

## DISTRIBUTION OF PLANKTONIC LARVAE OF HANASAKI CRAB IN THE WATER AROUND NEMURO PENINSULA

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Tabl. – 4, fig. – 14 (1-1—1-3; 2; 3-1—3-10), photo – 3, ref. – 5.

### 1. OBJECTIVES

Hanasaki crab distributes in the coasts of Kuril Islands, Kamchatka Peninsula, the Sea of Okhotsk, and the Bering Sea; as for the water around Hokkaido Island, in the Pacific coast from eastside of the Cape Erimo to the Cape of Nosappu, especially in the Pacific coast of Nemuro Peninsula. The past surveys on planktonic larvae of Hanasaki crab in the water around Nemuro Peninsula had been made four times; from 1984 to 1985 by Torisawa et al. (1999), from 2006 to 2007 by Kudo (2007), and by Yamada et al. (2008), and the most recent survey made during 2008 was the fifth one. The development of seed production and intermediate culturing technology is being performed by Stock Enhancement Technology Section (Akkeshi Station), Coastal Fisheries and Aquaculture Division, Hokkaido National Fisheries Research Institute, Fisheries Research Agency, or by Nemuro City Fisheries Research Institute and along with development of technology on hatch-out and culturing, the developmental stages of early life larvae from hatch out to settling.

However, as the field survey on planktonic larvae of Hanasaki crab in the water around Nemuro Peninsula had not been performed not so frequently, and for the recognition of current status of stock and identification of stock enhancement policy, accumulation of data on larval distribution and time of appearance on each developmental stages together with environmental data of distribution areas such as temperature and salinity is necessary, thus this survey was performed.

## 2. METHOD OF SURVEY

As the hatch-out larvae from fertilized eggs of matured female Hanasaki crab show strong phototaxis and accumulate in the surface layer, the larvae was sampled by vertical tow of larva-net (mesh GG54, diameter 80cm, length 2.8m) (**photo 1**). The obtained samples were fixed by 10% formalin solution or by 99.5 dehydrated ethanol, and preserved in dark place until identification.



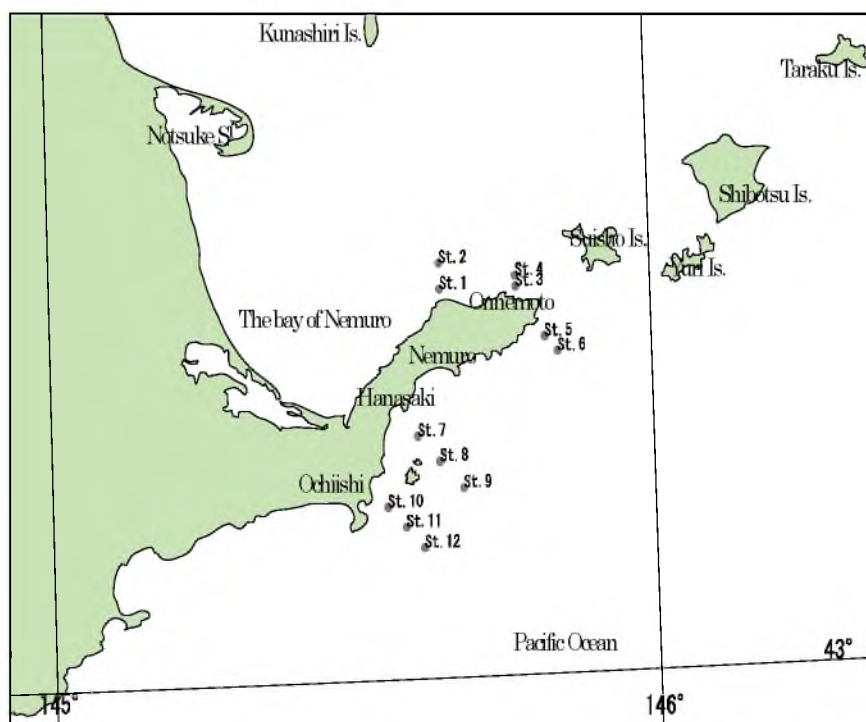
*Photo 1. The method of survey*

The sampling periods, as though differing from year to year, were from the last 10-days of April to the middle 10-days of June. This time of the year was selected because matured crabs move to the coast for mating and spawning during reproduction period in spring. The sampling points were extended from the Nemuro Bay side and Pacific side of the water around Nemuro Peninsula. The positions of sampling points for each survey were shown in **table 1** and **fig. 1**.

**Table 1**

**The sampling position in surveys on Hanasaki Crab larvae**

St. No.	2006			2007			2008		
1	N43° 24' 050	E145° 39' 310		N43° 23' 900	E145° 31' 600		N43° 26' 230	E145° 35' 464	
2	N43° 25' 640	E145° 39' 310		N43° 27' 000	E145° 28' 400		N43° 29' 098	E145° 31' 539	
3	N43° 24' 050	E145° 46' 840		N43° 30' 000	E145° 25' 000		N43° 31' 962	E145° 27' 600	
4	N43° 24' 710	E145° 46' 840		N43° 24' 050	E145° 39' 310		N43° 34' 824	E145° 23' 659	
5	N43° 20' 920	E145° 49' 560		N43° 25' 640	E145° 39' 310		N43° 37' 685	E145° 19' 712	
6	N43° 20' 000	E145° 50' 820		N43° 28' 050	E145° 39' 310		N43° 25' 975	E145° 42' 989	
7	N43° 15' 080	E145° 36' 800		N43° 24' 050	E145° 46' 840		N43° 28' 846	E145° 39' 067	
8	N43° 13' 510	E145° 38' 940		N43° 24' 710	E145° 46' 840		N43° 20' 920	E145° 49' 560	
9	N43° 11' 830	E145° 41' 190		N43° 20' 920	E145° 49' 560		N43° 20' 000	E145° 50' 820	
10	N43° 10' 790	E145° 33' 680		N43° 20' 000	E145° 50' 820		N43° 17' 200	E145° 43' 100	
11	N43° 09' 540	E145° 35' 450		N43° 17' 200	E145° 43' 100		N43° 15' 700	E145° 45' 200	
12	N43° 08' 240	E145° 37' 190		N43° 15' 700	E145° 45' 200		N43° 14' 800	E145° 47' 300	
13				N43° 14' 800	E145° 47' 300		N43° 15' 080	E145° 36' 800	
14				N43° 12' 600	E145° 49' 500		N43° 13' 510	E145° 38' 940	
15				N43° 15' 080	E145° 36' 800		N43° 11' 830	E145° 41' 190	
16				N43° 13' 510	E145° 38' 940		N43° 09' 700	E145° 44' 000	
17				N43° 11' 830	E145° 41' 190		N43° 10' 790	E145° 33' 680	
18				N43° 09' 700	E145° 44' 000		N43° 09' 540	E145° 35' 450	
19				N43° 10' 790	E145° 33' 680		N43° 08' 240	E145° 37' 190	
20				N43° 09' 540	E145° 35' 450		N43° 10' 774	E145° 26' 055	
21				N43° 08' 240	E145° 37' 190		N43° 09' 342	E145° 28' 013	
22				N43° 04' 300	E145° 40' 000		N43° 06' 477	E145° 31' 924	
23							N43° 03' 611	E145° 35' 829	
24							N43° 09' 692	E145° 20' 672	
25							N43° 06' 831	E145° 24' 589	
26							N43° 03' 968	E145° 28' 500	



