Possible origin and abundant fluctuant mechanism of *Nemopilema nomurai* in the northern part of China Sea

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Research background

Since the middle and end of 1990's, jellyfish blooms happened successively in the northern part of East China Sea and Yellow Sea. This situation was aggravating year by year and causes ecological disaster in these areas.

The main jellyfish which affect on the fishery in the East China Sea and Yellow Sea was *Nemopilema nomurai*, the secondary species was *Cyanea nozakii*, the effect of *Aurelia aurita* and *Sanderia* sp. were less.

The fishing was seriously troubled and the catch decreased sharply.

Harm of macro-jellyfish

Fishing impacted: The net stuffed with jellyfish and swelled to break.

Sea environment deteriorated: Macro-jellyfish prey on zooplankton, fish eggs and larvae, which affect the sea ecosystem balance.

Fishery resource declined: In the sea areas of macro-jellyfish aggregated, all of the species and quantity of fish decreased obviously.

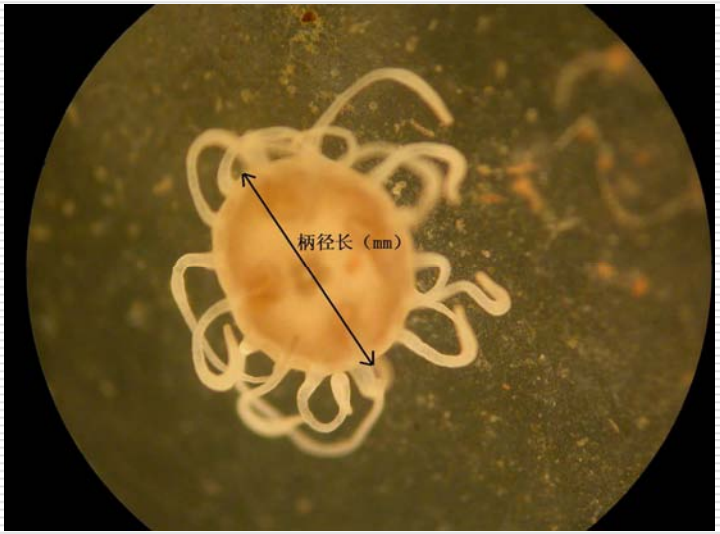
The fishing gears seriously troubled and the catch decreased sharply

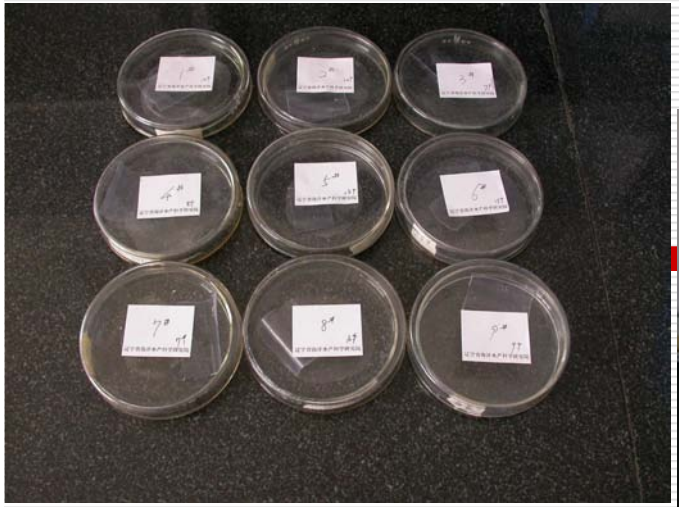
Laboratory experiments-----

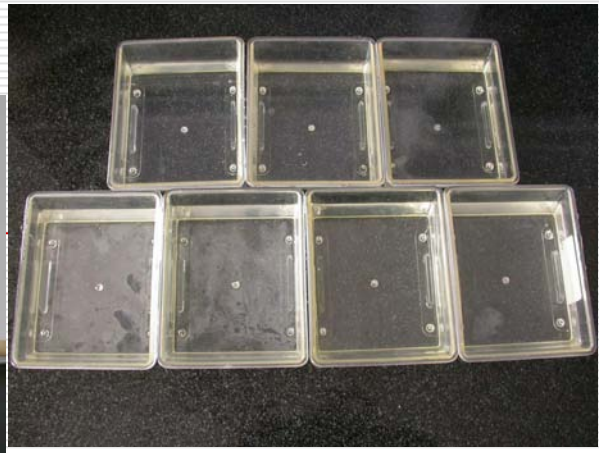
The Effect of Salinity on Survival and Growth of Polyps

Materials and Methods

salinity : 30.5
17 salinity groups: 2.5, 5, 7, 10, 12, 15, 17, 20, 22, 25, 28, 30, 32, 35, 37, 40, 45
scyphistomae amount/group： 10
fed: *Artemia salina* ;once daily
lasting time: 3 months
observation: every day
growth indicator: diameter of the scyphistomae







Survival rate (%) = (The final number of survival/The starting number) *100

Germination rate = (Number of germination/ Number of podocyst) *100

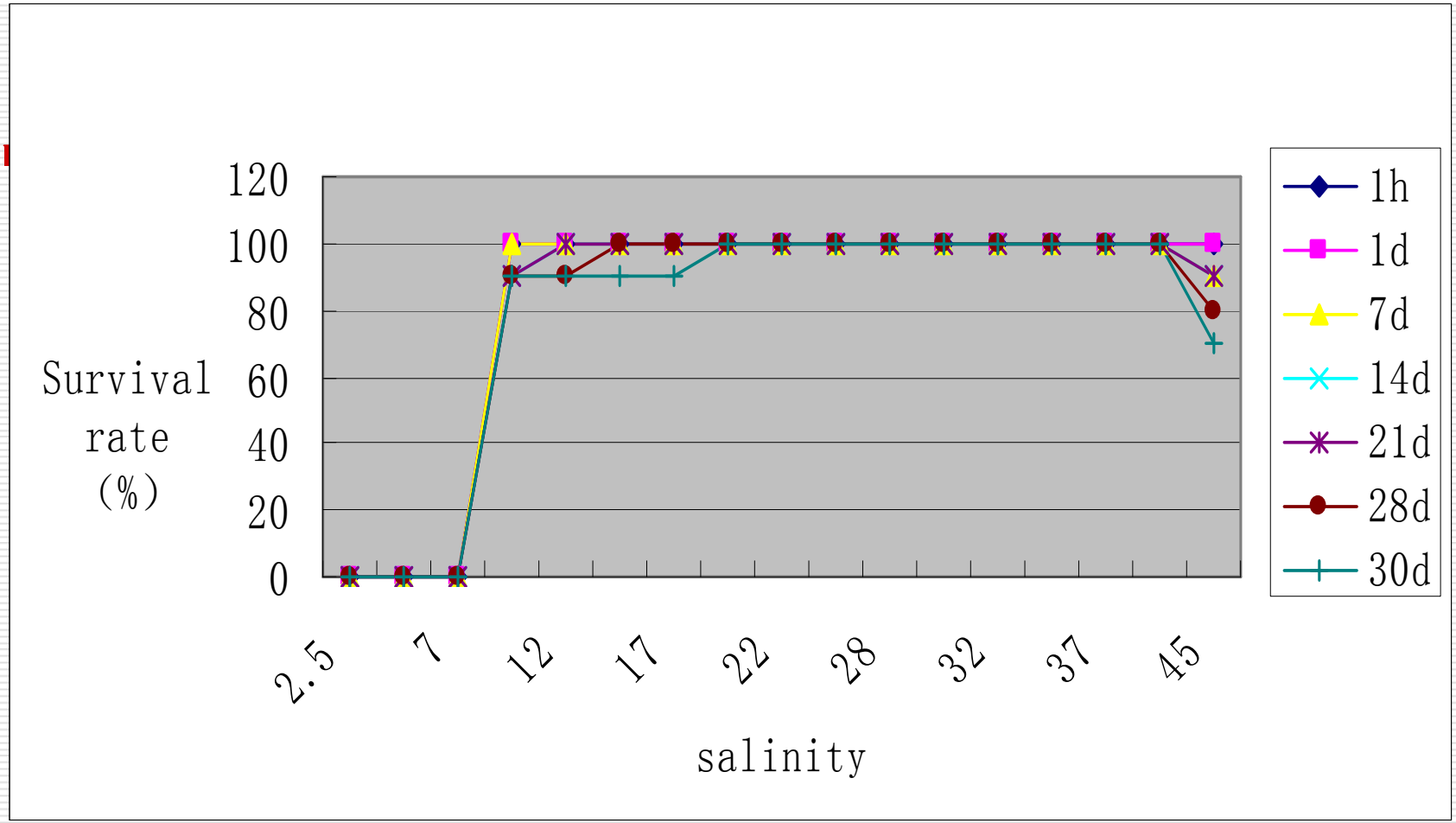
Daily specific growth rate = (Final average diameters – Initial average diameters/ days)

