A study on the summer mortality of black rockfish(*Sebastes schlegeli*) in South Korea

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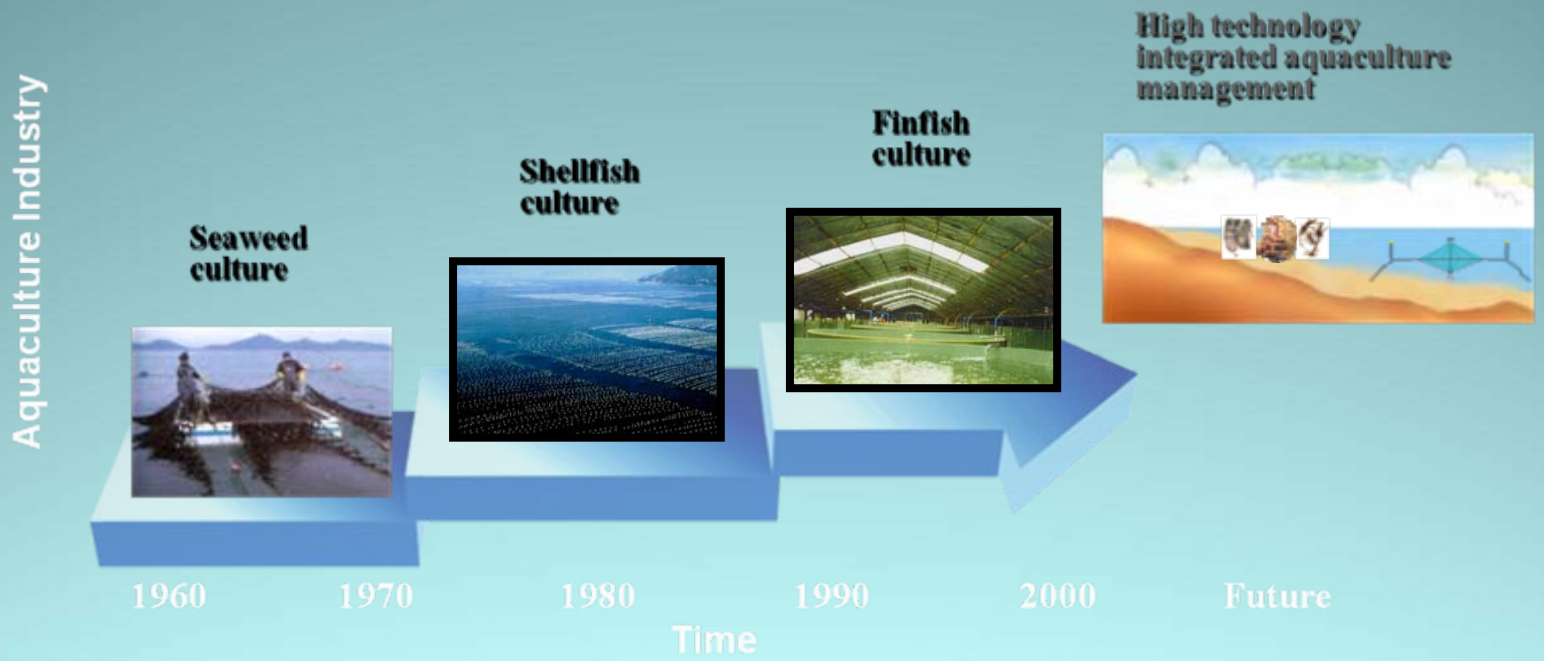
Current Status of Aquaculture in Korea



- Marine culture has rapidly developed since the last 30 years in Korean sea and the major species have changed every 10-year term.
- Seaweed culture used to be the main species of marine culture from the 1960s to the middle 1970s, so as shellfish farming from the middle 1970s to the middle 1980s.
- Meantime, breeding and hatching techniques have been established for some marine fish, red sea bream, olive flounder as well as black rockfish from the 1980s to the 1990s.
- Since 1990s, marine fish farming has become the most rapidly growing industry in Korea.