*Fig. 1-1. Map of survey stations in 2006*

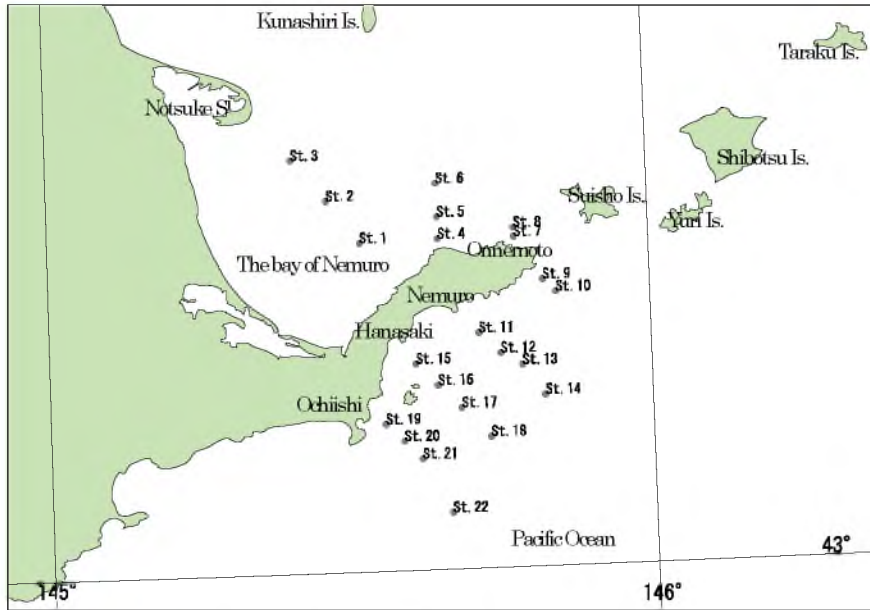


Fig. 1-2. Map of survey stations in 2007

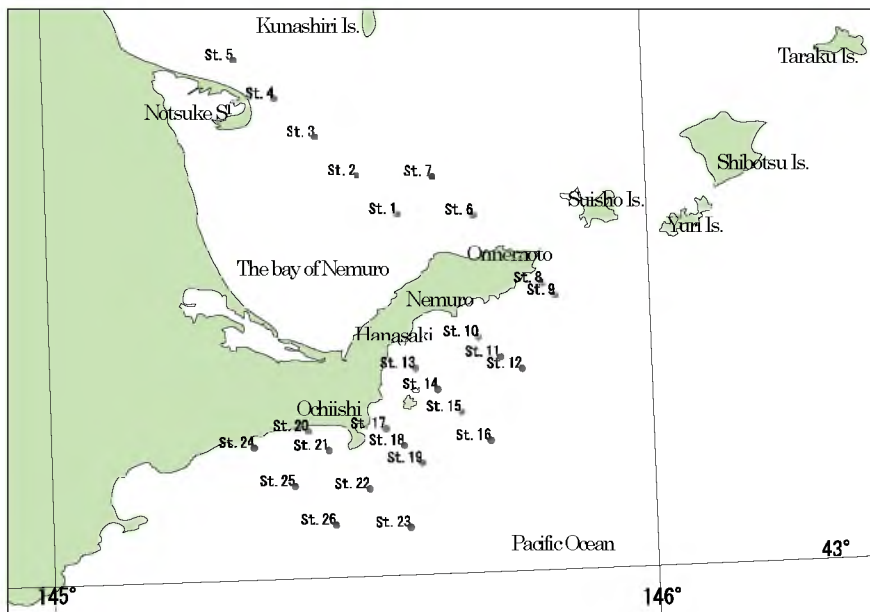
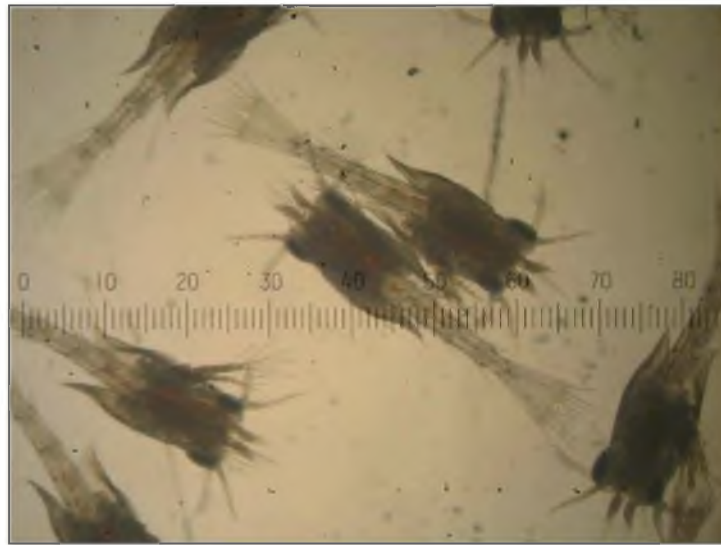


Fig. 1-3. Map of survey stations in 2008

The number of sampling station in 2006 survey was 4 stations in the water of Nemuro Bay side, 8 stations in the Pacific side, and total of 12 stations; in 2007 survey, 8 stations in the Nemuro Bay side, 14 stations in the Pacific side, and total of 22 stations; in 2008 survey, 7 stations in the Nemuro Bay side, 19 stations in the Pacific side, and total 26 stations.

