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TRANSLATION

ESTIMATION OF VULNERABILITY OF SURVEY
TRAWL NET BY TAGGING EXPERIMENTS

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Estimation of vulnerability of trawl survey gear is indispensable for obtaining estimates of population abundance. As abundance estimates of the tanner crab population in the eastern Bering Sea by Japanese and U.S. scientists have been based on the results of grid surveys using trawl gear, an estimation of the vulnerability of survey trawl nets has been a pressing need. A Japan-U.S. joint survey program using the ATA method (alternate tail attack) was conducted in 1979 and 1980 to obtain vulnerabilities of the survey gears but no agreement was reached on the figures of vulnerability.

The results of tagging experiments for estimation of vulnerability of trawl survey gear, which were carried out by authors independently of the joint survey, are reported here.

Method

The experiment was carried out during the period 1981 May 23 to 25. Twelve tagged crab release lines were established in a north south direction in a tagging area two miles square with the northwest point at $57^{\circ}12'N$, $172^{\circ}00'W$ (Fig. 1). On each line, 500 tagged crabs were released at similar intervals. Each crab was released with a tiny weight so as to reach the planned spots on the bottom. The weight was devised so that it would separate easily from the body of the crab after the crab reached the bottom. The 6,000 crabs used for the experiment were caught by pots.

After release of all tagged crabs, and before the start of trawling in the tagging area, trawling was conducted around the perimeter of the area to gather data for estimating the dispersion of tagged crabs. The experimental trawl area was 0.8 miles in a north south direction and two miles in an east west direction in the center of the tagging area (Fig. 2). The number of tagged crabs in the trawl experiment zone was estimated as follows--

$$6,000 \text{ crabs} \times \frac{0.8 \text{ miles}}{2.0 \text{ miles}} = 2,400 \text{ crabs}$$

One tow was conducted along seven trawl paths intersecting the release lines with a 0.1 mile distance between tows to avoid overlap. Fixing the vessel position at the release points for tagged crabs and for trawling was determined by a combination of loran C and satellite navigation systems. This was considered to be the best for determining the position of the vessel.

Results

Estimation of effective number of released tagged crab

A total of 77 crabs were recovered in seven tows of the trawl net in the experimental zone. The trawl experiment zone was subdivided into subareas with 0.2 mile width and a center line of each trawl path. The relationship between release and recovery for 77 recovered crabs was studied on the basis of subareas (Table 1 and Fig. 2).

Recoveries of tagged crabs in the subarea of release predominated and constituted about 53% of the total recovery, and recoveries decreased gradually departing from the subarea of release (Fig. 3). By using these results, dispersion from the trawl experiment zone will be estimated as follows--

			Subarea						
			A	B	C	D			
7.5	7.5	12.6	52.8	10.2	5.7	3.8			
	7.5	7.5	12.6	52.8	10.2	5.7	3.8		
		7.5	7.5	12.6	52.8	10.2	5.7	3.8	
			7.5	7.5	12.6	52.8	10.2	5.7	3.8
12.5%			79.2%				8.3%		

Dispersion of crabs to the direction of north and south was estimated to be 20.8% or 499 crabs (2,400 crabs x 0.208 = 499 crabs).

Dispersion of crabs also occurred to the east and west and was estimated as follows. Recoveries of tagged crabs by trawl around the tagging area were six crabs to the north and south and 11 crabs to the east and west. Assuming that those two figures are relative values of dispersions to the north and south and to the east and west, and as the length of the side of the trawl experiment zone was 40% of that of the tagging area, the following calculation is possible--

$$499 \text{ crabs} \times \frac{11 \text{ crabs} \times 0.4}{6 \text{ crabs}} = 366 \text{ crabs}$$

Thus, the total dispersed crab from the trawl experiment zone was estimated to be 865 crabs (499 crabs + 366 crabs = 865 crabs) and effective number of releases in the trawl experiment zone was estimated as 1,535.

Estimation of vulnerability of the trawl survey gear

Vulnerability of the trawl survey gear is--

R: Effective number of releases in the trawl experiment zone

S: Swept area (square miles) per one tow

r: Number of recovered tagged crab

A: Area of the trawl experiment zone

T: Number of tows

$$V = \frac{r}{\frac{R \cdot S \cdot T}{A}}$$

From the results of the experiment--

$$r = 77 \quad R = 1,535 \quad A = 1.6 \quad S = 0.02065 \quad T = 7$$

Therefore $V = 0.555$

In estimation of biomass of crabs in 1979 and 1980, an estimate of the vulnerability of the Japanese trawl survey gear of 0.345 as calculated from the experiment in 1977 was used as the best estimate at that time. However, the result acquired from the experiment in 1981 would be more accurate than the aforementioned figure because the size and detailed procedure of the experiment in 1981 exceeded those of the past experiment.

