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ON THE DEVELOPMENT OF TAGGING TECHNOLOGY FOR SPINY KING CRAB *PARALITHODES BREVIPES*

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Tabl. – 2, fig. – 1, photo – 10, ref. – 1.

1. INTRODUCTION

In order to clarify survival and movement after release, many types of tag have been tested, but they had problems that almost tags drop off during molting, or cuttings on body part for marking are recovered during repeated molting, and thus, it is difficult to differentiate from appearance of crab between released individuals or wild ones. Thus, the short term movement before molting can be identified but long term movement over seasons remain unknown, and the development of effective tagging method is strongly needed, to obtain ecological information on *Paralithodes brevipes* including movement in wild water.

2. TEST ON STRAIGHT-TYPE ANCHOR TAG AND EXCISION OF SIDE CARAPACE

2.1. Objectives

The spaghetti-type anchor tag, which we are using in survey (**photo 1**), has a tube at the top of stem extending from anchor part with step of diameter, and this step tends to be caught by obstacles and easy to drop off. In this test, as the method for tracking released *Paralithodes brevipes*, I have tested new tagging methods for practicable field use by placing emphasis on preventing drop-off at molting and identification from appearance.

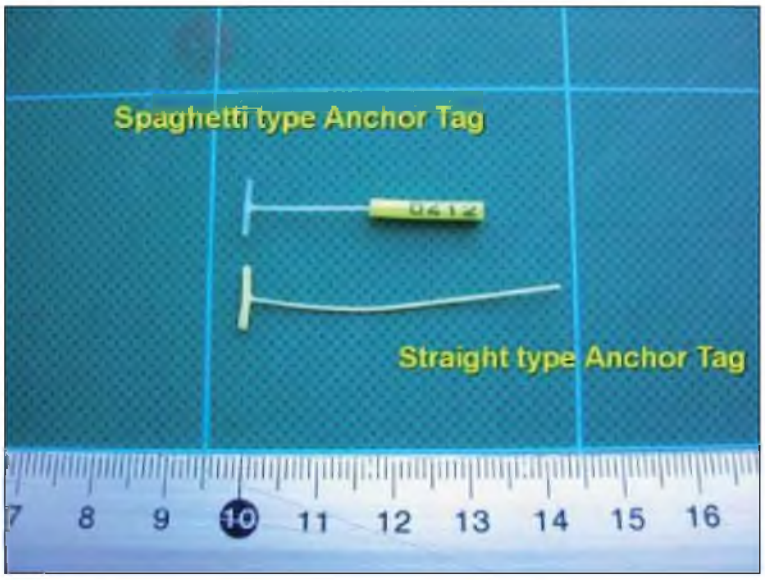

Photo 1. *Anchor tag*

2.2. Materials and methods

The individuals of *Paralithodes brevipes* used for tests were obtained from the water off Goyo-mai, in the Pacific coast of Nemuro Peninsula, on June 24, 2006, by flat crab pots under special catch approval. The tested tagging methods are following two:

1) Straight-type anchor tag: The straight-type anchor tags (photo 1, **fig.**) are prepared by removing the label part, having stepwise increase of diameter, from the spaghetti-type tag. They were installed by tagging gun (Banok 203-L) on the border between 1st and 2nd abdominal segments avoiding center part to the left or right (**photo 2**);

