

# Comparative analyses on abundance trend for Antarctic minke whales between JARPA and IWC/IDCR-SOWER in Areas IV and V

Takashi Hakamada<sup>1</sup>

The Institute of Cetacean Research

Contact e-mail: hakamada@i-cetacean-r.or.jp

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## ABSTRACT

The trend in Antarctic minke whale abundance in Areas IV and V was compared between estimations by JARPA and IWC/IDCR-SOWER surveys. While the analysis of JARPA sighting data showed a constant trend in Areas IV (6 surveys examined for the period 1989/90 to 1999/2000) and V (6 surveys examined for the period 1990/91 to 2000/01), the analysis based on IDCR/SOWER data showed a negative trend in these Areas (3 surveys in Area IV; 3 surveys in Area V). There are some reasons to think that JARPA surveys could reflect better the trend in abundance for minke whales in these Areas. Among them are the number of surveys, which are larger in JARPA than in IDCR/SOWER survey, and consistency among JARPA surveys (in terms of survey method, geographical and temporal covering of the surveys). IDCR/SOWER surveys could not represent the true trend of abundance of minke whale in Areas IV and V.

## INTRODUCTION

At the 53<sup>rd</sup> Scientific Committee meeting, Hakamada *et al.*, (2001) presented that there was no significant trends of Antarctic minke whales in Areas IV and V. This contrasts with the drop in abundance estimates reported in Branch and Butterworth (2000), although it should be noted that the JARPA surveys occur only in Areas IV and V, whereas the IDCR/SOWER surveys cover all Areas. The Committee recommended that an attempt should be made before the next SC meeting to determine whether there is a statistically significant difference in trend between density estimates from JARPA survey data and those from IDCR/SOWER surveys in Areas IV and V (IWC, 2002).

## MATERIALS AND METHODS

### Abundance estimates from IWC/IDCR-SOWER

IWC/IDCR-SOWER surveys have been conducted since 1978/79. Abundance estimate for Antarctic minke whale have been reported (Haw, 1993; Burt and Stahl, 2001). Abundance estimate in Areas IV and V used in this analysis are shown in Table1. Note that we add abundance estimate in 1994/95 to abundance estimate in 1998/99, because a part of Area IV from 70°E to 80°E was not covered in 1998/99 SOWER survey (see Fig. 1a).

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<sup>1</sup> The Institute of Cetacean Research, 4-5, Toyomi-cho, Chuo-ku, Tokyo Japan 104-0055

### **Abundance estimate from JARPA**

After two preliminary surveys conducted in 1987/88 and 1988/89, JARPA surveys started in 1989/90 and have been conducted in Areas IV and V alternatively every two years. Abundance estimate reported in Hakamada *et al.*, (2001) were used to estimate abundance because they took off the effect of sampling activity on abundance estimate by applying method in Haw (1991).

### **Estimate of the abundance trend**

Increasing rate per year in Areas IV and V was estimated respectively by using regression analyses assuming abundance estimate is distributed log-normally (Buckland, 1993). This method requires at least three abundance estimates. Its confidential interval was estimated using Bootstrap. Pseudo samples (i.e. abundance estimate) are generated assuming they are log-normally distributed in order to take their precision into account. Next, abundance trend was estimated from pseudo samples. This procedure repeated 999 times. Details this procedure was described in Hakamada *et al.*, (2001).

## **RESULTS**

From IWC/IDCR-SOWER surveys, increasing rate per year was calculated as  $-7.34\%$  (95%CI is  $[-10.09\%, -4.39\%]$ ) in Area IV and  $-6.15\%$  (95%CI is  $[-11.37\%, -0.11\%]$ ) in Area V. Estimated trend of Antarctic minke whale abundance is  $-0.04\%$  (95%CI is  $[-4.32\%, 2.90\%]$ ) in area IV and  $0.83\%$  (95%CI is  $[-2.44\%, 4.19\%]$ ) in Area V, respectively from JARPA (Table2).

## **DISCUSSIONS**

### **Abundance estimate in Areas IV and V in the 3<sup>rd</sup> circumpolar from IWC/IDCR-SOWER**

In 1991/92 surveys, eastern part of survey area ( $165^{\circ}\text{E}$ - $170^{\circ}\text{W}$ ) was not covered north of  $66^{\circ}\text{S}$  at all, as Fig. 1b shows. This insufficient coverage may results in underestimate of abundance. In fact, at last SC meeting, SOWER was planned to conduct in Area V in 2001/02 and 2002/03 (IWC, 2002) as part of the 3<sup>rd</sup> circumpolar survey.