Experiment Result

1. The results of experiment under the salinity mutation

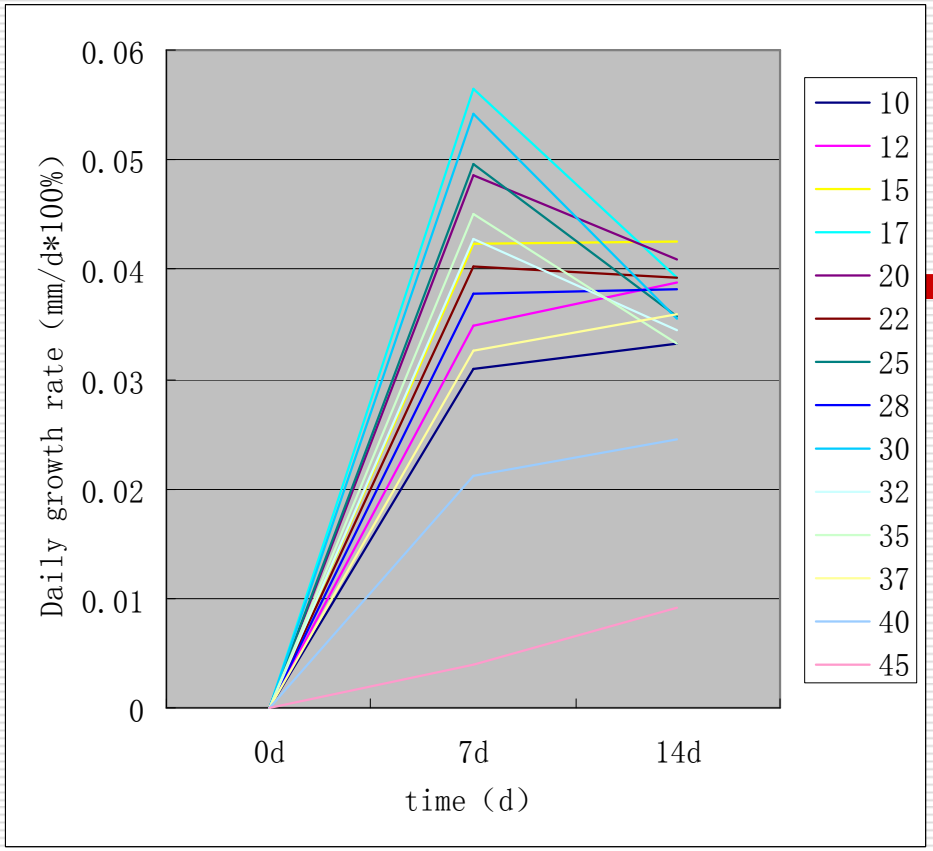
different salinity	The varying state of scyphistomae are added into different salinity from the initial salinity (30.5)
2.5	The scyphistomae are contracted and the color are changing into white, then them are decomposed and die after 5 minute.
5	The scyphistomae are contracted and the color are changing into white, After 10 minute, the tentacles are becoming faint, After 20 minutes, they looks like white cotton decomposed and die after 30 minutes.
7	The scyphistomae are contracted and the color are changing into white, After 15 minute, the tentacles are becoming faint, After 20 minutes, they looks like white cotton, then they are decomposed and die after **40 minutes.**
10	The scyphistomae are contracted and after 30 minute, the tentacles begin to stretch, then recover into good state. one of the scyphistomae died after 14 days. In experiment, we found that some scyphistomae tentacles are recovered in one or two days after they are decomposed. In 30 days, the survival rate is 90%.
12	The scyphistomae are contracted and after 20 minute, the tentacles begin to stretch, then recover into good state. one of the scyphistomae died after 28 days. **In 30 days, the survival rate is 90%.**
15	The scyphistomae are contracted and after 10 minute, the tentacles begin to stretch, then recover into good state. In 28 days, the survival rate is 90%.one of the scyphistomae died in 30 days..
17	The scyphistomae are contracted and after 10 minute, the tentacles begin to stretch, then recover into good state. In 28 days, the survival rate is 90%.one of the scyphistomae died in 30 days..
20-37	The scyphistomae have no changed and in good state when they are added into the salinity, there are no death in 30 days..
40	The scyphistomae have no changed and in good state when they are added into the salinity, there are no death in 30 days.. But they feed little *Artemia* naupii, and merely grew at standstill.
45	The scyphistomae have no changed when they are added into the salinity, On the 1st day, they are in good state, no death. On the 7th day, one of the scyphistomae died, some are still alive when they have no tentacles and no capability to feed. In 30 days, the survival rate is 70%.