The species and stage identification was based on taxonomical keys of larvae by Kurata (1956), determined through morphological observation under microscope (**photo 2, 3**). As for the identification of sample obtained by 2008 survey was contacted to Marine Biological Research Institute of Japan Co., Ltd. In identification of sample from each of survey, the alcohol fixed samples of each developmental stage, obtained through seed production by Nemuro City Fisheries Research Institute, were used as the reference.



*Photo 2. Zoea larvae*



*Photo 3. Glaukotoe larvae*

### 3. RESULTS OF SURVEYS

#### 3.1. Sampled individuals and appearance of each developmental stages in the series of surveys

In the survey performed in the water off Ochi-ishi in 1984 and 1985 (Torisawa et al., 1999), Hanasaki crab larvae was not sampled in the last 10-days of April 1984, then zoea-I appeared in the middle 10-days of May, zoea-II and III in the middle 10-days of June, and zoea-III in the last 10-days of June, after that no planktonic larvae of Hanasaki crab was sampled by the end of survey in the middle 10-days of July (**table 2**). In the survey of 1985, the larvae were sampled at any of sampling point in every sampling from the start of sampling in the first 10-days of May to the end in the middle 10-days of June. The stage of larvae was zoea-I in the first 10-days of May, and then as progress of time, the stages of larvae proceeded to further developed ones and it was glaukotoe stage at the end of sampling in the middle 10-days of June (**table 2**). In both years, the water temperature during the period when planktonic larvae of Hanasaki crab larvae was sampled was about 2–6°C.

In the survey of 2006, the total number of all the larvae sampled was 777 individuals, and 507 individuals in the first 10-days of May, 270 individuals in the first 10-days of June, and after that decreased gradually (**table 3**). Among them, the planktonic larvae of Hanasaki crab was sampled 57 individuals. As for developmental stages, 16 and 36 individuals for zoea-I and II in the first 10-days of May, 4 individuals of zoea-III and 1 individual of glaukotoe in the first 10-days of June (**table 2**).

In the 2007 survey, the total number of all the larvae sampled was 5,604 individuals, and peaked as 1,841 individuals in the first 10-days of May and, decreased as the lapse of time, 851 individuals in the middle 10-days of June (**table 3**). Among them, the Hanasaki crab larvae were 51 individuals. The zoea-II and III was 1 individual each in the first 10-days of May, 51 individuals of zoea-III in the last 10-days of May, and 1 individual of glaukotoe larva in the first 10-days of June (**table 2**).

In the 2008 survey, the total number of all the larvae sampled was 15,458 individuals, peaked at 5,242 individuals in the last 10-days of April, and decreased to 2,490 individuals in the last 10-days of June (**table 3**). As for the Hanasaki crab larvae, 3 individuals of zoea-II in the last 10-days of April, and 2 individuals of zoea-III in the last 10-days of May were sampled, and no sampled individuals from the early 10-days to middle 10-days of May and the middle 10-days of June (**table 2**).

**Table 2**

**Results of field survey of planktonic larvae of Hanasaki Crab in 1984,  
1985, 2006, 2007 and 2008 (\*: data from Torisawa et al., 1999)**

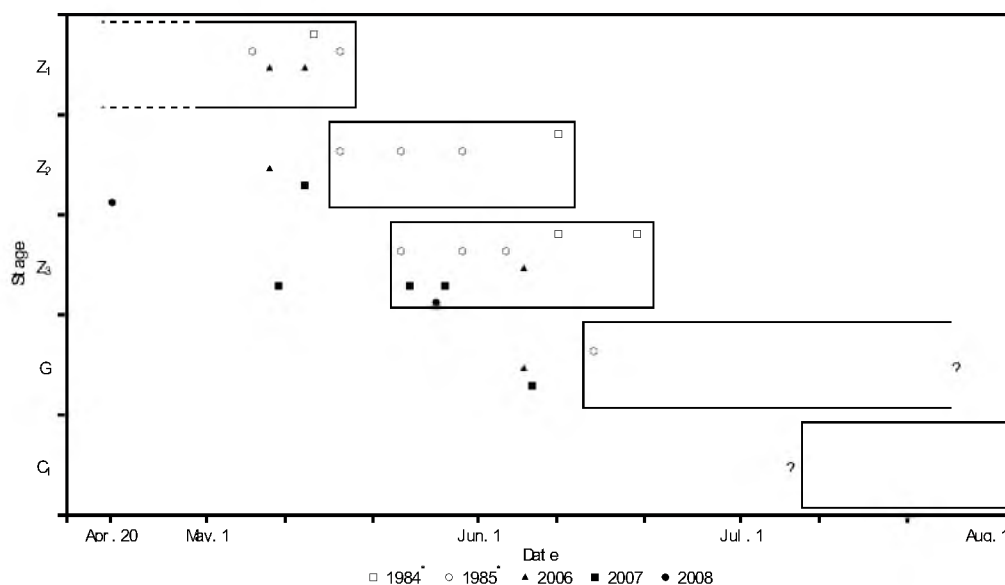
Date	Stage																			
	1984*				1985*				2006				2007				2008			
	Z <sub>1</sub>	Z <sub>2</sub>	Z <sub>3</sub>	G	Z <sub>1</sub>	Z <sub>2</sub>	Z <sub>3</sub>	G	Z <sub>1</sub>	Z <sub>2</sub>	Z <sub>3</sub>	G	Z <sub>1</sub>	Z <sub>2</sub>	Z <sub>3</sub>	G	Z <sub>1</sub>	Z <sub>2</sub>	Z <sub>3</sub>	G
Apr. 20	0	0	0	0																
Apr. 21																	0	3	0	0
Apr. 23																	0	0	0	0
Apr. 24																	0	0	0	0
Apr. 27	0	0	0	0																
May. 07					35	0	0	0												
May. 09									12	36	0	0					0	0	0	0
May. 10													0	0	1	0	0	0	0	0
May. 12																	0	0	0	0
May. 13									4	0	0	0	0	1	0	0				
May. 14	10	0	0	0																
May. 16													0	0	0	0				
May. 17					2	6	0	0												
May. 24					0	29	8	0												
May. 25													0	0	36	0				
May. 28																	0	0	2	0
May. 29													0	0	15	0	0	0	0	0
May. 31					0	8	78	0												
Jun. 02																	0	0	0	0
Jun. 04													0	0	0	0				
Jun. 05					0	0	15	0												
Jun. 06									0	0	0	0								
Jun. 07									0	0	4	1								
Jun. 08													0	0	0	1				
Jun. 11	0	1	4	0	0	0	0	0												
Jun. 13													0	0	0	0				
Jun. 15					0	0	0	4												
Jun. 16																	0	0	0	0
Jun. 17																	0	0	0	0
Jun. 18																	0	0	0	0
Jun. 20	0	0	1	0																
Jun. 26													0	0	0	0				
Jun. 27	0	0	0	0									0	0	0	0				
Jun. 28													0	0	0	0				
Jul. 06	0	0	0	0																
Jul. 10	0	0	0	0																
Jul. 17	0	0	0	0																
Subtotal	10	1	5	0	37	43	101	4	16	36	4	1	0	1	52	1	0	3	2	0
Total	16				185				57				54				5			