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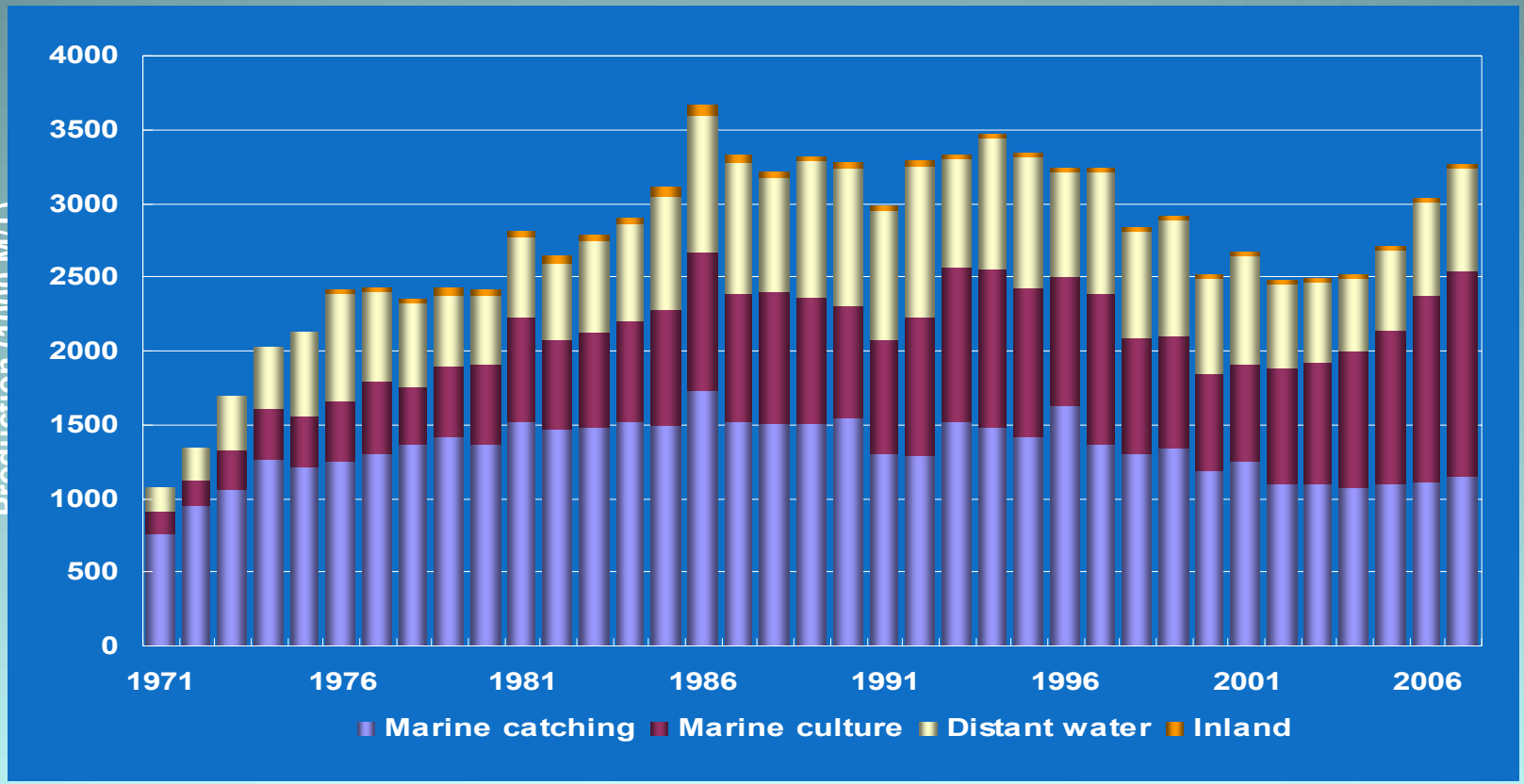

Fig. Fisheries and aquaculture production in Korea, 1971~2007.

- Caught fisheries are unlikely to increase, and it is expected that the shortfall will be met by aquaculture production.
- Aquaculture production continued to increase until late 1980s or early 1990s.
- Thereafter, the production fluctuated, mainly due to the advent of adverse environments and the outbreak of red tides and diseases.
- Again, aquaculture production has continuously increased since 2001.

