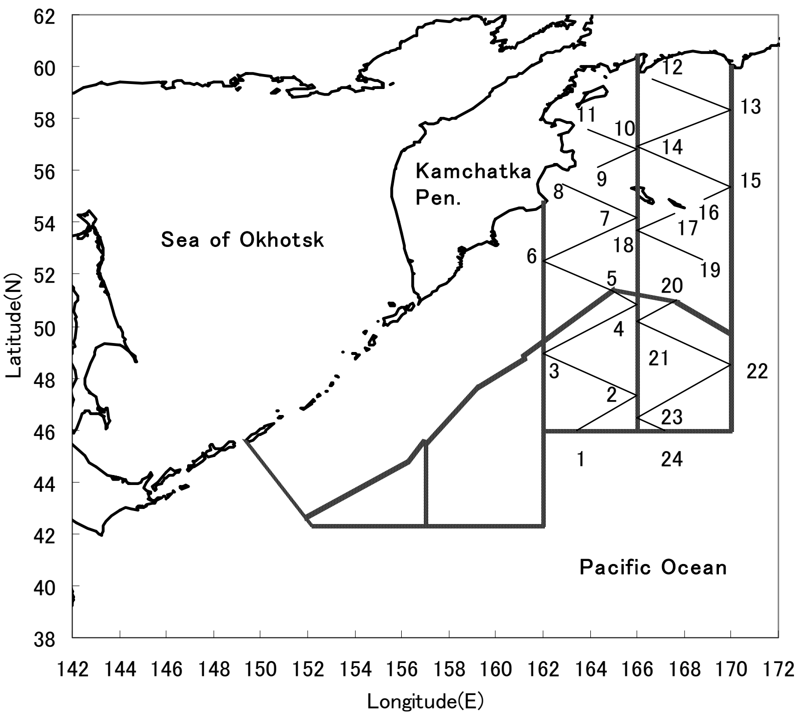

Fig. 6. Pre-determined track line for *Shonan-maru* in 2005.

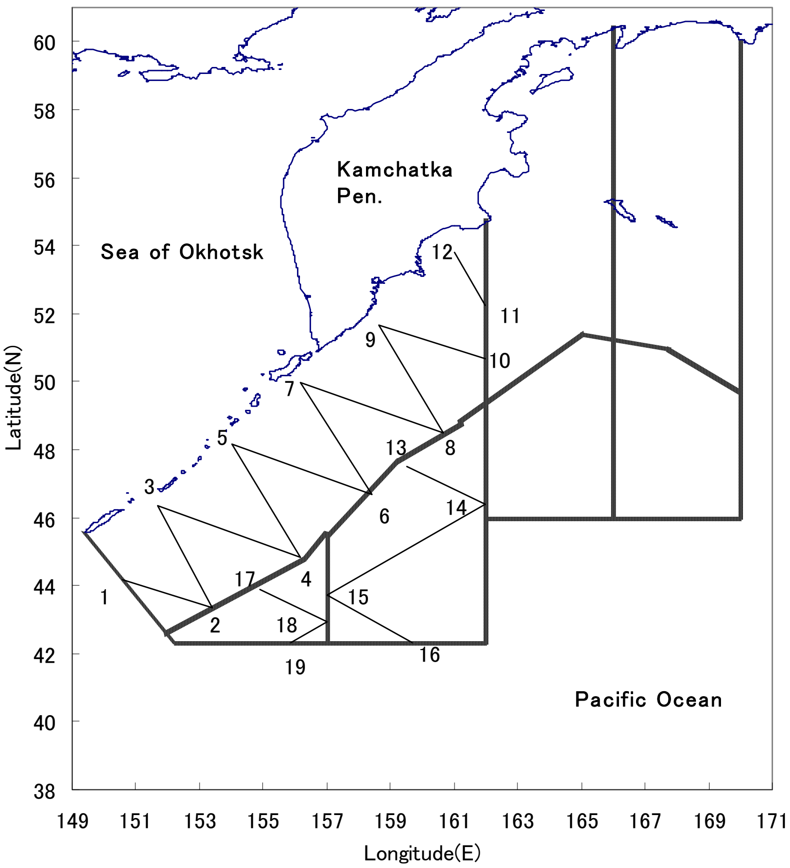

Fig. 7. Pre-determined track line for *Shonan-maru No.2* in 2005.