TABLE 1 AND FIGS. 1 TO 3 ARE IN ENGLISH IN THE JAPANESE DOCUMENT

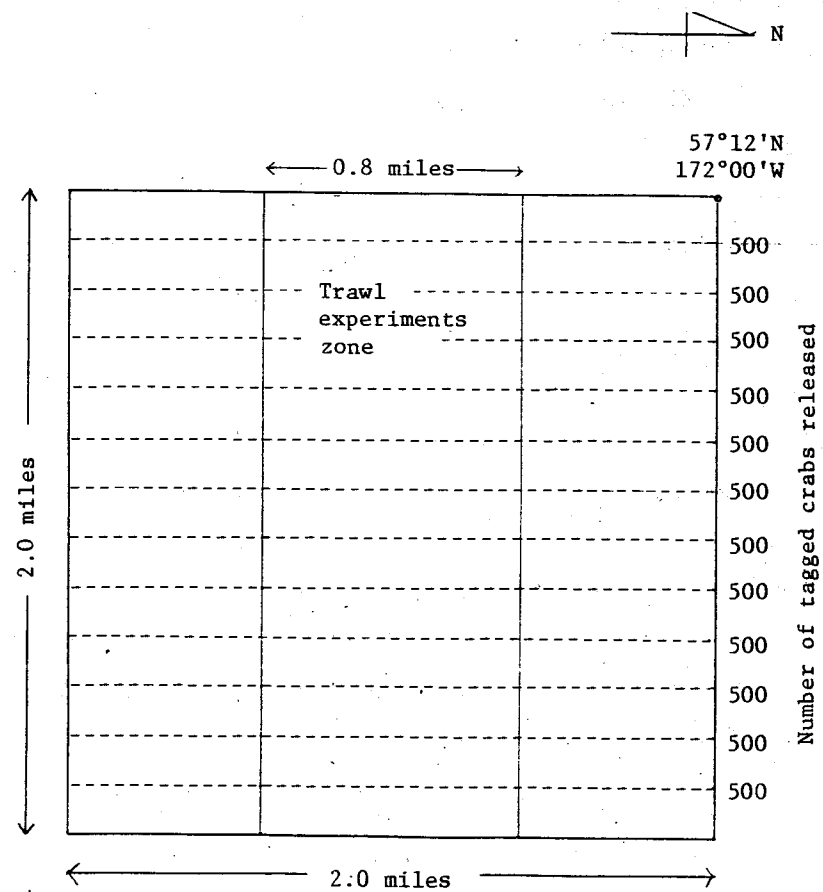


Fig. 1. Trawl experiments zone and tagged crabs release lines in tagging area.

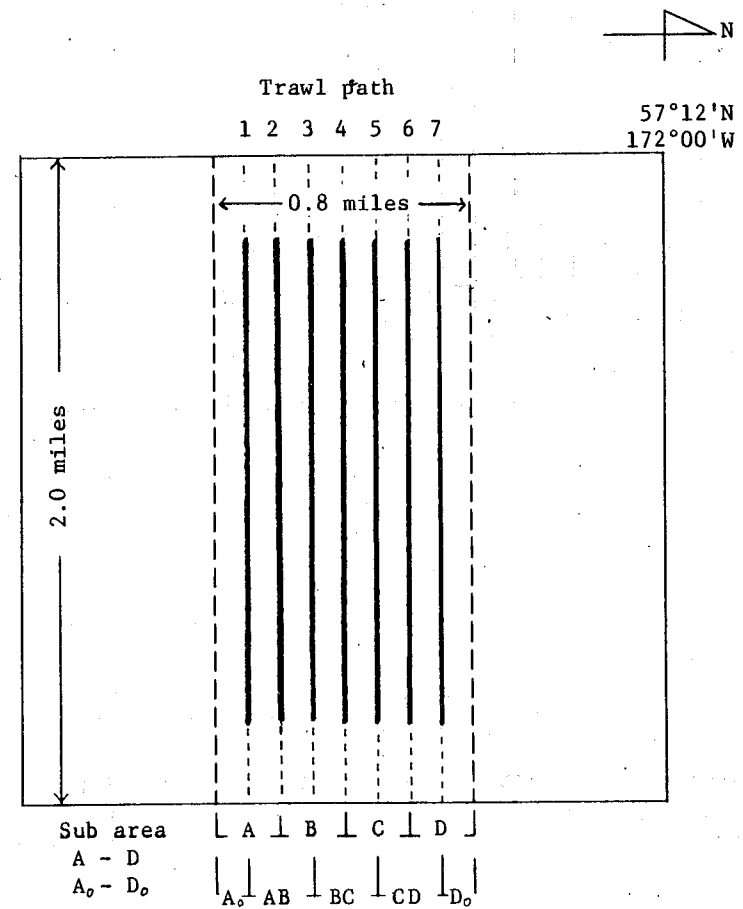


Fig. 2. Trawl paths and sub areas.

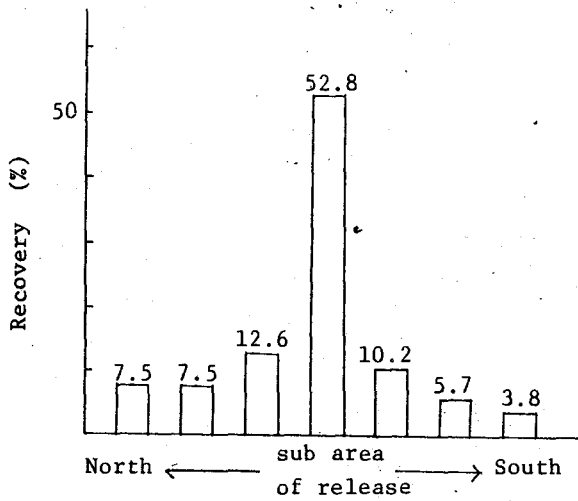


Fig. 3. Relative distribution of tagged crab recovered.

Table 1 Number of tagged crabs recovered, by sub area of release and recovery

Trwal path number	Sub area of recovery	Sub area of release								Total crabs recovered	CPUE			
		A _o	A	AB	B	BC	C	CD	D			D _o		
1	A		6		1		0		0					
2	AB	1		12		0		0		1				
3	B		3		5		4		2					
4	BC			2		0		9		1		1		
5	C				0		2		4		1			
6	CD					0		1		3		7		
7	D						0		1		1	6		
	Total crabs recovered		2			4			10			49	8	1.33
	CPUE		1			1			1.67			7		