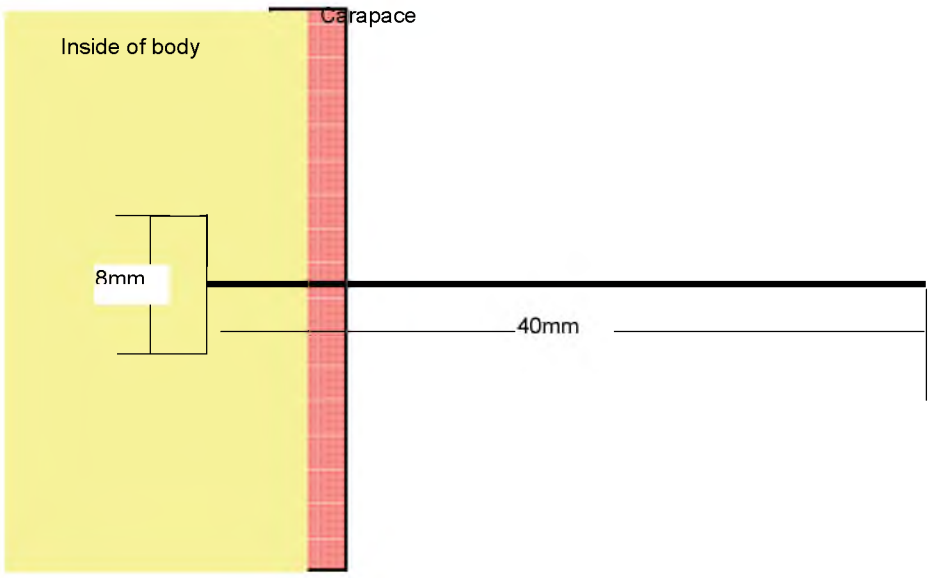

Fig. *Schematic diagram of anchor tag*

Photo 2. *The position of tag installed*

Excision of side carapace: This method is to make notch by excising at the side part of carapace, which should be difficult to regenerate after molting and should not reduce commercial value of notched crabs. For 20 individuals of *Paralithodes brevipes*, the side of carapace was excited by a dissecting scissors to form a triangle notch at the edge of the side carapace, making the apex on the upper edge of side carapace (linea anomurica) **(photo 3, 4)**.

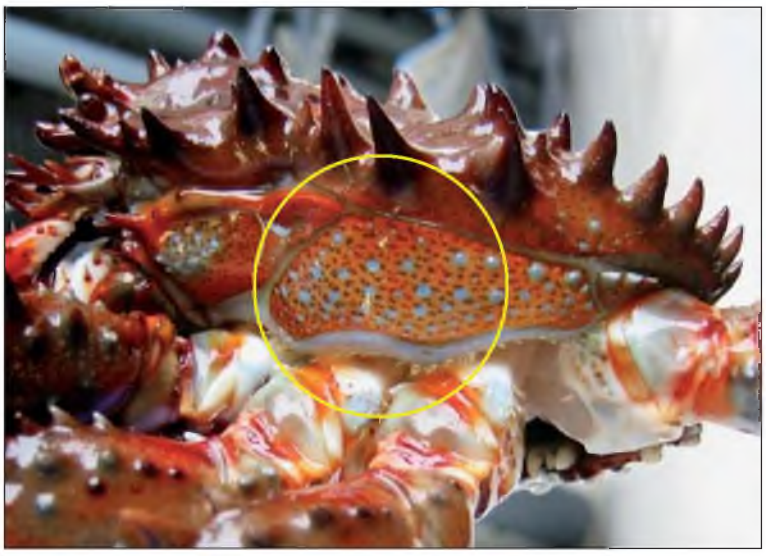

Photo 3. *The excised part of carapace (before excitement)*

Photo 4. *The excised part of carapace (just after excitement)*

2.3. Results

1) Straight-type anchor tag

The tests were started with 84 individuals, and after the 1st molting the tags were identified for 79 individuals, which was 94% of total. After the 2nd molting, the tags remained on 65 individuals; equivalent to 89% of total, and after the 3rd molting, the tags can be identified on 38 individuals, equivalent to 86% among total 44 individuals. After that, molting was repeated and the tags remaining after 5th molting on some of individuals. During rearing, as though some individuals died by cannibalism during molting, the final tag retaining rate after 2 years was 11% (**photo 5, table 1**).