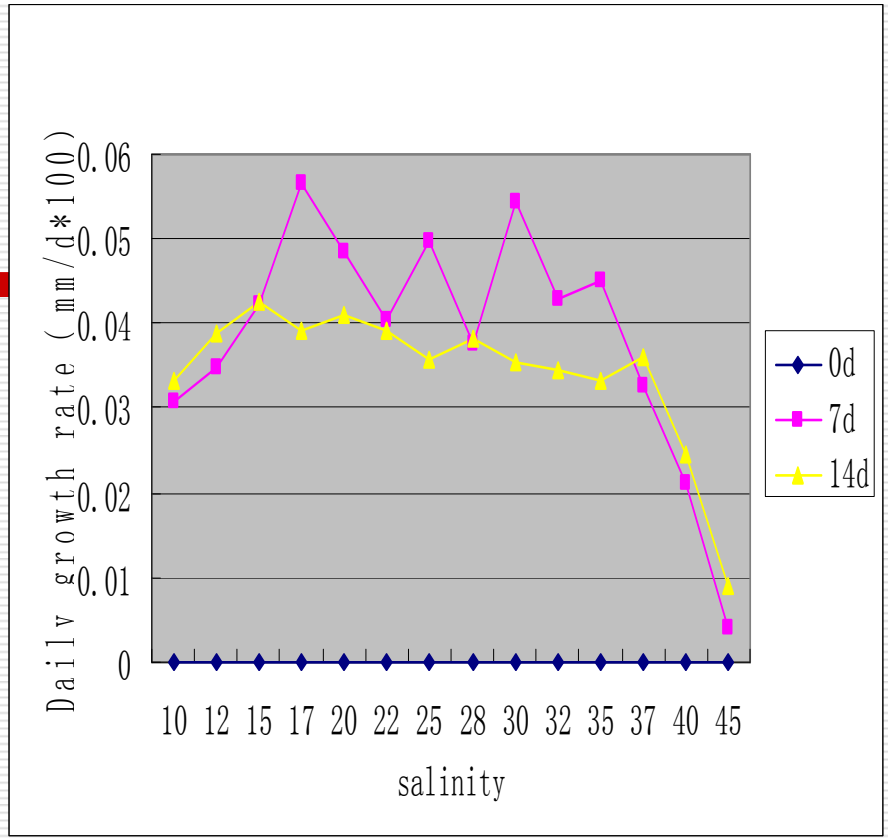
The effect of experiment under the salinity mutation



The lower limit of salinity is 10 for the survival of polyps *N. nomurai*, the upper limit of salinity is 40 and the fairly optimum salinity range for growth is from 17 to 35.

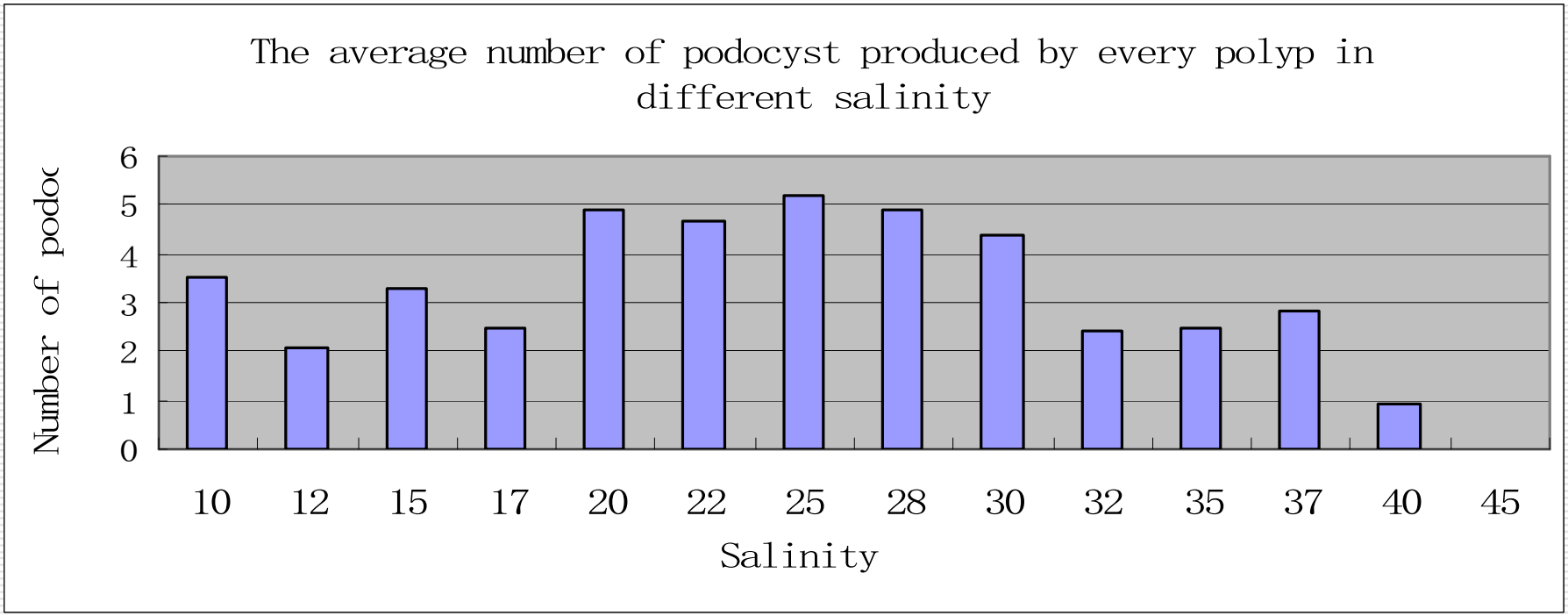
2. The effect of salinity on the growth of scyphistomae





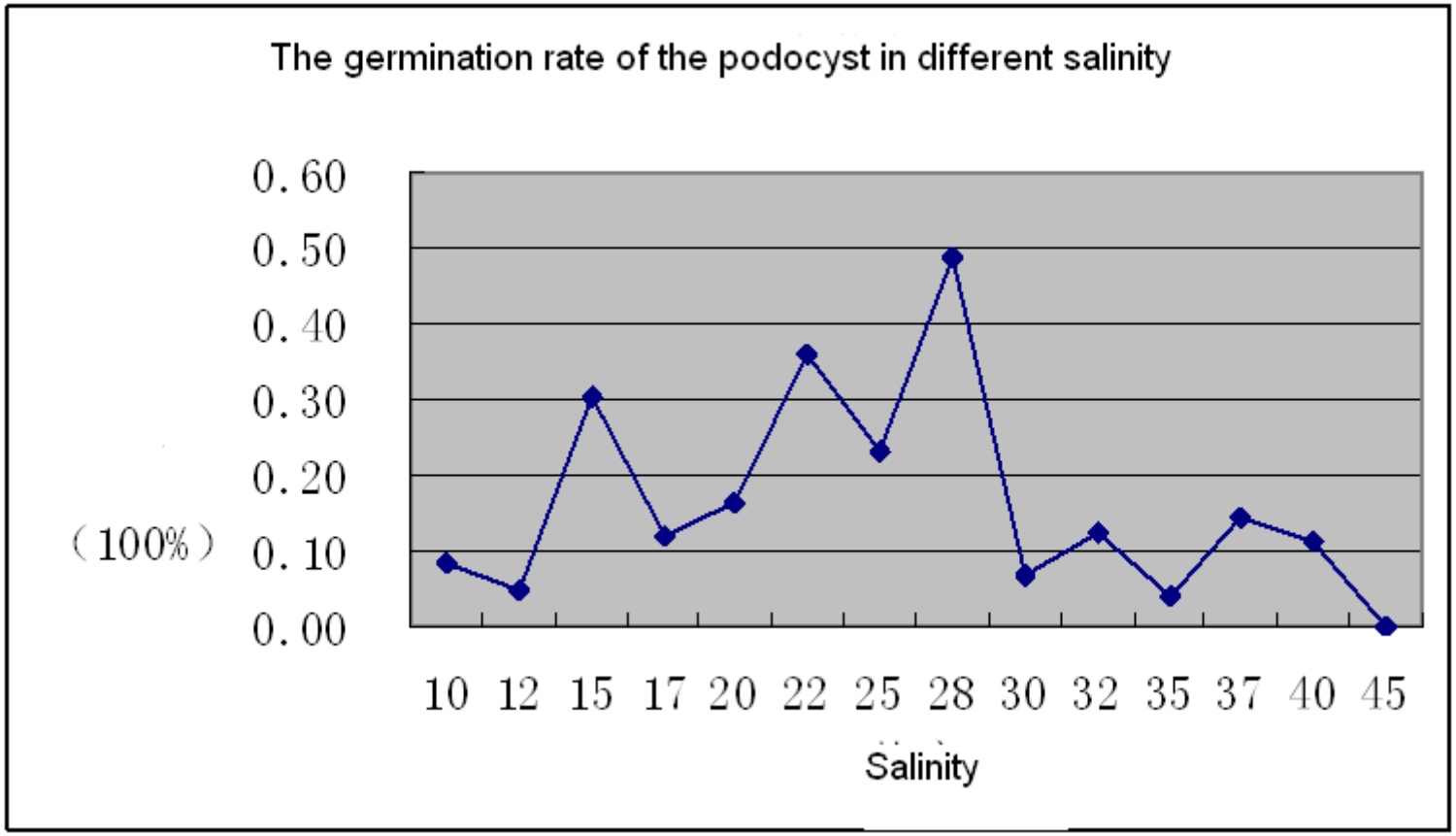
Compared with the results, the growth rate for salinity of 17 to35 are higher than that of other salinity