**Table 3**

**Total number of individuals sampled**

Kind/Stage	2006		2007				2008			Subtotal		
	May	June	May		June		April	May (June)			June	
	9-13	6-7	10-16	25-29	4-13	20-28	21-24	9-12	28-2		16-18	
<i>P. brevipes</i>	Z <sub>1</sub>	16									16	
	Z <sub>2</sub>	36		1				3			40	
	Z <sub>3</sub>		4	1	51					2	58	
	G		1			1					2	
<i>T. cheiragonus</i>	Z <sub>1</sub>	168										
	Z <sub>2</sub>	107										
	Z <sub>3</sub>		6	830	711	1,031	727	637	2,167	2,130	2,309	11,028
	Z <sub>4</sub>		23									
	Z <sub>5</sub>		54									
	G		24				104					
<i>Anomura</i>	Z <sub>1</sub>											
	Z <sub>2</sub>											
	Z <sub>3</sub>	180	147	1,009	534	77	123	4,602	1,747	1,680	181	10,695
	Z <sub>4</sub>											
G		11		389	14	1						
Total	507	270	1,841	1,685	1,227	851	5,242	3,914	3,812	2,490	21,839	

Comparing the appearance of Hanasaki crab larvae of each developmental stages between survey of 1984/1985, 2006, 2007, and 2008, the appearance of zoea-II and III, and glaukotoe became a little earlier, and especially, the appearance of zoea-III in 2007 and zoea-II in 2008 become considerably earlier, from which the tendency of earlier appearance of planktonic larvae can be observed in recent three years (**fig. 2**). And further, this earlier appearance of planktonic larvae of each developmental stage suggests earlier start of hatch-out period in the water around Nemuro Peninsula.



**Fig. 2.** Comparison of appearing time of Hanasaki Crab larvae of different developmental stages, among surveys in 1984, 1985, 2006, 2007 and 2008 (\*: data from Torisawa et al., 1999)



### 3.2. Geographical distribution of planktonic larvae of Hanasaki crab in each survey

In the 2006 survey, zoea-I larvae were sampled in the first 10-days of May, at Station 5, off Goyomai, 43°20'900N, 145°49'560E, and at Station 7, off Hanasaki, 43°15'080N, 145°36'800E, and zoea-II at Station 7, off Hanasaki and Station 10, off Ochi-ishi, 43°10'790N, 145°33'680E. In the first 10-days of June, zoea-III larvae were sampled at Station 8, off Hanasaki, 43°13'510N, 145°38'940E, and at Station 11, off Ochi-ishi, 43°09'540N, 145°35'450E, and glaukotoe larva was at Station 10, off Ochi-ishi (fig. 3-1, 3-2).

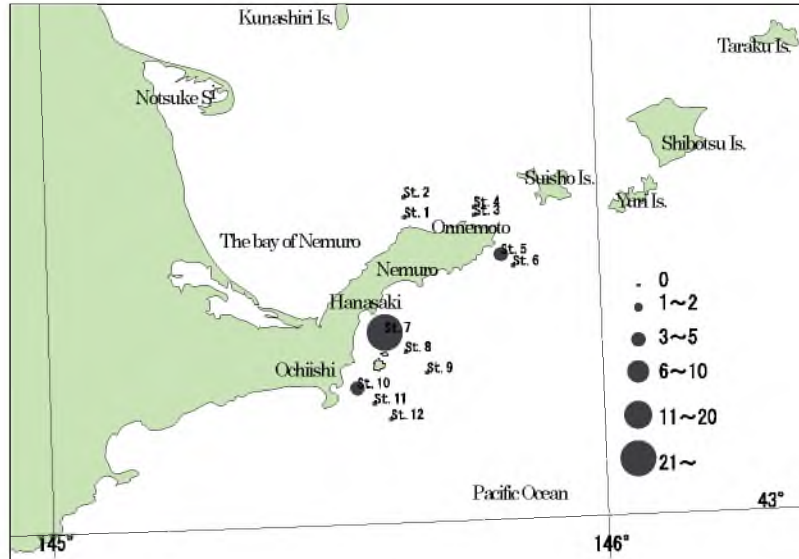


Fig. 3-1. The distribution of Hanasaki Crab larvae during the period of survey. (The 1<sup>st</sup> 10days of May in 2006)