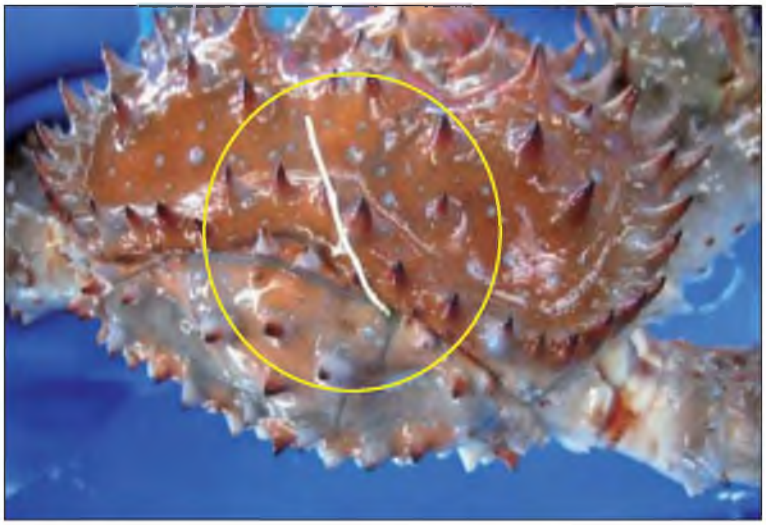

Photo 5. *Anchor tag after 5th molting*

Table 1

Results of rearing test on tagged Hanasaki crab

Test Section	Starting Size	Starting Date	Date Finished Molting	Molting Times	Starting Individuals	Tag		Tag Retaining Rate (%)	Year passed	Tag Retaining Rate Total (%)
						On	Drop off			
Straight-type anchor Tag	CL=52.9 CW=60.4	2006 6/30	2006 12/23	1	84	79	5	94		94
	CL=61.0 CW=69.7	2006 11/18	2007 6/26	2	73	68	8	89		77
	CL=70.5 CW=80.8	2007 6/10	2008 1/3	3	44	38	6	86	1	45
	CL=75.8 CW=87.2	2007 10/24	2008 8/12	4	20	17	3	85		20
	CL=79.1 CW=91.2	2008 6/19	2009 1/28	5	9	9	0	100	2	11
Excision of side carapace	CL=52.9 CW=60.4	2006 6/30	2006 11/30	1	20	20	0	100		100
	CL=58.5 CW=67.3	2006 11/21	2007 6/25	2	19	19	0	100		95
	CL=69.3 CW=78.8	2007 6/4	2007 12/17	3	17	17	0	100	1	85
	CL=76.2 CW=88.1	2007 10/23	2008 11/9	4	11	11	0	100		55
	CL=83.6 CW=96.8	2008 6/10	2009 2/20	5	5	5	0	100	2	30

2) Excision of side carapace

The initial number of tested individual was 20 and the notch on the side of the carapace can be indentified on all of the individuals after the 1st to 5th molting. In the case of this side carapace excision method, there was no individual that regenerated excised carapace after molting. The final mark retaining ratio after 2 years was 30%, because of death by cannibalism etc. under rearing conditions. The notch was also made on the other side of carapace and the notch can be identified easily (**photo 6,** table 1).

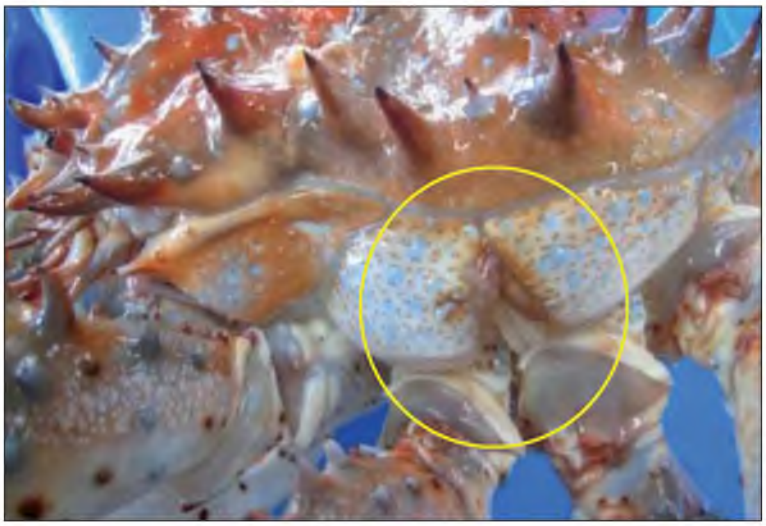

Photo 6. *The excised notch after 5th molting*

2.4. Discussions

The results of tests indicated that tags by both of the tagging methods retained after 5th molting with high probability. As a matured *Paralithodes brevipes* molts once a year, the fact that the tags were retaining after 5th molting means possibility of tracking tagged crabs for 5 years after tagging and releasing. If tested crabs are reared individually or under appropriate density for both of the tests, the survival rate can be increased and resultant tag retaining rate can be improved. However, as the problem in attaching anchor tag, when tags were installed not deep enough to the deep part of body but close to the carapace, it is confirmed that the anchor part of tag was wrapped within the old carapace and dropped off at molting (**photo 7, 8**).

This may because that the tag seems to be recognized as a foreign matter when it is installed near to or in the inner membrane of carapace. Further, the occurrence of unusual molting during low water temperature period of December – January, are confirmed, when some individuals died during molting. This unusual molting may be caused by accelerated molting for the purpose of ejecting foreign matter from the inside of body, which obstructed normal molting cycle. Further investigation to find appropriate place of setting tags not causing unusual molting must be made.