3. The effect of salinity on the formation of the podocyst of scyphistomae



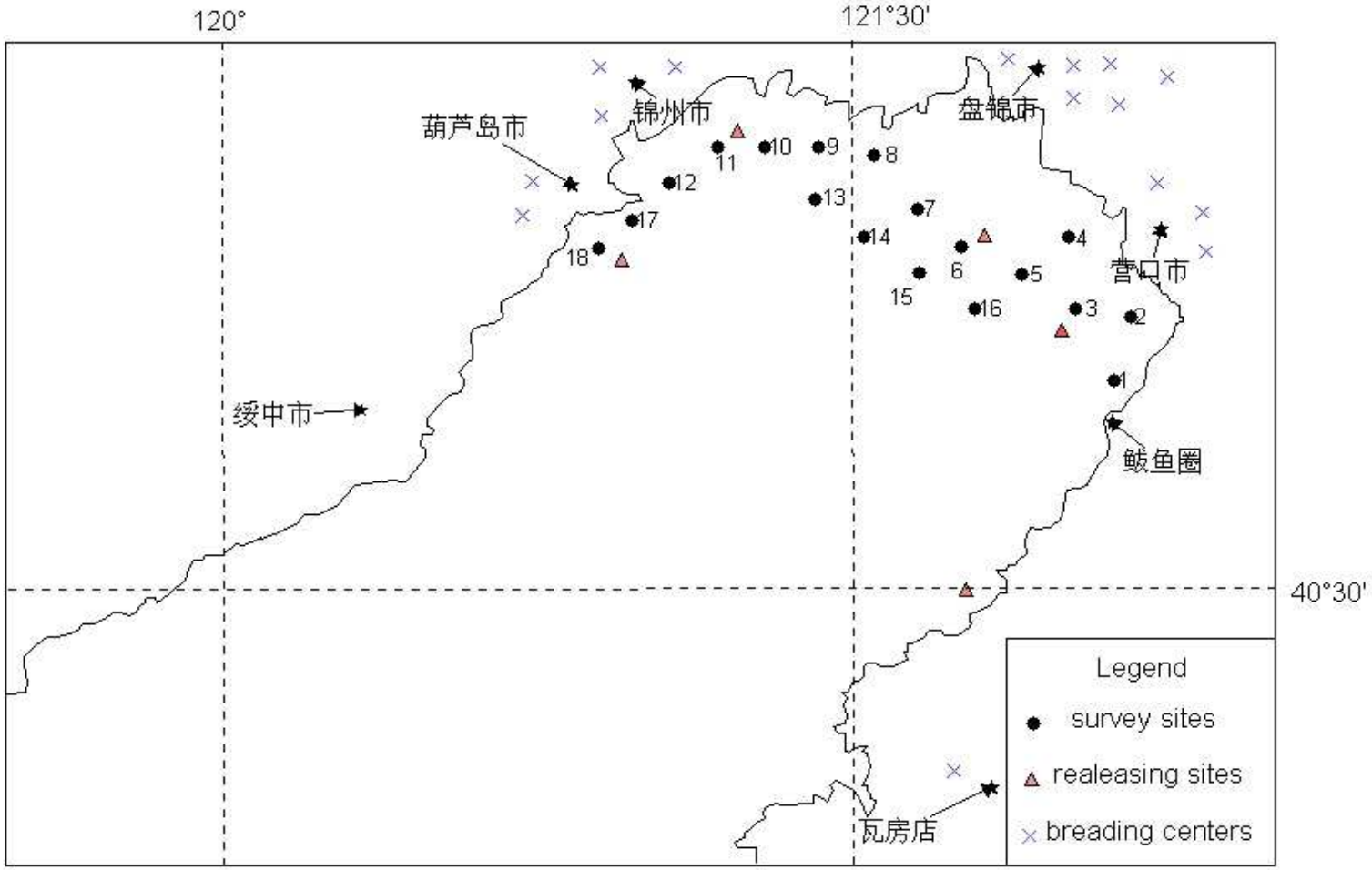
The average number of podocyst produced by every polyp is more than 4 when salinity ranges from 20 to 30, and the number is less than 4 when salinity is higher than 30 or lower than 20. The average number of podocyst produced by every polyp is 5.2 of maximum under salinity 25.