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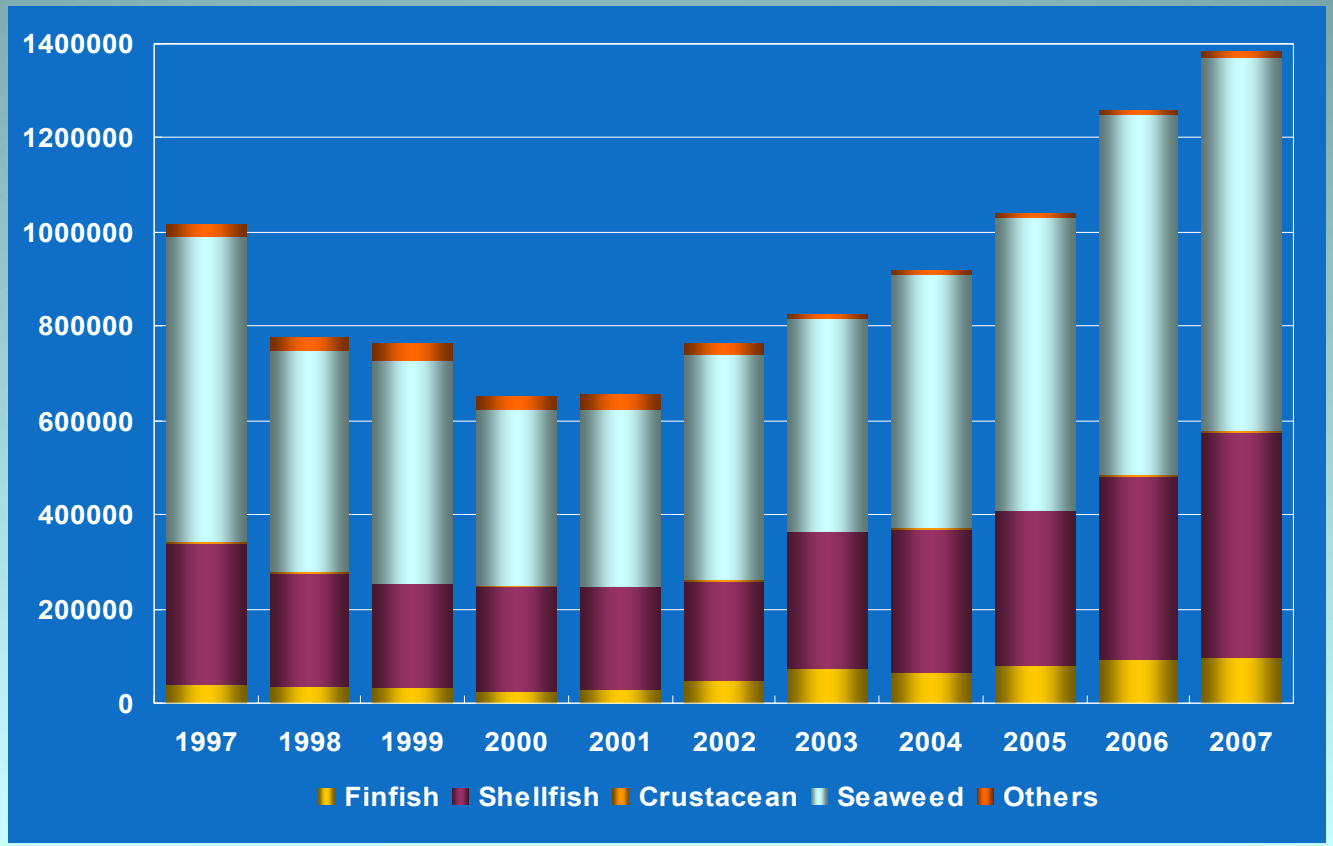

Fig. Marine aquaculture production in Korea, 1997-2007.

- The majority of marine aquaculture production is focused on seaweeds, followed by shellfish.
- However, it is worthy to note that marine fish production is significantly increasing.