Abundance estimate in the 3<sup>rd</sup> circumpolar used in this study has not adequately considered factors that might affects abundance estimate (e.g.  $g(0)$ , animals in south of ice edge etc.). In order to estimate unbiased abundance trend, we should take these factors into considerate.

As a result of substantial change in survey design of IDCR/SOWER from the 2<sup>nd</sup> circumpolar to the 3<sup>rd</sup> circumpolar, IDCR/SOWER survey lost its consistency. For this reason, the abundance from IDCR/SOWER in the 3<sup>rd</sup> circumpolar underestimated (Murase *et al.*, 2002; Okamura *et al.*, 2002).

### **Reliability of abundance trend from JARPA compare to IDCR/SOWER**

One hand, JARPA survey is conducted in Areas IV and V every two year. As the JARPA surveys have been conducted consistently in the same area, its sighting data must be suitable for estimation of abundance trend. On the other hand, IWC/IDCR-SOWER surveys Areas IV and V once in 6 or more years because it was designed to cover whole of circumpolar in 6 or more years. There are only three abundance estimates in Areas IV and V, respectively for IWC/IDCR-SOWER, whereas there are six for JARPA. Three is the least sample size to apply regression analysis. The less sample are there, the more outliers affect estimate of abundance trends. As mentioned above, abundance estimate in 1991/92 in Area V and that in 1998/99 in Area IV seem to be outliers.

From examinations of trends of biological parameters, there were no positive evidences to suggest

change in population level of the Antarctic minke whale in Areas IV and V (Zenitani *et al.*, 2001).

#### **Absolute abundance estimate from JARPA**

Abundance estimates from JARPA used in this study take into effect of sampling activity on school density estimate into account by using the method of Haw (1991), which was applied to convert abundance closing mode in IWC/IDCR-SOWER into that in pseudo-passing (Hakamada *et al.*, 2001). Survey was conducted on closing mode during JARPA. Closing mode in IWC/IDCR-SOWER and Sighting Vessel, which didn't conduct sampling the minke whale, in JARPA is very similar. Assuming correlation factor  $R=0.751$  ( $CV=0.152$ ) estimated by Haw (1991) can be applied, abundance estimate in 1999/2000 would be 61,445 ( $CV=0.207$ ) and that in 2000/01 would be 137,515 ( $CV=0.222$ ). However, it was suggested that effect of sampling activity on abundance estimate might depend on relative density substantially. Further examinations are necessary to investigate this dependency.

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Table 1. Abundance estimate used for this analysis

Area IV (70E-130E, south of 60S)					Area V (130E-170W, south of 60S)				
	IDCR/ SOWER*		JARPA **		(south of 60S)	IDCR/ SOWER*		JARPA **	
1978/79	97,027	0.218	-	-	1978/79	-	-	-	-
1979/80	-	-	-	-	1979/80	-	-	-	-
1980/81	-	-	-	-	1980/81	177,606	0.264	-	-
1981/82	-	-	-	-	1981/82	-	-	-	-
1982/83	-	-	-	-	1982/83	-	-	-	-
1983/84	-	-	-	-	1983/84	-	-	-	-
1984/85	-	-	-	-	1984/85	-	-	-	-
1985/86	-	-	-	-	1985/86	294,610	0.138	-	-
1986/87	-	-	-	-	1986/87	-	-	-	-
1987/88	-	-	-	-	1987/88	-	-	-	-
1988/89	74,692	0.257	-	-	1988/89	-	-	-	-
1989/90	-	-	33,096	0.179	1989/90	-	-	-	-
1990/91	-	-	-	-	1990/91	-	-	118,785	0.172
1991/92	-	-	33,351	0.211	1991/92	92,709	0.194	-	-
1992/93	-	-	-	-	1992/93	-	-	77,858	0.187
1993/94	-	-	27,097	0.170	1993/94	-	-	-	-
1994/95	-	-	-	-	1994/95	-	-	104,792	0.236
1995/96	-	-	25,660	0.183	1995/96	-	-	-	-
1996/97	-	-	-	-	1996/97	-	-	106,878	0.228
1997/98	-	-	19,342	0.223	1997/98	-	-	-	-
1998/99***	21,105	0.206	-	-	1998/99	-	-	118,570	0.166
1999/00	-	-	46,145	0.141	1999/00	-	-	-	-
2000/01	-	-	-	-	2000/01	-	-	103,274	0.162

\*: *Rep. int. Whal. Commn*, 41, 1991.

