ABUNDANCE ESTIMATION OF WESTERN NORTH PACIFIC MINKE WHALES USING THE KOREAN SIGHTING SURVEY IN 2010

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ABSTRACT

A sighting survey for the abundance estimation of minke whale was conducted in the sub-area 6W in 2010. Distance data which were collected from the survey were applied to robust models (Half-normal, Hazard-rate, Uniform) that can take the variety of detection function g(x). Uniform model was chosen based on Akaike's Information Criterion (AIC). The value of g(0) was assumed to be 1. The abundance of minke whale was estimated at 1,014 individuals (95% CI=479-2,145).

INTRODUCTION

Korea has conducted systematic sighting surveys in the East Sea and the Yellow Sea under the cooperative research between Korea and Japan since 1999. The plans of this sighting survey were presented to the SC in compliance with the guideline of the IWC. This document presents the abundance estimation of minke whales in the sub-area 6W.

SURVEY AND METHODS

A vessel-based sighting survey was conducted to estimate the abundance of minke whale in the East Sea (sub-area 6W) in 2010 (Fig. 1). The survey was conducted on the research vessel, Tamgu-3 (stem trawler, 360 G/T and 1,600 HP) that has a top barrel at the height of 11.5m from the sea level.

Only the good weather condition with two or longer nautical miles visibility and three or smaller Beaufort scale allowed the survey to be conducted. The survey adopted semi-IO passing mode using the two channeled walkie-talkies in order to estimate g(0).

Density and abundance were estimated from sighting and effort data collected during the primary sighting effort using conventional line transect method. The estimates were made using the computer program DISTANCE 5.0 (Thomas et al., 2006).

The abundance of minke whale, N was estimated as:

$$\hat{N} = \frac{n \cdot f(0) \cdot E(s) \cdot A}{2 \cdot L}$$

(1)

where, n = number of sightings

f(0) = probability density function

E(s) = expected group size

A = size of the survey area

L = total length of each survey

Three key functions (Half-normal, Hazard-rate and Uniform) were combined with three adjustments functions (cosines, simple polynomials, hermite polynomials) respectively, and used to estimate the detection function. Akaike's information criterion (AIC) was used to select suitable combination. Bias in the school size estimation was corrected by the regression of log (group size) on the detection probability with significance level at 0.1 (Buckland et al., 2001). Detection probability of on the line g(0) could not be estimated but assumed to be 1 in this survey because IO platform was not equipped in the research vessel. Five percent of perpendicular distances has truncated as suggested by Buckland et al. (2001).

$$\text{vâr}(N) = N^2 [\frac{\text{vâr}(2n)}{n^2} + \frac{\text{vâr}\{f(0)\}}{\{f(0)^2\}} + \frac{\text{vâr}[E(s)]}{E(s)}$$

(2)

Following Burnham et al. (1987), the lower and upper 95% confidence interval was respectively given by

$$\hat{N}/C \quad \text{and} \quad \hat{N}C$$

where

$$C = \exp\{1.96\sqrt{\log_e[1 + \frac{\text{vâr}(\hat{N})}{\hat{N}^2}]}\}$$

RESULTS

The sighting positions of minke whales and summary of survey result are shown in Figure 1 and Table 1, respectively. A total of 21 sightings of minke whale were made in this survey. Fig. 2 shows the histogram of the perpendicular distance data. The highest frequency occurred within 200 meters.

Uniform model with cosines adjustment was selected by minimum AIC for this survey (Table 2). The effective search half-width (esw) was estimated at 333.7m. Expected group size, $E(s)$, was estimated to be 0.065 (CV=38.7%) individuals based on regression of log (group size) on $g(x)$. The abundance of minke whale was estimated at 1,014 (95% CI=479-2,145) individuals while half-normal model was estimated to be 1,159 (95% CI=550-2,442) and Hazard-rate model was estimates to be 1,173 (95% CI=451-3,051).