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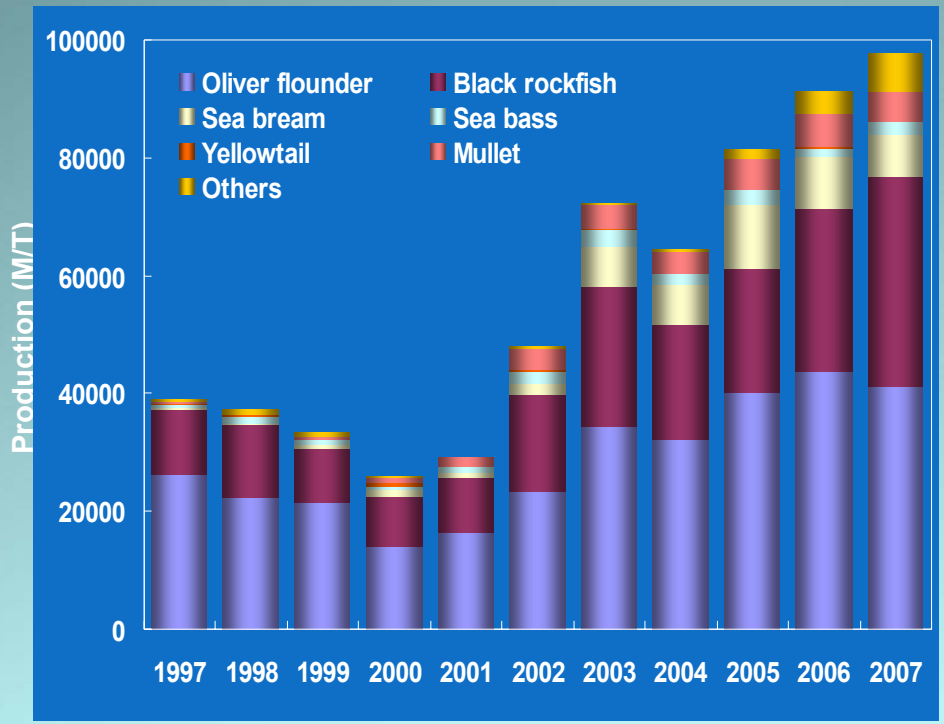

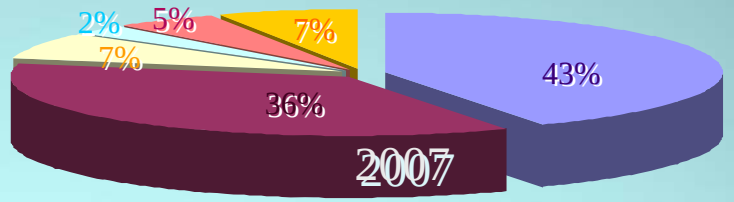

Fig. Korean marine aquaculture production of finfish species, 1997~2007.

- Finfish production has been increasing each year in Korea, and was recorded at 98 thousand tons in 2007.
- In fish culturing, olive flounder is a primary species in terms of production amount.
- It produced nearly 41 thousand tons last year.
- The other species comprising Korean finfish aquaculture production are black rockfish, sea bream and mullet, in the order of their productivity.
- Olive flounder and black rockfish occupy about 80% of finfish aquaculture production amount.