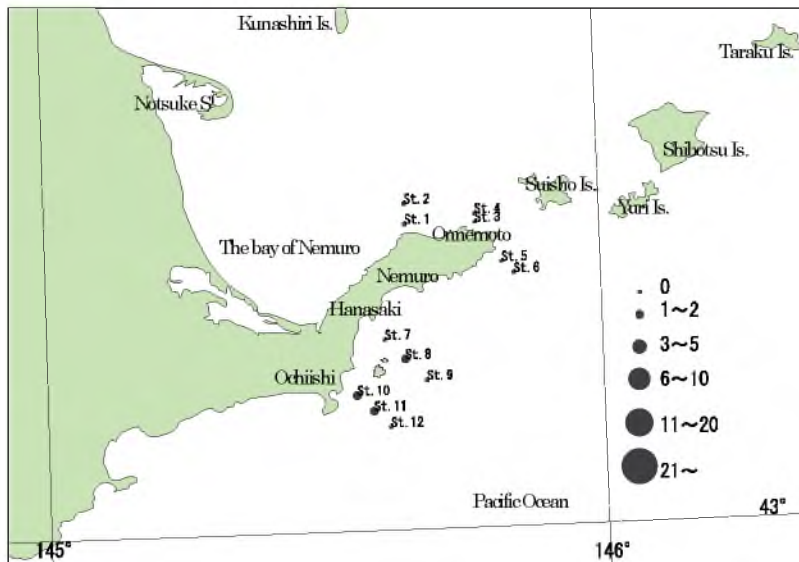
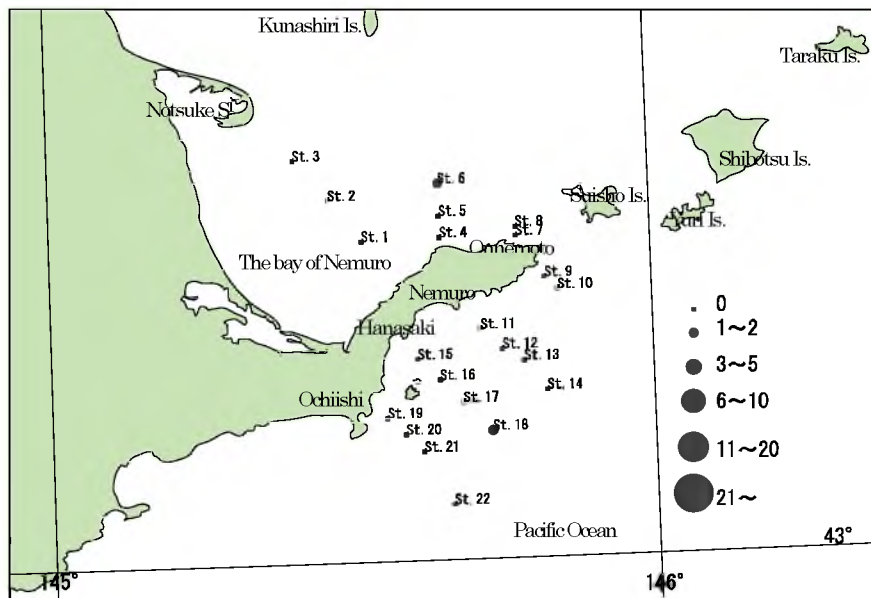


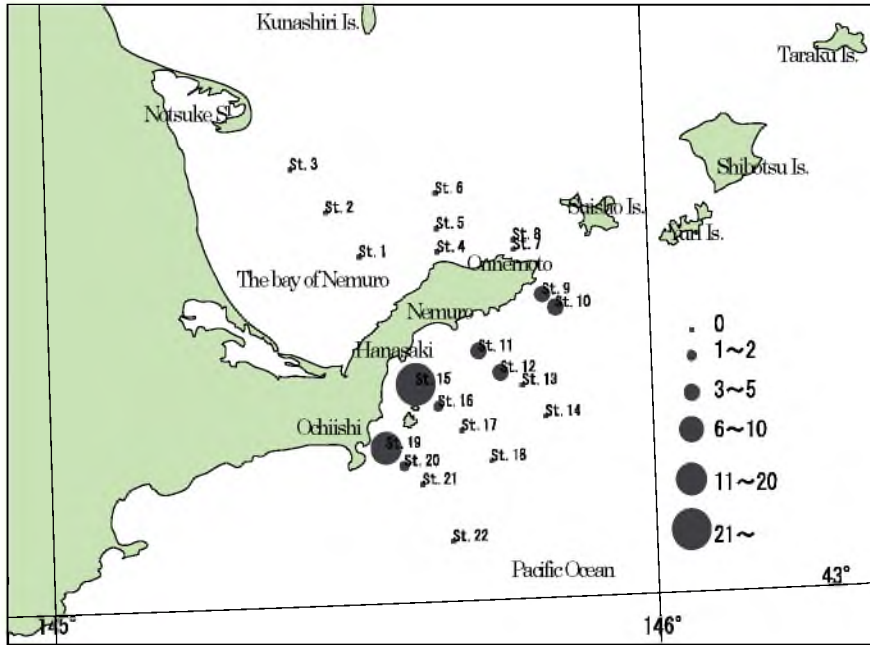
Fig. 3-2. The distribution of Hanasaki Crab larvae during the period of survey. (The 1<sup>st</sup> 10days of June in 2006)

In the 2007 survey, zoea-III larvae were sampled on May 10 at Station 6, off Onnemoto, 43°28'050N, 145°39'310E; zoea-II on May 13, at Station 18, off Hanasaki, 43°09'700N, 145°44'000E; zoea-III was sampled on May 29 at Station 9, off Goyomai, 43°20'920N, 145°49'560E, at Station 10, off Ochi-ishi, 43°10'790N, 145°33'680E, at Station 11, off Tomoshiri, 43°17'200N, 145°43'100E, and at Station 12, 43°15'700N, 145°45'200E; on May 25 zoea-III were sampled at Stations 15 (43°15'080N, 145°36'800E) and 16 (43°13'510N, 145°38'940E), off Hanasaki, and Stations 19 (43°10'790N, 145°33'680E) and 20 (43°09'540N, 145°35'450E), off Ochi-ishi. On June 8, at Station 19 off Ochi-ishi, glaukotoe larva was sampled. During June 26–28, no Hanasaki crab larva was sampled at any stations (fig. 3).