4 The effect of salinity on the germination of the podocyst of scyphistomae

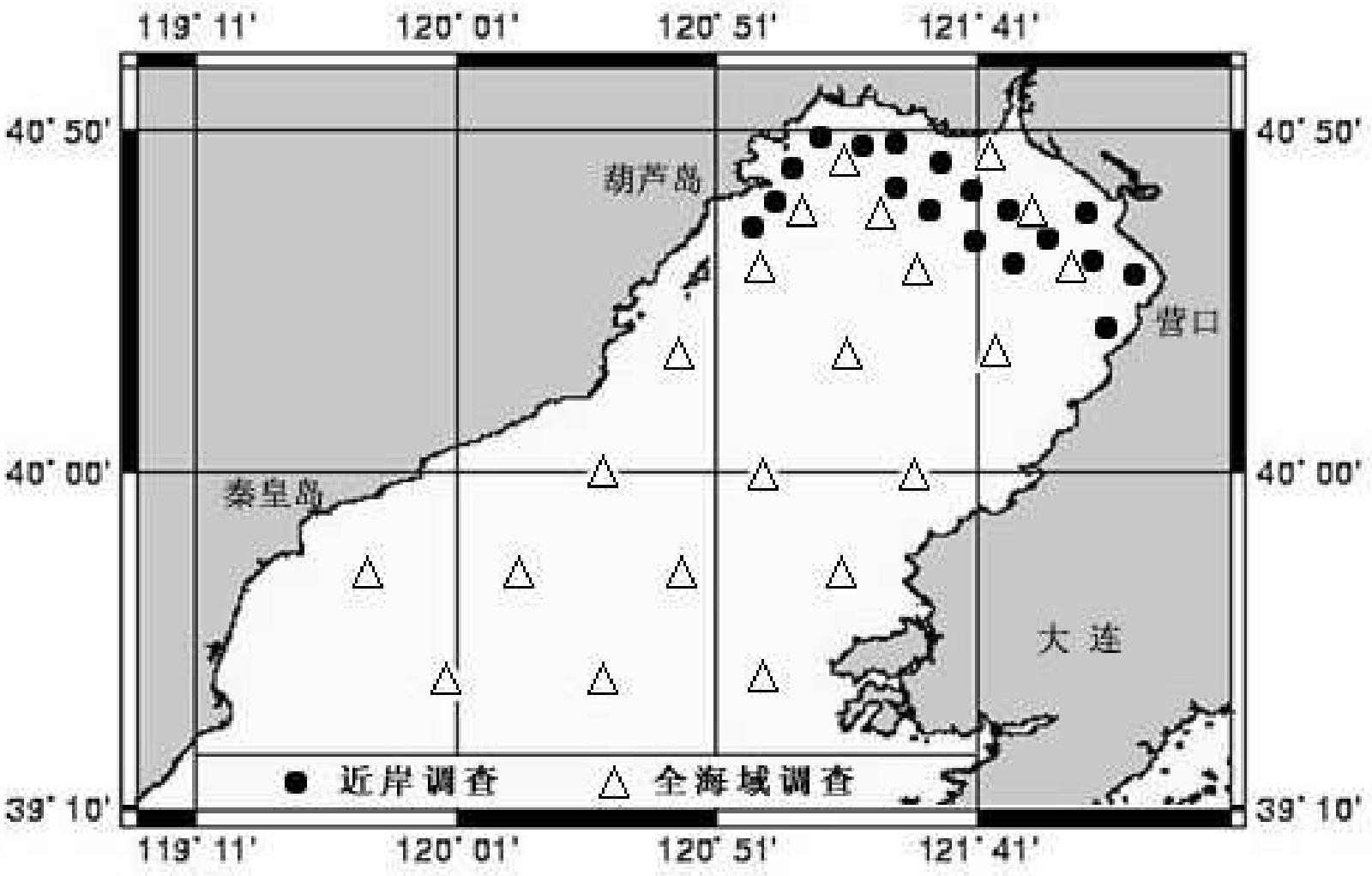


The germination rate of the podocyst is the highest of 49% under 28, and the fairly optimum salinity range for the germination of the podocyst is from 15 to 28.

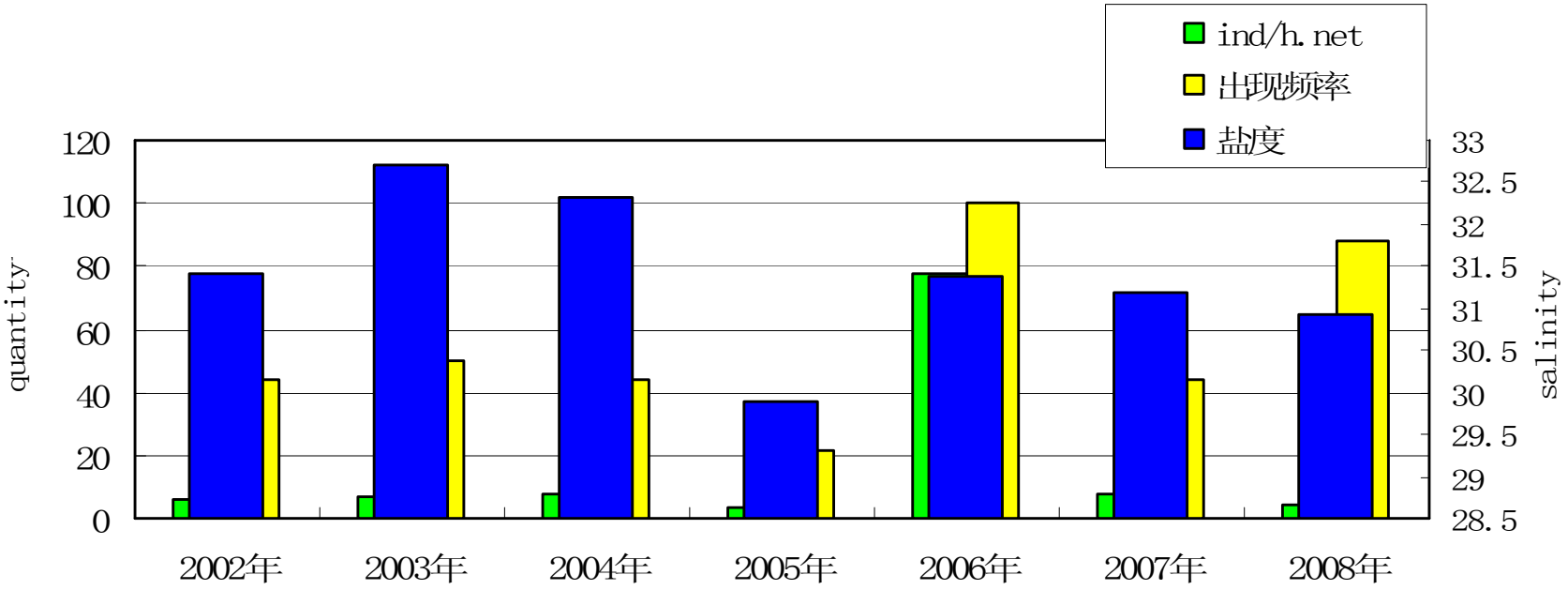
Giant jellyfish investigation in inshore waters in Liaodong Bay



Giant jellyfish investigation in the whole Liaodong Bay



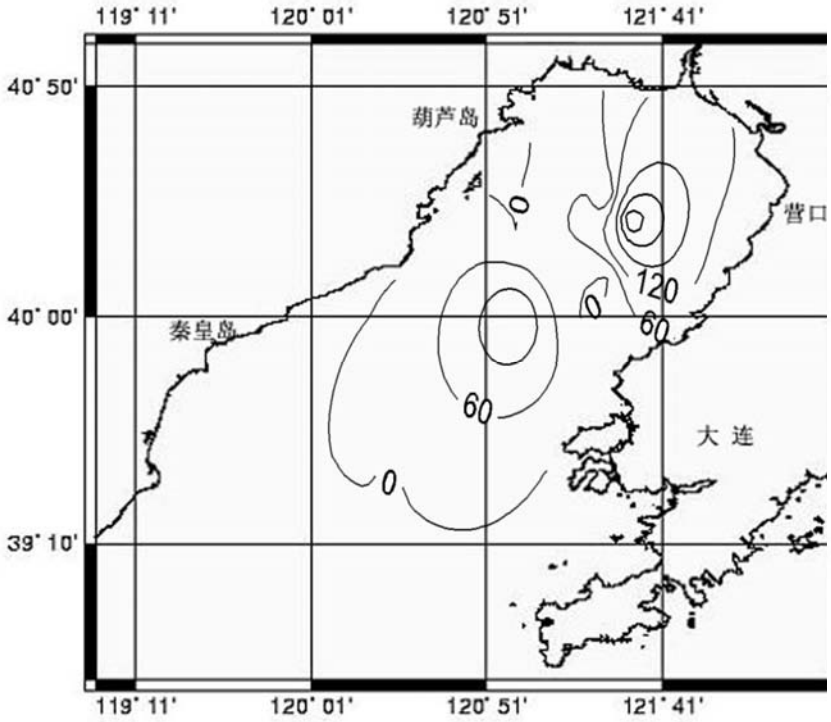
The quantity of the medusae and the salinity changes from 2002 to 2008