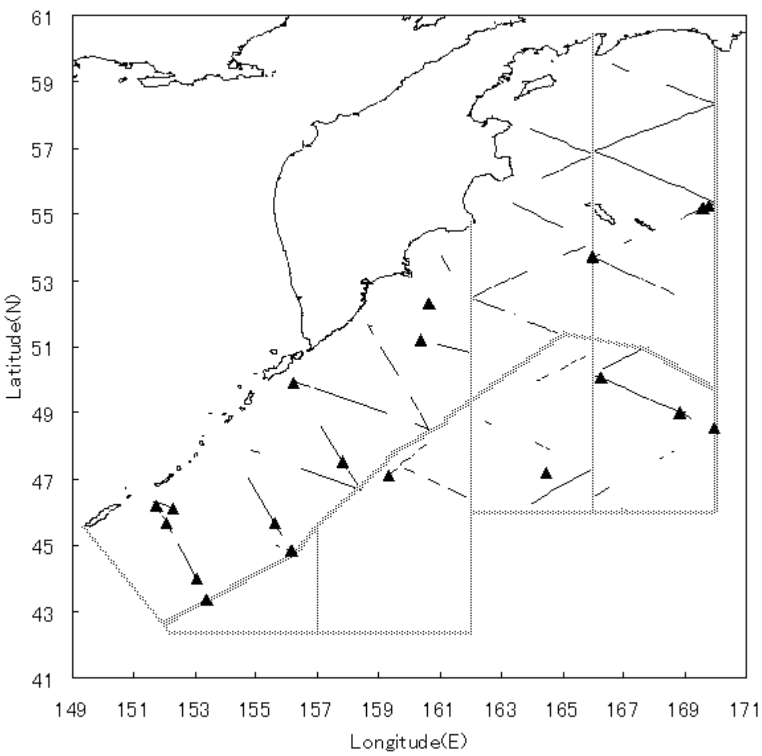

Fig. 8. Track line traversed with sighting effort and sighting positions of common minke whale (black triangle) in 2005.

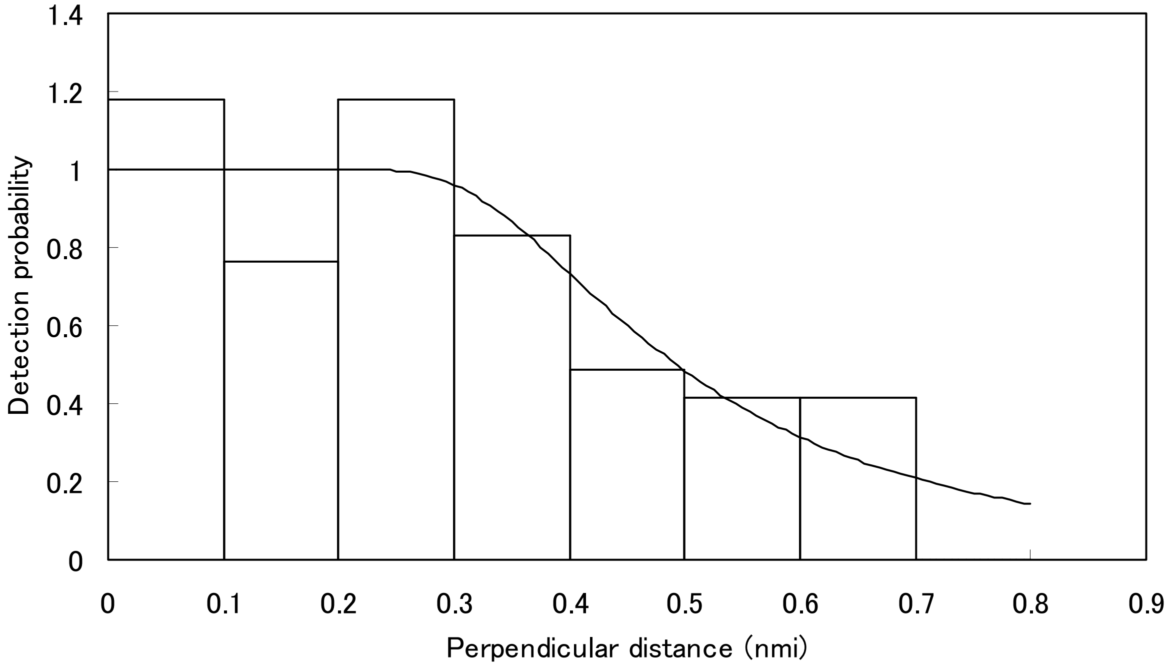

Fig. 9. Detection curve fitted to the sighting data of *Shonan-maru* and *Shonan-maru No.2* in 2003 and 2005.