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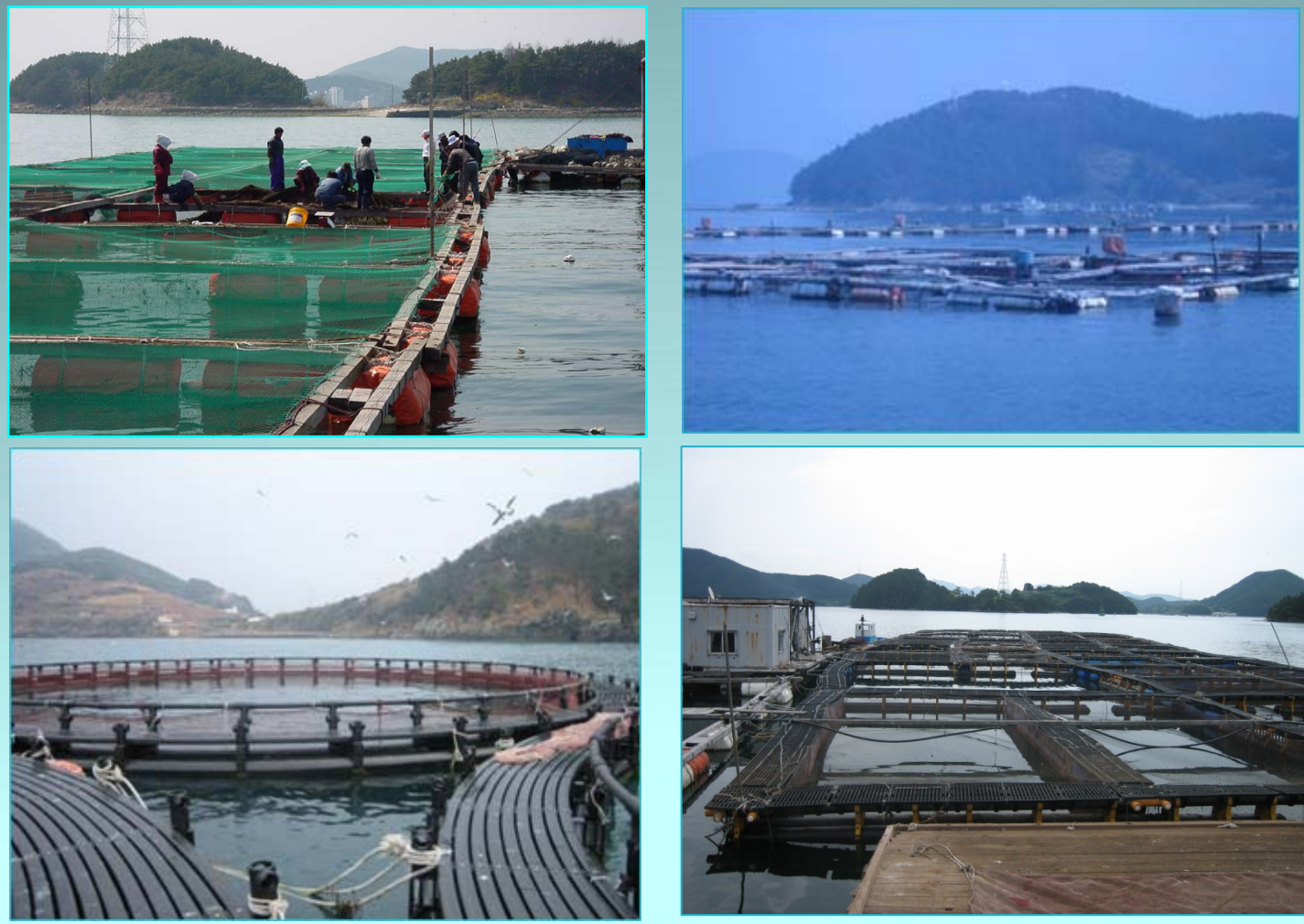


Fig. Fish farms in Korea.

What is the problem of Korean aquaculture these days ?

Continued aquaculture activities

- Loss of integrity in farming grounds
- Lowered growth rate

Pollution-driving happenings

- Frequent outbreak of diseases
- Expanded HAB
- Loss of physiological viability

Annual damage by typhoons

- Facilities confined in inner bay

We have lots of problems, self-contamination of marine farms and lower productivity from continued aquaculture activity in limited area, and water pollution is driving frequent outbreak of diseases. And then Red tide and typhoon caused widespread damage in Korean aquaculture.

Disease

These days, the outbreak frequency of diseases increases from 5% in the 1990's to 30% at present. The situation takes a bad turn, from bacterial diseases to viral, bacterial and parasite multiplex diseases, and from summer season outbreak with a high temperature to the whole year round.

- Frequency: 5% (1990's) ➡ 25-30% (present)
- Diseases: bacteria diseases ➡ viral + bacterial + parasite multiplex diseases Season: summer season (high temperature) ➡ whole year
- Amount of damage: $ 200 million