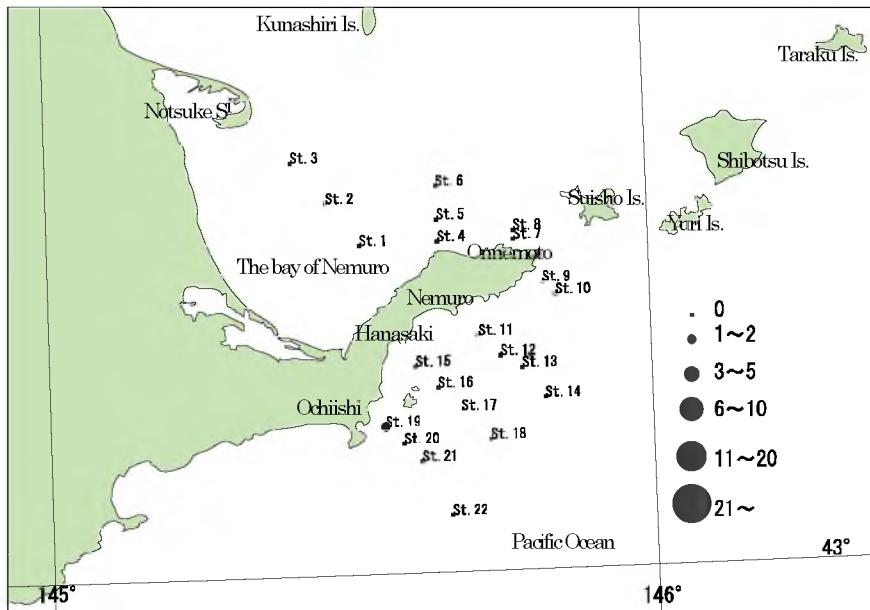
In the survey of 2008, zoea-II were sampled on April 21 at Stations 13 (43°15'080N, 145°36'800E) and 20 (43°10'774N, 145°26'055E), and 24 (43°09'692N, 145°20'67E); and zoea-III were sampled on May 28 at Stations 17 (43°10'790N, 145°33'680E) and 24 (43°09'692N, 145°20'672E). Zoea-I and glaukotoe larva was not sampled during this survey. Further, Hanasaki crab larva was not sampled from Nemuro Bay and water around Notsuke peninsula (fig. 3).



**Fig. 3-3.** The area of distribution Hanasaki Crab larvae during the period of survey. (The 1<sup>st</sup> 10 days of May in 2007)



**Fig. 3-4.** The area of distribution Hanasaki Crab larvae during the period of survey. (The 3<sup>rd</sup> 10days of May in 2007)



**Fig. 3-5.** The distribution of Hanasaki Crab larvae during the period of survey. (The 1<sup>st</sup> 10days of June in 2007)

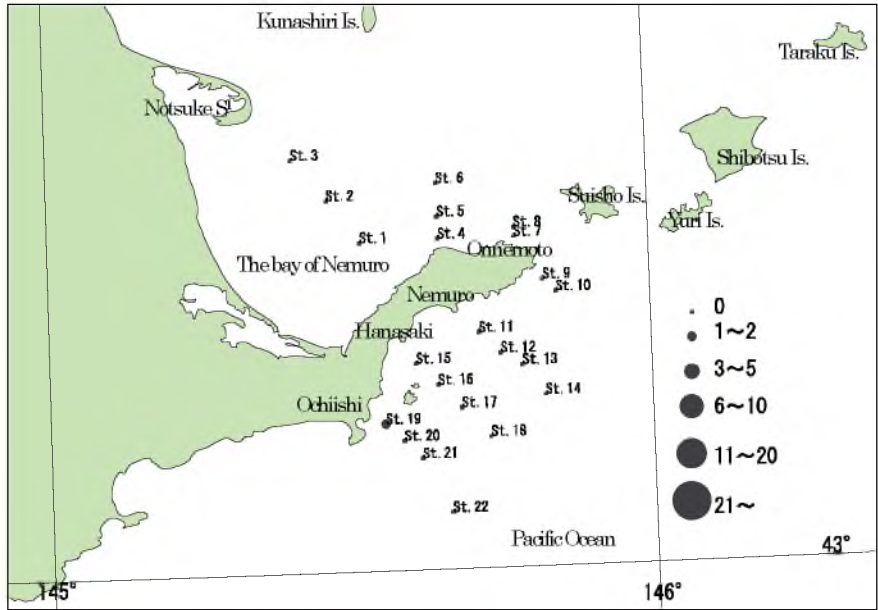


Fig. 3-6. The distribution of Hanasaki Crab larvae during the period of survey. (The 3<sup>rd</sup> 10days of June in 2007)