Photo 7. *Depression of new carapace formed by drop off of tag at molting*

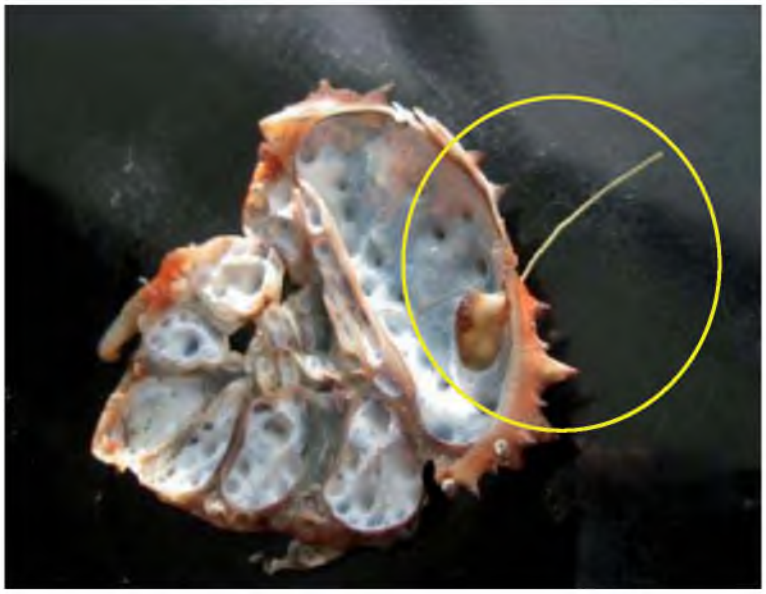

Photo 8. *Old carapace wrapped in the anchor part of tag*

3. COMPARATIVE TEST ON DROP OF ANCHOR TAG

3.1. Objectives

The drop-off rate and survival rate was compared among the spaghetti tag and the straight tag.

3.2. Material and method

The individuals of *Paralithodes brevipes* with carapace length about 70mm or so, sampled under special catch approval from the water off Goyo-mai, Nemuro City, in June 2007 and 2008, were used in the tests.

For the straight tag, the drop-off rate and survival rate were compared between the group of crabs of 20 individuals installed straight tag and the control group without tag of 20 individuals, in July 2007. For the spaghetti tag, the drop-off rate and survival rate were compared between the tagged group and the control group, each of 35 individuals, in July 2008.

3.3. Results and discussions

Comparing drop off of the straight tag and the spaghetti tag, the tag retaining rate for the straight tag was 90%, while for the spaghetti tag was 29% (**table 2**). As mentioned above, the tag installed close to the carapace is supposed to be recognized as foreign matter and to be dropped off being wrapped within old carapace, while the shape of anchor part is the same for both type of tag. In spite of these situations, the tag retention rate is quite different between two tags. This difference in retention rate is thought to be caused by following process: in the case of spaghetti tag, as the step between stem and anchor part may be caught by some obstacle or so, then the anchor part is pulled close to carapace and the tag tends to be dropped at molting.

Table 2

The retention rates of straight tag and spaghetti tag and survival rate of tagged crabs

	Straight tag	Control	Spaghetti tag	Control
Test period	2007/7/3 – 12/8		2008/7/15 – 12/29	
Starting individuals (ind.)	20	20	35	35
Carapace length (mm)	63.0	64.0	53.8	57.8
Carapace width (mm)	72.0	74.0	67.6	67.2
Retained tag after molting	18	–	10	–
Tag retention ratio (%)	90	–	29	–
Died individuals (ind.)	2	2	17	2
Survival rate (%)	90	90	51	94

The survival rates for the outer tags were, 90% for the straight tag and 51% for the spaghetti tag, which indicated large difference. On the other hand, the survival rates for the control groups without tag were similar large values of 90% and 94%. Thus, this difference in survival rate is also thought to be caused by the stress at dropping off of the spaghetti tag.

At the time when the needle of tagging gun was pulled out from the belly part of crab, the considerable amount of body fluid flow out depending on individuals. This phenomenon did not depend on the type of tag and the impact on the survival of the individual could be the same. The effect of this phenomenon on the survival after tagging and releasing at field survey is the matter of concern. In the case of excising side carapace, the scar is larger than the case of tag, but the flow out of body fluid is hardly observed, thus, at present, the excision of side carapace is thought to be the most promising tagging method.