\*\* : Combined estimate of SV and 'pseudo SV' in Hakamada et al, (2001) are used

\*\*\*Matsuoka and Hakamada (2002); Hakamada and Matsuoka (2002); 1998/99 + 1994/95 (70-80E)

Table 2. Estimates of abundance trend from JARPA and IDCR/SOWER surveys and its confidential interval.

Area	survey	trend	confidential interval	
Area IV	JARPA	-0.04%	-4.32%	2.90%
Area IV	IDCR/SOWER	-7.34%	-10.09%	-4.39%
Area V	JARPA	0.83%	-2.44%	4.19%
Area V	IDCR/SOWER	-6.15%	-11.37%	-0.11%

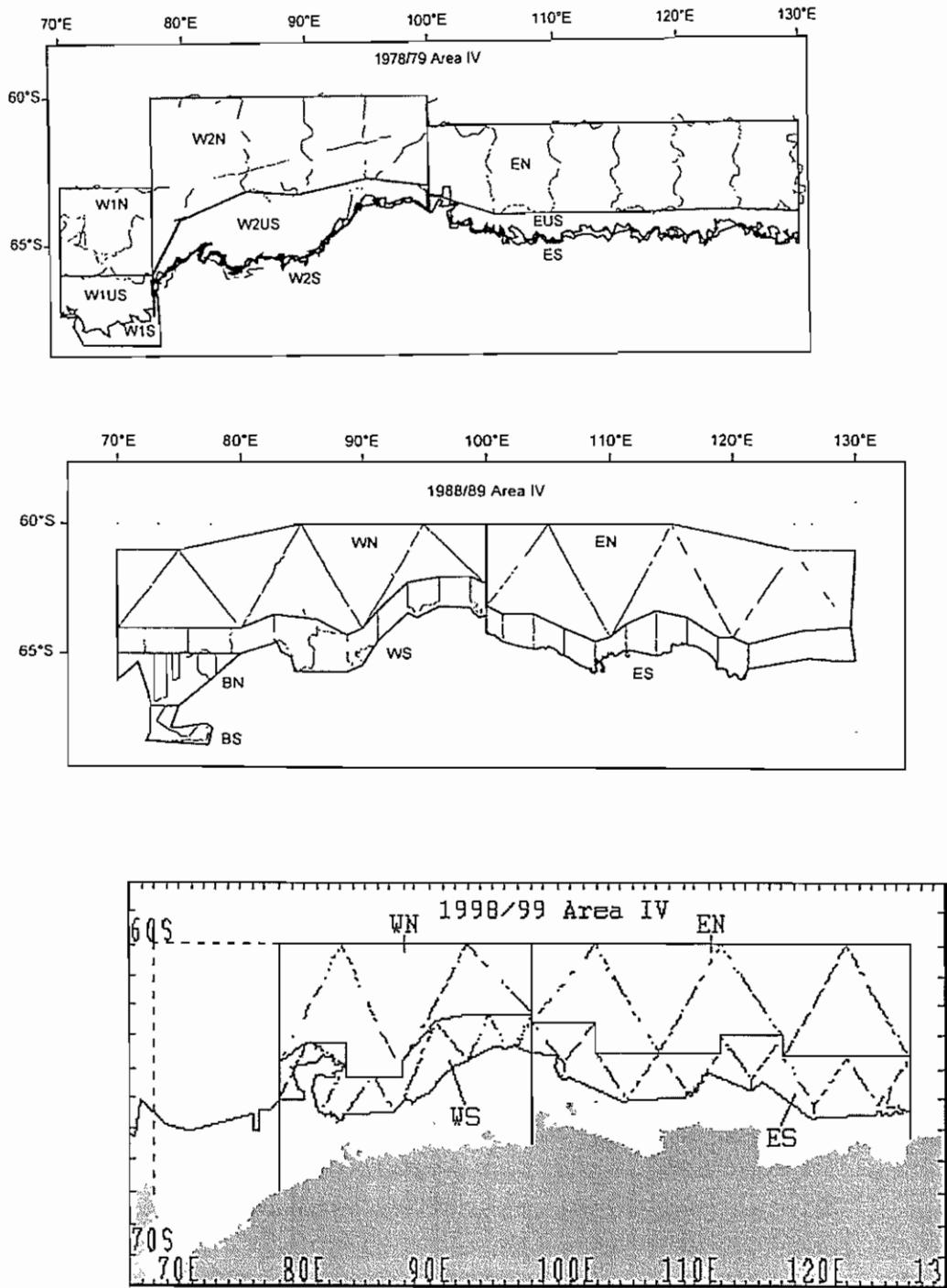


Fig 1a. Survey area for IWC/IDCR-SOWER surveys in Area IV.