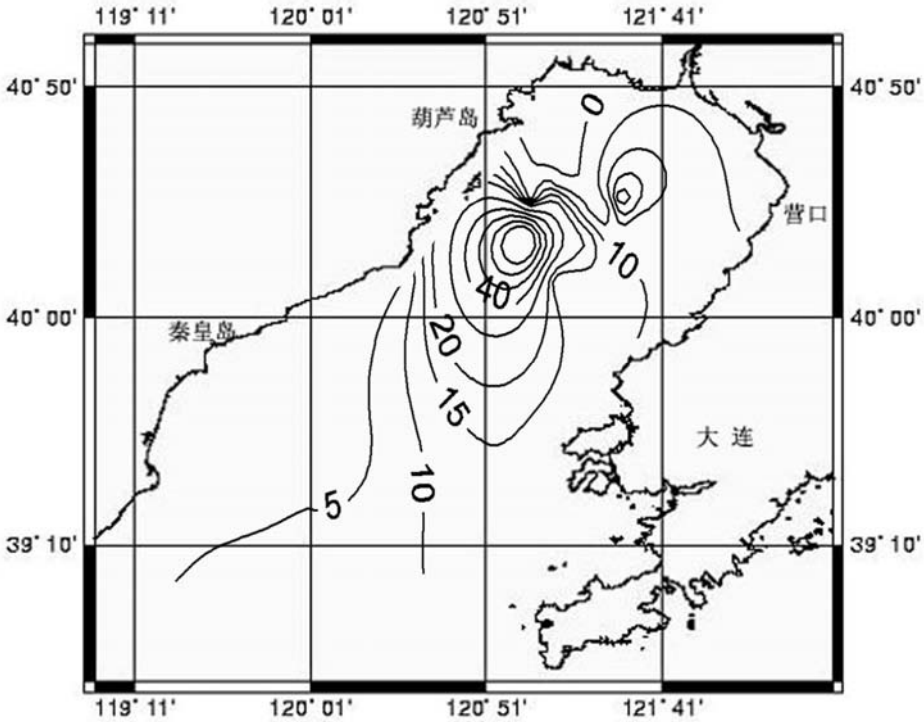
The abundance fluctuant of *N.nomurai* is related to salinity . The higher abundance year of *N.nomurai* occur in the higher salinity year, the average salinity is generally in the range of 30 to 32, but the amount of *N.nomurai* decrease when the average salinity is more than 32.0 or less than 30.

Dynamic distribution of *N. nomurai* in liaodong Bay

June,2008



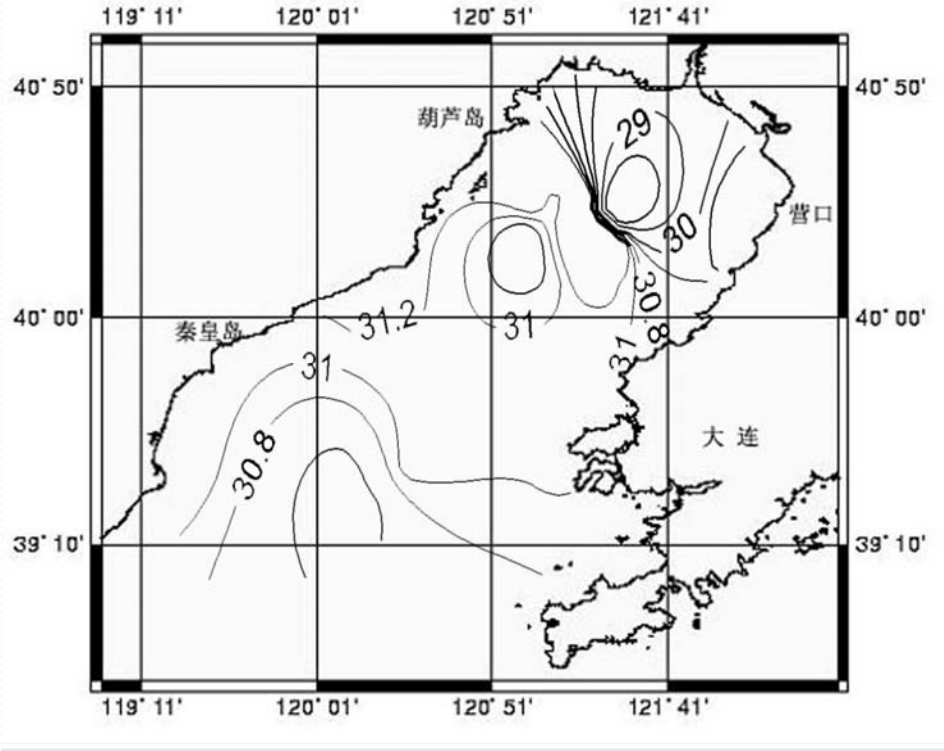
June to August,2008



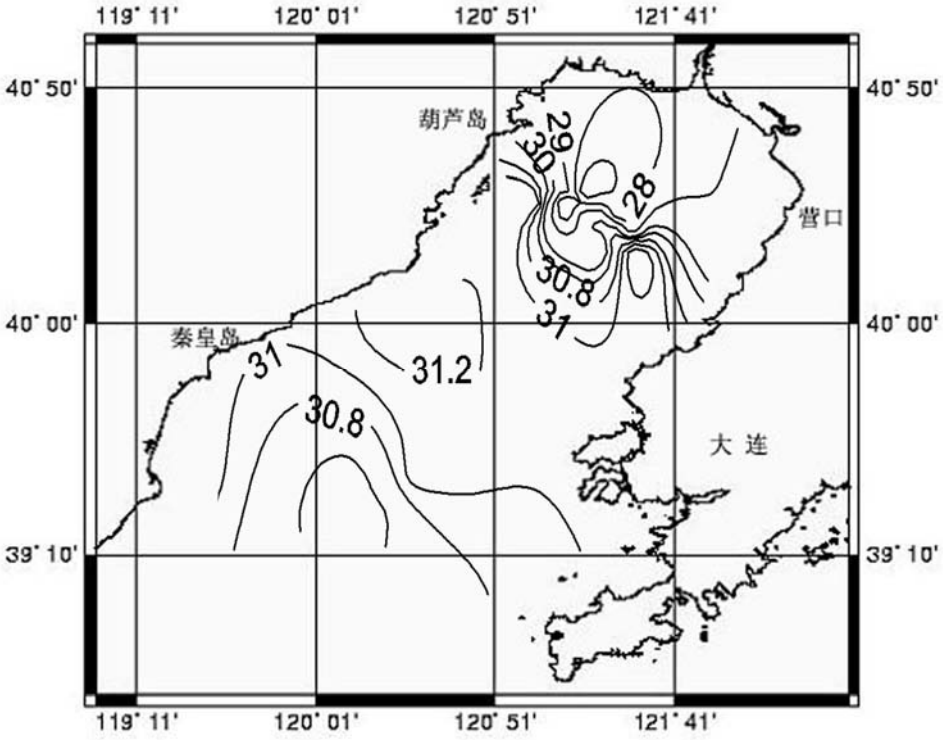
June: Massive aggregations occurred in Shuangtaizi estuary .
July to August: Massive aggregations moved to southwest part .