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Table 1. Summary of survey effort and sightings for minke whale in the East Sea in 2010

Survey	Surveyed Area (n.m.^{2})	Coverage in sub-area 6W (%)	Survey effort (n.m.)	Number of Primary sightings	Sighting rate (pod/n.m.)
2010	15,599	23.6	2,310.3	21	0.01

Table 2. Estimation summary for the minke whale sighting surveys in the East Sea in 2010

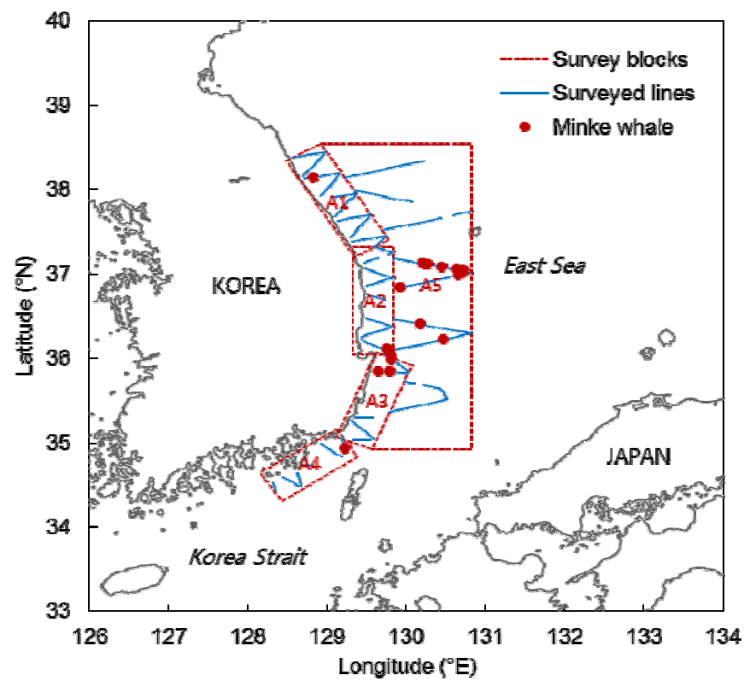| Model	AIC	ESW (m)	D	D CV	N	N 95% CI
Uniform	231.9	333.7	0.065	0.387	1,014	479-2,145
Half-**normal**	233.1	294.6	0.074	0.384	1,159	550-2,442
Hazard-**rate**	232.4	290.9	0.075	0.497	1,173	451-3,051

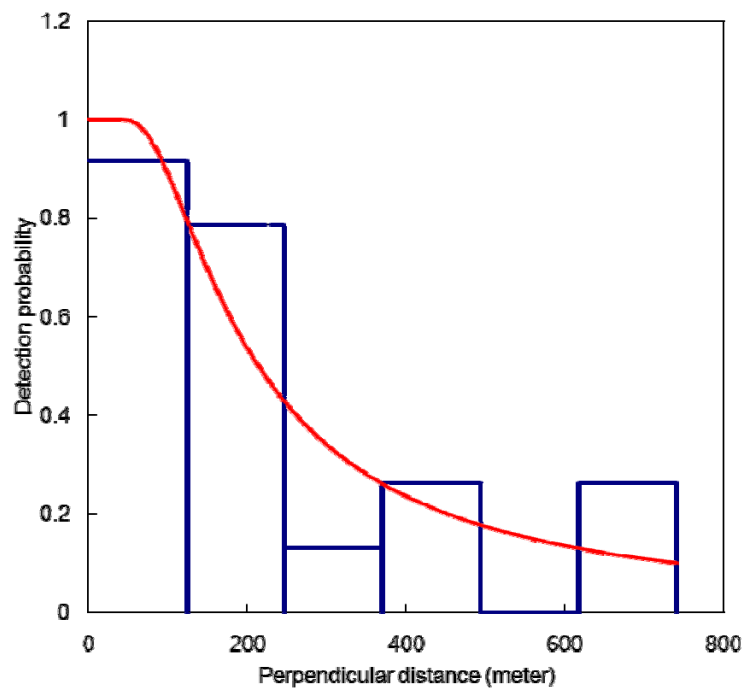Fig. 1.   Surveyed lines and sighting positions of minke whales in the East Sea in 2010.

Fig. 2.   Frequency histogram of the perpendicular distance data for minke whales.