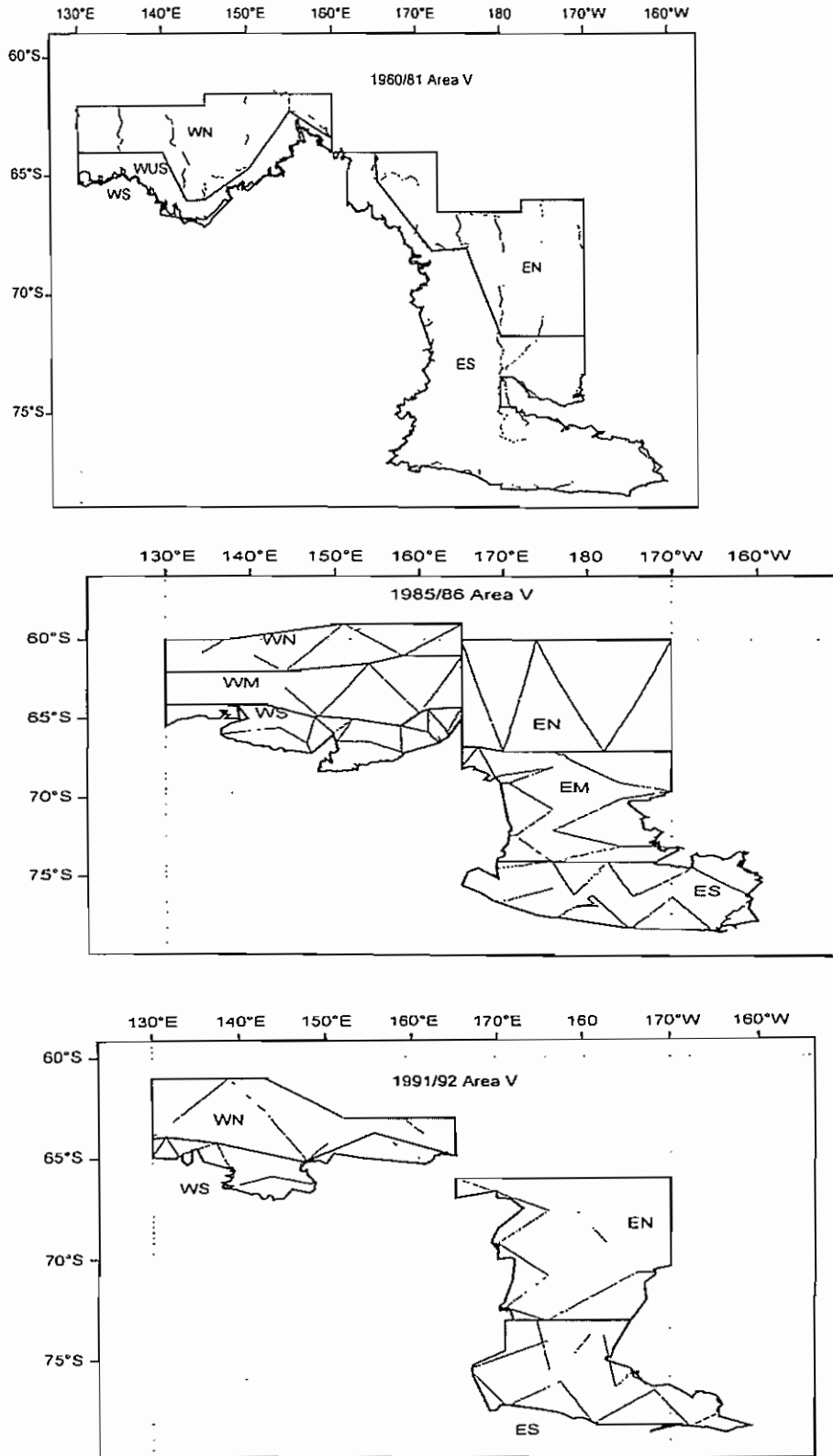


Fig 1b. Survey area for IWC/IDCR-SOWER surveys in Area V