Mass mortality in KOREA

- Variation of Marine Environment

✓Water temperature : Sudden rising, Dropping

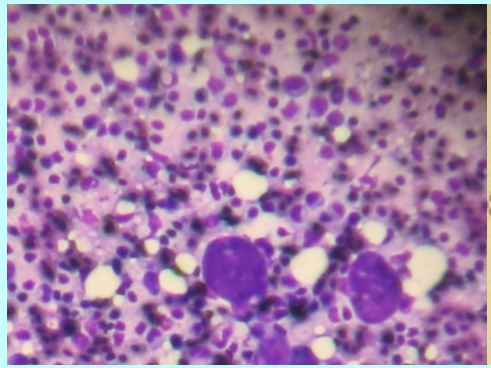
✓Dissolved oxgen : Below 4 ppm

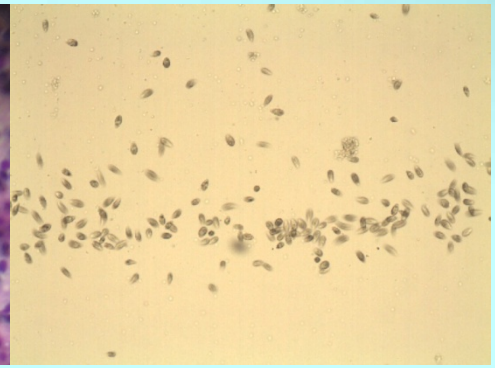
- Disease

✓Bacteria : *Steptococcus* sp., *E. tarda*, *Vibrio* sp.

✓Parasite : Scuticocillate,

✓Virus : Iridovirus, HRV





Total Marine Aquaculture Production in Kyeongsang Province

Division	2007	
	Korea(ton)	Kyeongnam(ratio)
Total production	**3,270,735**	**653,574 (20.0%)**
Marine	1,152,294	231,707 (20.1%)
Shellfish	1,385,798	419,147 (30.2%)
Inland	26,760	2,720 (10.1%)

Mass mortality events in 2001~2007

Year	Species	No. of farm	Dead fish (1,000 fish)	Amount (1,000$)	Cause
2001	Fish, Oyster, Abalone, Sea squirt	83	6,604	6,183	Red tide, High WT
2002	Fish, Oyster	22	1,522	1,037	Red tide, Low DO
2003	Fish	46	3,985	3,209	Red tide, Cold water
2004	Oyster, Sea squirt	408	382 ha	4,344	Abnormal current
2005	Fish, Oyster, Abalone, Tunicate	5	39	175	Red tide, Abnormal current
2006	Fish	90	3,893	5,132	Low WT, Red tide, High WT, Low DO
2007	Fish	66	7678	10,508	Red tide

Black rockfish (*Sebastes schlegeli*)

- Ecology : Ovoviviparous species
- Aquaculture : 2,170 households
- Production : 27,517 ton (2006)

Seedling production
From April,
Land,
embankmanent

Mid –bring up
From June, Moving the net cage (EP, MP, EP+frozen raw fish)

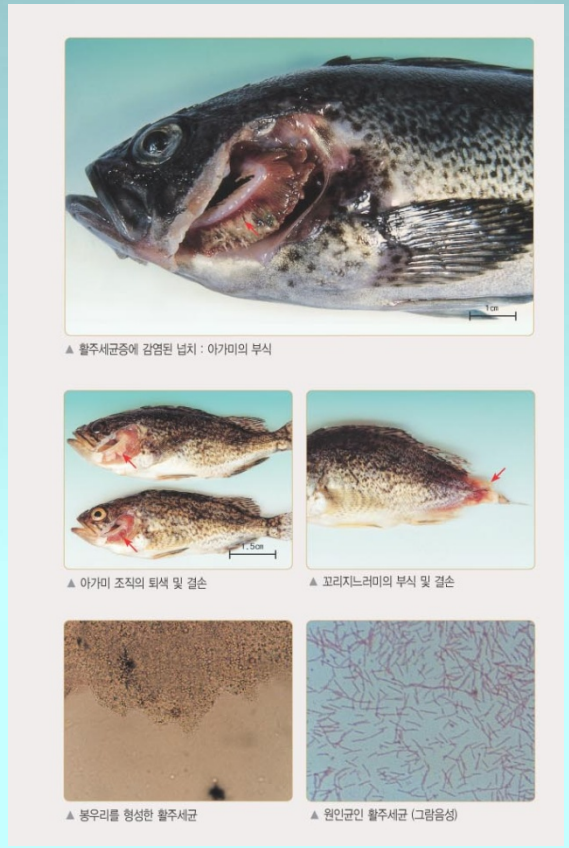
Bring up
Net cage fish farm(Frozen raw fish)