Distribution of Surface salinity in the *N. nomurai* distribution areas of liaodong Bay

June,2008



June to August,2008

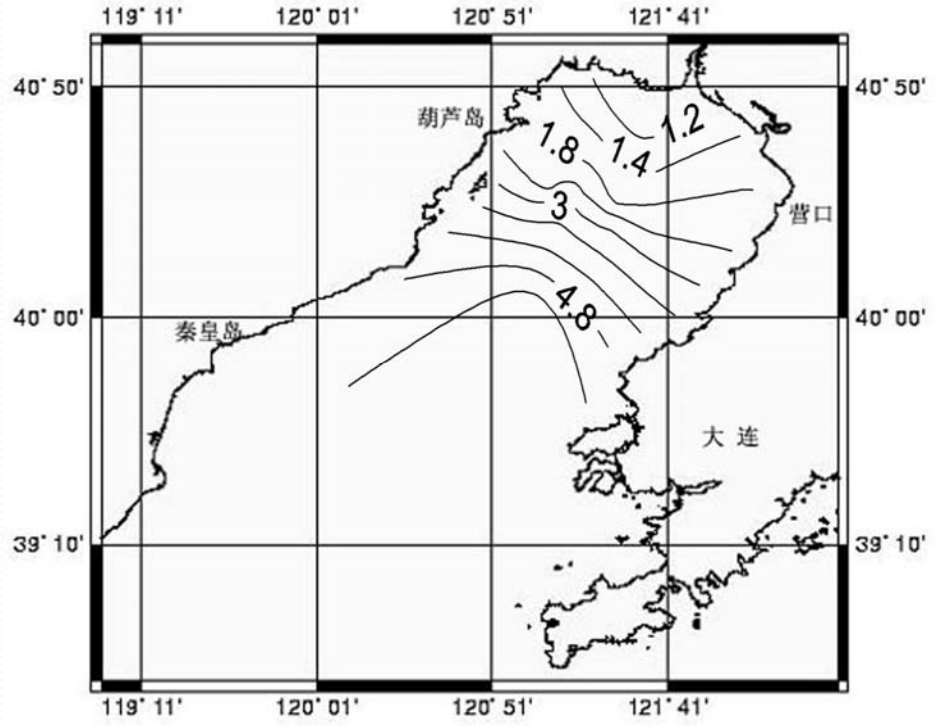


June: In massive aggregations areas, surface salinity is between 26.0 and 31.8

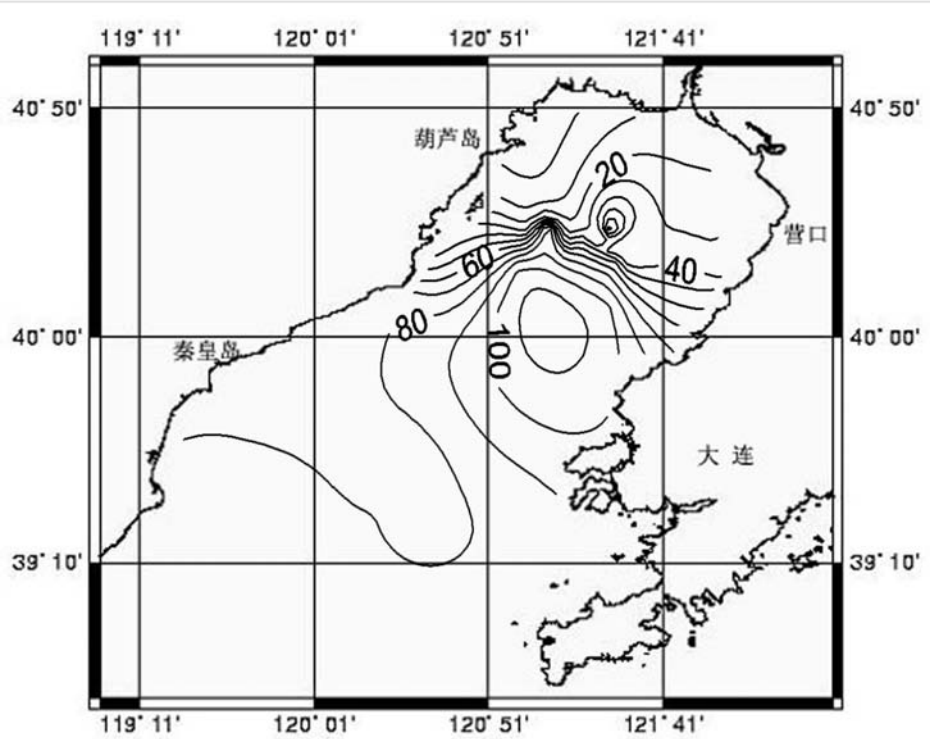
July to August: The largest quantity is at 194 station where surface salinity is 3