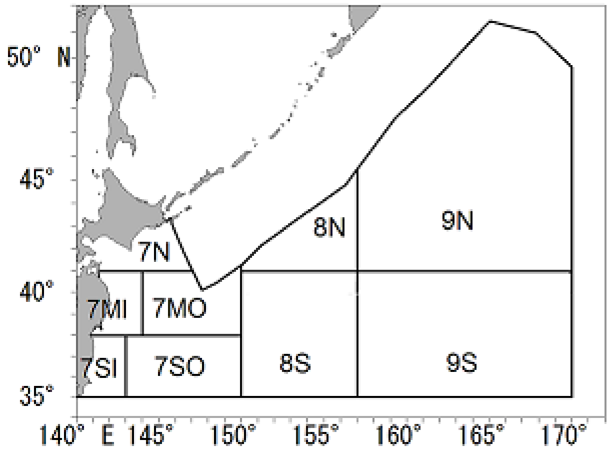

Fig. 10. JARPN II survey area.

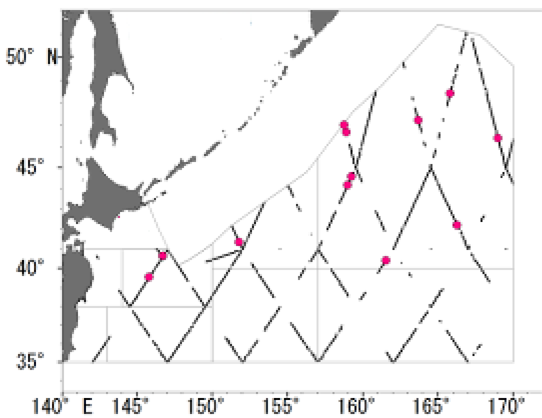

Fig. 11. Track line traversed with sighting effort and sighting positions of common minke whale (pink circle) in 2006 and 2007 used for the estimation of abundance in late season.

Appendix V

Data used for the analyses in Appendices I to IV

The data used in the main text can be obtained from the text itself. The data used for the analyses in the Appendices I to IV are listed in Table 1 below and they are available under *Procedure A* (IWC, 2004) to scientists interested in conducting analyses and producing papers for the Scientific Committee meeting that are directly relevant to the current subject. Those scientists should request the data to the Data Availability Working Group of the IWC SC following the *Procedure A*.

Table 1. List of the data in the Appendices I to IV that will be available under *Procedure A* (IWC, 2004).

Appendix I：Genetic stock structure of common minke whales from the SA7 to SA9.
- Mitochondrial DNA control region sequence (JARPN, JARPNII)
- Nuclear DNA microsatellite (16 loci) (JARPN, JARPNII)

Appendix II：An assessment of plausibility of sub-stock scenarios on western North Pacific minke whales using the historical CPUE series.
- None*****

Appendix III：Genetic basis for limiting whaling operations on O stock common minke whales to waters 10 nautical miles or more from the Japanese Pacific coast.
- Mitochondrial DNA control region sequence (JARPN, JARPNII)
- Mitochondrial DNA control region sequence (bycatch)
- Nuclear DNA microsatellite (16 loci) (JARPN, JARPNII)
- Nuclear DNA microsatellite (16 loci) (bycatch)
- Distance from coastal line

Appendix IV：Available information on abundance estimates of common minke whales in the Russian EEZ in the Sea of Okhotsk, east of Kuril Islands - Kamchatka peninsula, in the Sea of Japan and western North Pacific for assessment of J and O stocks.
- Sighting data for *Shonan-maru* and *Shonan-maru No.2* in 2003 and 2005 seasons
- Effort and Weather data for *Shonan-maru* and *Shonan-maru No.2* in 2003 and 2005 seasons
- Sighting data, Effort data and Weather data for *Kyoshin-maru No.2* in 2006 and 2007 seasons

* All of the data used were from Kawahara (2003) and had been already submitted to the IWC.

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