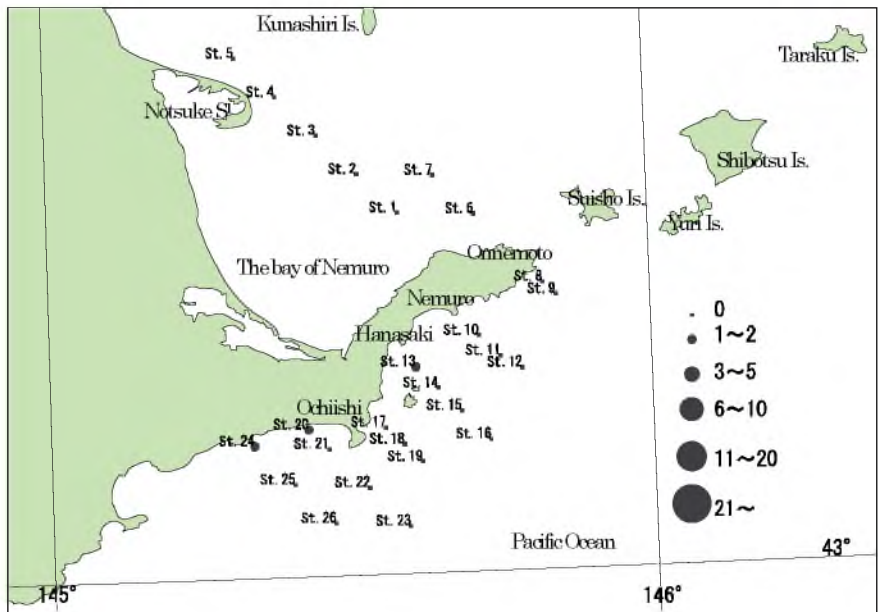
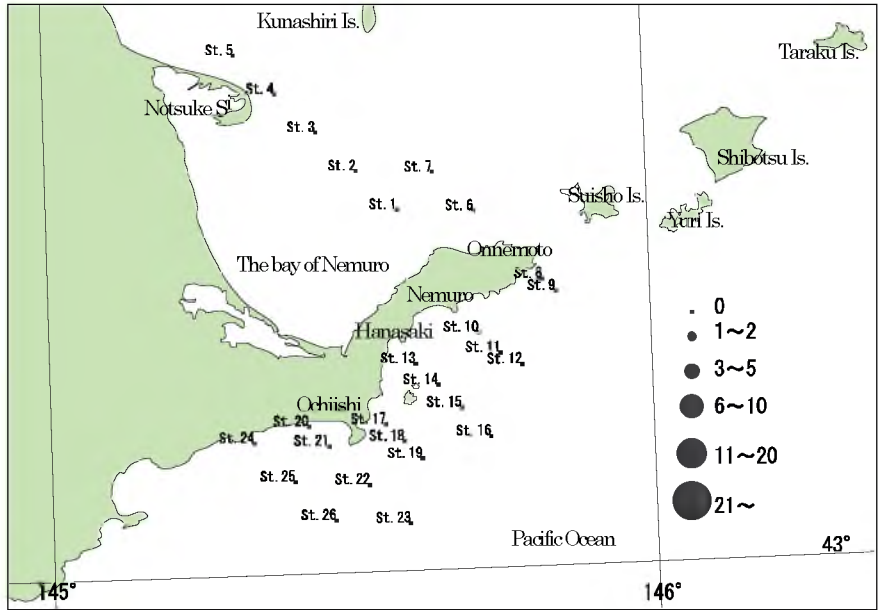
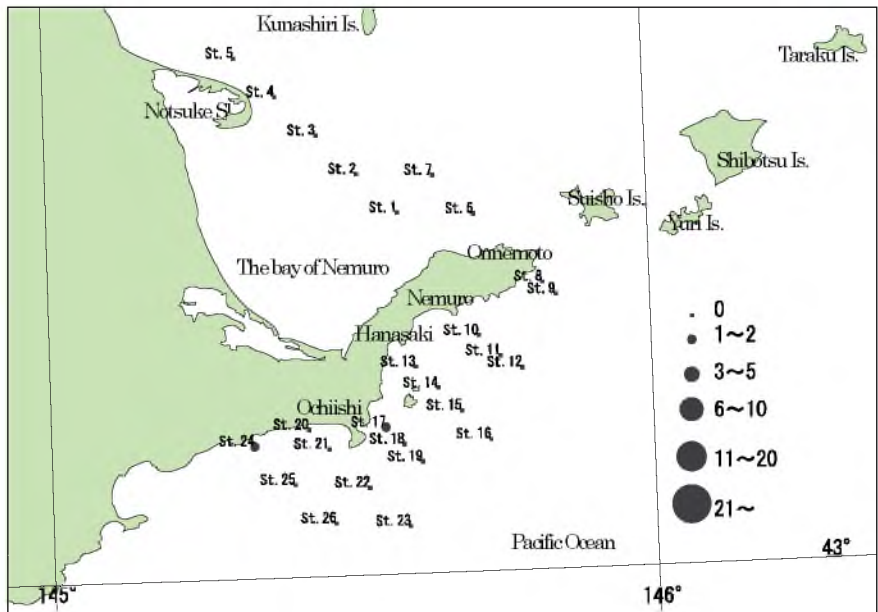


Fig. 3-7. The distribution of Hanasaki Crab larvae during the period of survey. (The 3<sup>rd</sup> 10days of April in 2008)



*Fig. 3-8. The distribution of Hanasaki Crab larvae during the period of survey. (The 3<sup>rd</sup> 10days of May in 2008*



*Fig. 3-9. The distribution of Hanasaki Crab larvae during the period of survey. (The 3<sup>rd</sup> 10days of May in 2008)*

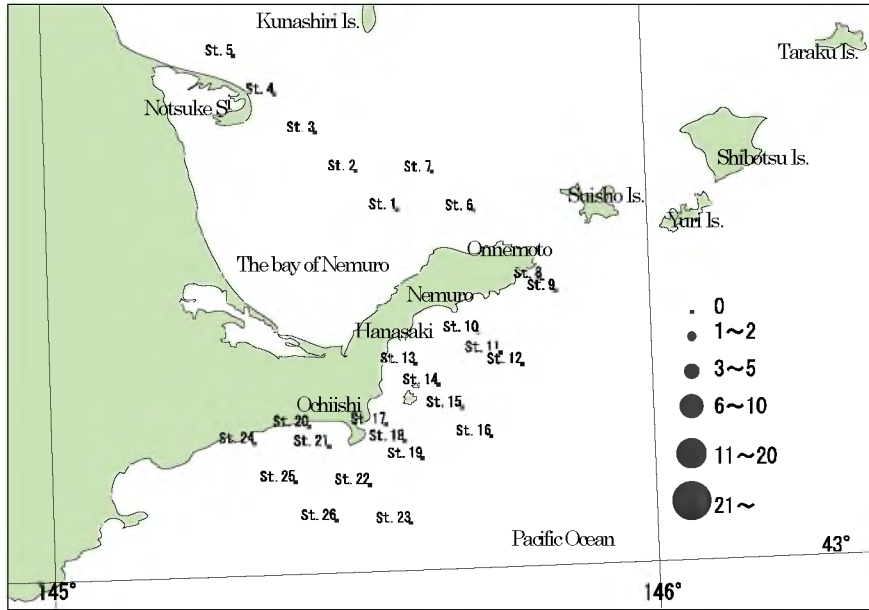


Fig. 3-10. The distribution of Hanasaki Crab larvae during the period of survey. (The 2<sup>nd</sup> 10days of June in 2008)