Diameter of extraumbrella

June,2008



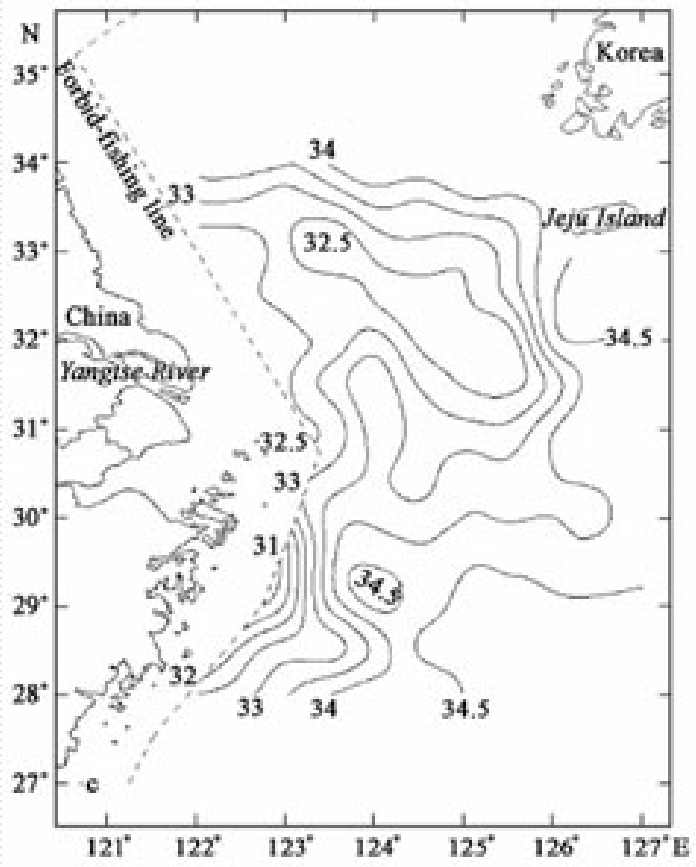
June to August,2008



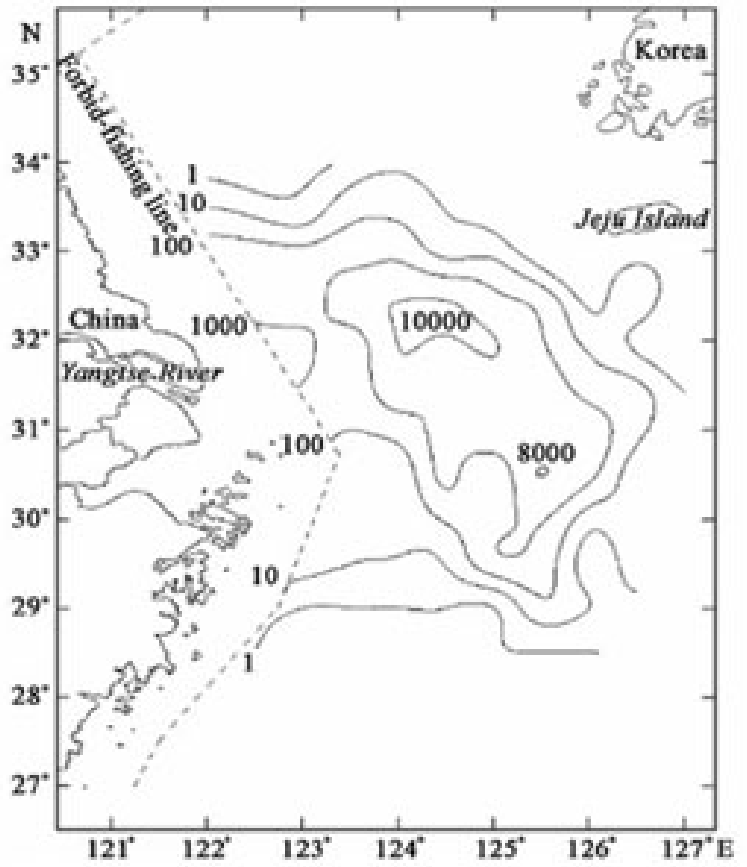
June: The smaller size approaches to the estuary with lower salinity .
July to August:The adult medusae move to the south with higher salinity.

Discussion

1. Distrubution of main jellyfish and salinity in the East China Sea.



Surface salinity of the East China Sea in June of 2004

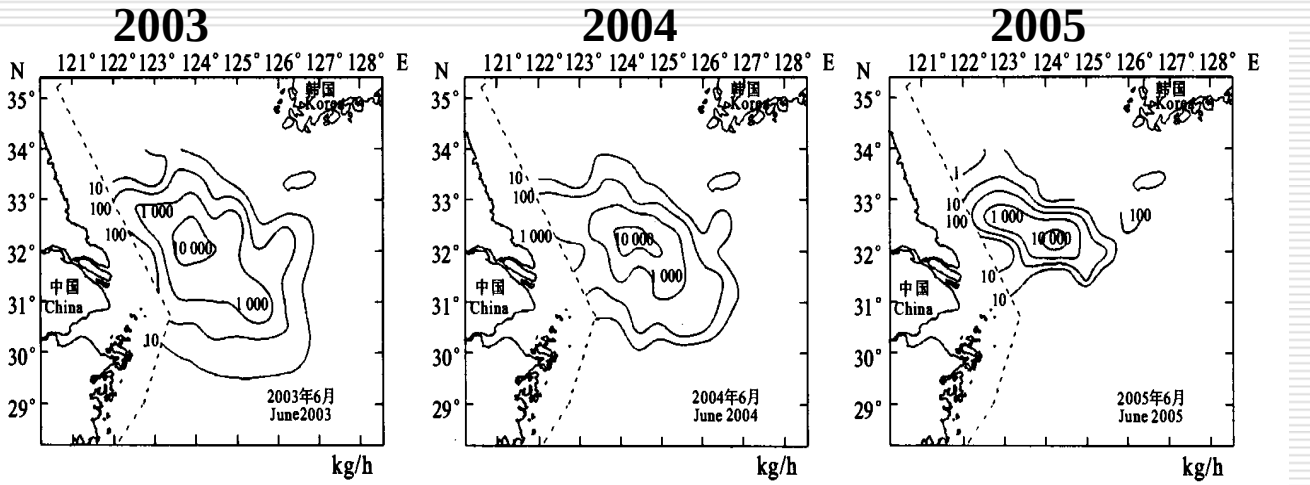


CPUE o f jellyfish of the East China Sea in June of 2004(kg/h)

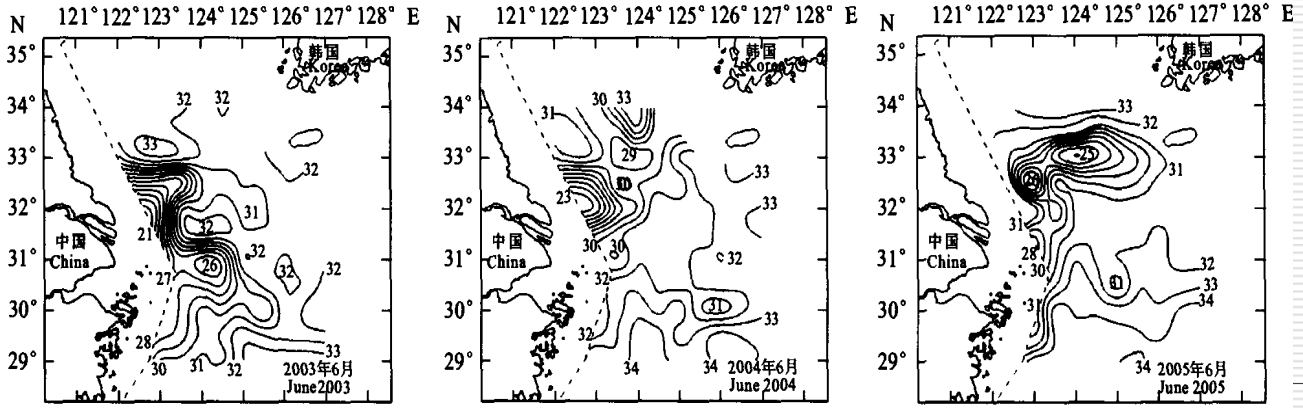
Surface salinity 28-32;Bottom salinity 32-34 (Cheng & Ding, 2005)

Discussion

2.Distrubution of *N. nomurai* and salinity in the East China Sea



CPUE



salinity

June:
Surface salinity :
28～32,
Bottom salinity:
31-32.5,
N.Nomurai is a high-salinity species.

(Ding & Cheng,2007)

Discussion

3. Salinity of 3 jellyfish species

	N. nomurai	*C. nozakii*	*R.esculentum*
limit of survival	10-40	12-35	10-
optimum salinity	15-35	20-30	14-20
podocyst produced	20-30 max25	--	16-26 Max20
podocyst germination	15-28	--	20-22
strobilation		30-32	-
Sources	DONG Jing ,2007	DONG Jing ,2007	Lu Nan,1989

Conclusion

Possible origin of Jellyfish (*Nemopilema nomurai*)

Estuary with lower salinity and abundant food

Migration

Young medusa migrated gradually from the coastal waters to deep waters. Adult medusa moved to the waters more than 20m in depth, with lower temperature and higher salinity .

The salinity for survival ranges from 10-40, and the fairly optimum salinity range for growth is from 17 to 35.

The average number of podocyst produced by every polyp is more than 4 when salinity ranges from 20 to 30, and the number is less than 4 when salinity is higher than 30 or lower than 20. The average number of podocyst produced by every polyp is 5.2 of maximum under salinity 25.

The germination rate of the podocyst is the highest of 49% under 28, and the fairly optimum salinity range for the germination of the podocyst is from 15 to 28.


Thank you for your attention!