4. TEST FOR SIMPLIFICATION OF THE EXCISION OF SIDE CARAPACE

4.1. Objectives

In search of tagging method of lesser impact on survival after practical field tagging operation, the tests for simplification of the excision of side carapace were performed.

4.2. Method

In order to make a notch, the excision of side carapace needs twice cutting with scissors. To make work simpler, the results of single cut after molting was observed (**photo 9**).

Photo 9. *Single cut at side carapace*

4.3. Results and discussions

As the results of comparison between the case of excising in notch and the case of single cut, it was confirmed that there was no difference in the condition after molting (**photo 10**). This result makes it possible to simplify largely the field operation in tagging and releasing.

As in this Hanasaki Program, it was confirmed that the excised notch-shaped carapace tip can be uses as a specimen for DNA analysis. Thus the excision of side carapace can be a tagging method capable of individual identification (Ikeda et al., 2009). In order to make the best use of this possibility, an excision tool, other than scissors, that capable of cutting notch by single action is to be shaped up for simplification of the tagging operation.

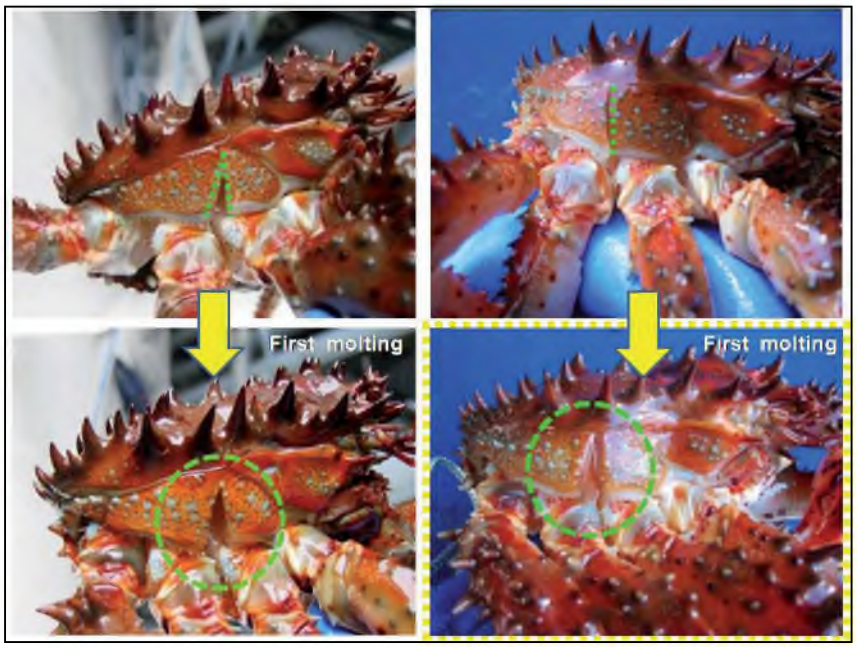

Photo 10. *Shape of cuts of different excision after molting*

5. SUMMARY ON DEVELOPMENT OF TAGGING METHODS

The future subject for improvement of the straight-anchor-tag is to make individual identification possible by development of technology to put on band marks on the tag stem. As for the marking by excision of side carapace, the individual identification was made possible by using excised carapace tip as specimen for DNA analysis, which can be the most efficient tagging method. However, when the excision of side carapace is used simply as the mark for tagging, the possibility of confusion with natural scar cannot be denied. The improvement of identification can be made by changing position of notch or by application of multiple notches. Together with improvements above, the further development is to confirm the minimum size of crab to be able to apply tag.

As the conclusion, if all of these subjects are solved, we will be able to make clear the dynamic feature of *Paralithodes brevipes* stock, and when the mass seed production technology is established and mass seed releasing become possible, we will be able to assess how released seed is recruiting to wild population. Further, using the developed methods in all of the survey of *Paralithodes brevipes*, their best efficiencies will be exerted in obtaining quantitative information such as estimation of stock abundance, natural mortality, or migration between fishing grounds etc. Moreover, these technologies can be extended to those applicable to the other crab species, and be expected to contribute in sustaining, increasing and recovering of *Paralithodes brevipes* stock.

REFERENCE

Nobuhiko Taniguchi, Ikeda Minoru, 2009: Genetic diversity and population structure of *Paralithodes brevipes*, The summary report of research achievements by *Paralithodes brevipes*, Promoting Committee for Nemuro City Hanasaki Program, March, 2009. 62–79.