### 3.3. Temperature and salinity of the water distributing planktonic larvae of Hanasaki crab

Torisawa et al. (1999) reports, from their results of survey in 1984 and 1985 off Ochi-ishi, that the water temperature of 15m deep during survey period when planktonic Hanasaki crab larvae sampled was almost in the range of 2–6°C.

In **table 4**, the surface water temperature (°C), 15m depth temperature (°C), and surface salinity (‰), at the station during the period when planktonic larvae of Hanasaki crab were sampled in 2006, 2007, and 2008 surveys. At the survey of 2006, the range of surface water temperature was 3.5°C in the first 10-days of May to 7.3°C in the first 10-days of June; 15m depth temperature was about 2.1°C in the first 10-days of May to 5.7°C in the first 10-days of June. At the survey of 2007, surface water temperature was almost from 2.7 to 6.5°C, and 15m depth temperature was almost 2.2 to 5.9°C. At the survey of 2008, the surface water temperature was almost from 1.6 to 5.1°C, and 15m temperature was almost from 1.3 to 4.9°C.

**Table 4****The water temperature and salinity where Hanasaki Crab larvae were sampled**

Date	St. No.	Water temp. (°C)		Salinity (‰)
		Surface	Depth of 15 m	Surface
2006	May. 09	7	3.91	32.31
		10	3.52	32.35
	May. 13	5	4.76	31.74
	Jun. 07	8	6.94	32.24
		10	6.79	32.33
		11	7.26	32.17
2007	May. 10	6	6.70	32.15
	May. 13	18	2.68	32.85
	May. 25	15	5.26	32.31
		16	5.44	32.29
		19	5.36	32.30
		20	4.97	32.41
	May. 29	9	4.73	32.50
		10	4.77	32.49
		11	5.61	32.35
		12	4.41	32.60
Jun. 08	19	6.49	32.35	
2008	Apr. 21	13	1.63	32.26
		20	2.40	32.26
		24	2.64	32.29
	May. 28	17	4.48	32.63
		24	5.09	32.57

Comparing 15m depth temperature of the water off Ochi-ishi, where brooding female crabs are relatively abundant, between surveys from 1984 to 2008, in the last 10-days of April 1984, when the planktonic larvae of Hanasaki crab were not sampled, water temperature was from -1 to below 0.5°C, and in the last 10-days of April 2008, when zoea-II larvae was sampled, water temperature was 1.3°C. Comparing the 15m temperature of the first 10-days of May among each survey, the water temperature of 15m depth in 1984 and 1985 survey were almost 1–2.5°C, while 2007 and 2008 survey showed 15m temperature of almost 3.2–3.8°C, i. e. considerable temperature rise.

**4. SUMMARY**

From the results of five field surveys on the planktonic larvae of Hanasaki crab in 1984, 1985, 2006, 2007, and 2008, in the water around Nemuro Peninsula, the followings can be summarized on the geographical distribution, time of appearance for each developmental stage, and water temperature at sampling stations.

1) Among the water around Nemuro Peninsula, there sampled no planktonic larvae of Hanasaki crab for the Nemuro Bay and water around Notsuke Peninsula;

2) Among the water around Nemuro Peninsula, the waters where planktonic larvae sampled were water off Onnemoto, off Tomoshiri, off Hanasaki, and off Ochi-ishi;

3) Comparing the timing of larval appearance between surveys of 1984 and 1985 and surveys in recent three years, the tendency of earlier appearance in timing of larval appearance for each developmental stage is observed;

4) This earlier appearance of larva of each developmental stage suggests earlier hatch out of Hanasaki crab in the water around Nemuro Peninsula;

5) The earlier appearance of larvae of each developmental stage, and the earlier hatch out suggested by the former fact, are supposed to be caused by rise in the 15m water temperature of distribution area in the last 10-days of April to the first 10-days of May.

### ACKNOWLEDGEMENTS

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### REFERENCES

Hokkai Suisan Shinbun-Sha (1994): Hanasaki crab, pp. 230–234, Production, Processing and Distribution of Crab.

Kudo Ryoji (2007): On the distribution of Hanasaki Crab larvae in the water around Nemuro Peninsula, 35–36, Proceedings of SakhNIRO/Nemuro Joint Workshop for Report and Discussion on Progress in FY2006 and Future Plan of Joint Study on Hanasaki Crab.

Kurata H. (1956): The larval stages of *Paralithodes brevipes* (Decapods, Anomura). Bull. Hokkaido Reg. Fish. Res. Lab., 14, 25–34, 1956. (in Japanese with English abstract).

Torisawa Masaru, Shouji Kohno, Kinori Sakamoto and Isao Hakata (1999): Growth in the early life stage of the spiny king crab, *Paralithodes brevipes* (Decapoda, Anomura) in the Pacific Ocean off the coast of the eastern Hokkaido, Sci. Rep. Hokkaido Fish. Exp. Stn., 55, 161–167.

Kazufumi Yamada, Kudo Ryoji and Nagase Keiichi (2008): Results of survey on planktonic larvae of Hanasaki Crab in the water around Nemuro Peninsula in early summer 2007, 31–34, Proceedings of SakhNIRO/Nemuro Joint Workshop for Report and Discussion on Progress in FY2007 and Future Plan of Joint Study on Hanasaki Crab.