Characteristics of Water temperature on Rock fish

WT(℃)	Remark	Management in fish farm	Immune response
15~22	Optimum WT	Normal feeding	Normal
Over 23	Decrease feeding	Decrease feeding	Physiological activity begin decline
Over 25	Occurrence bacterial disease	Stop the feeding	Physiological activity rapidly decline

Mortality and causative diseases of Rockfish

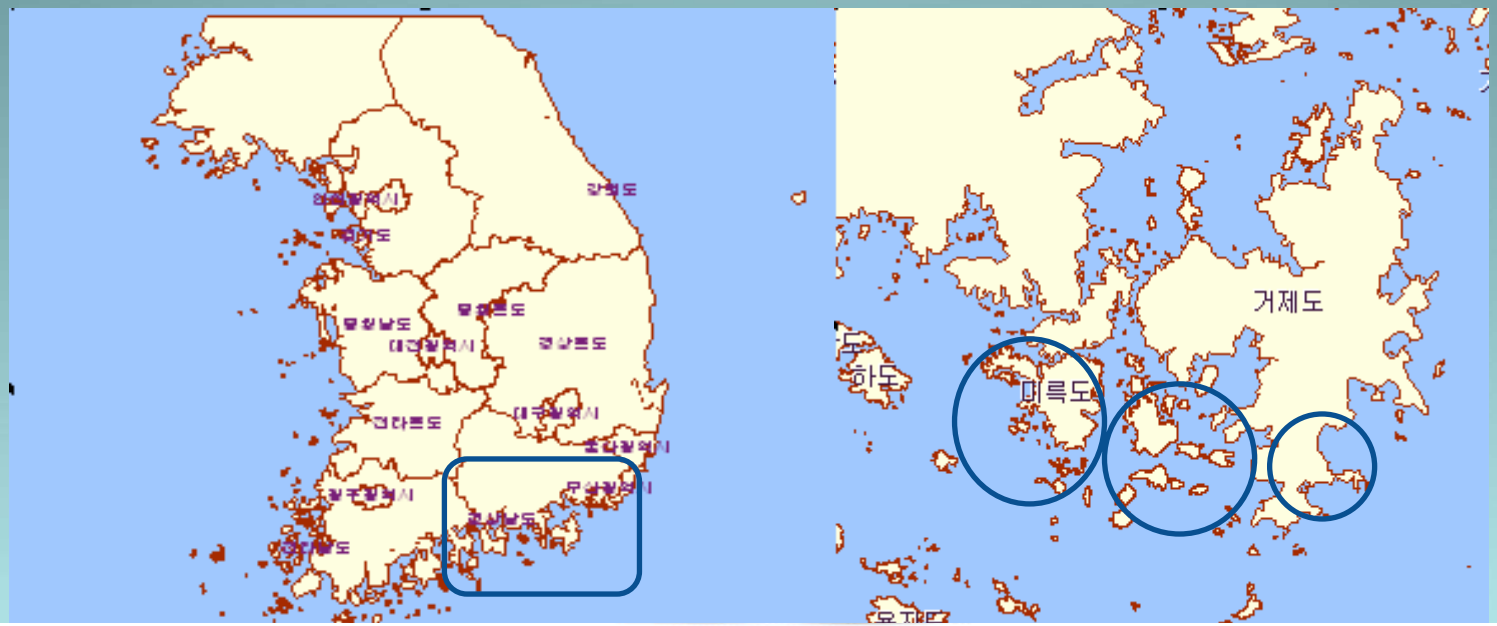
Fish species	Mortality (%)	Caused Disease
Rock fish	5.3	Vibriosis, Flavobacterial disease, Streptococcosis Gill monogenean



Mortality of Rock fish in 2006

Area	No. of farms	Hectare	No.(1000 fishes)
Tongyeong, Namhae, Gojae	60	30.3	2,150

Investigation station



Materials & Methods

- Investigation periods: AUG. to SEP, 2006
- Investigation station (10 sites)
  - Hansan island(3 sites)
  - Mireuk island(6 sites)
  - Geoje island (1 sites)

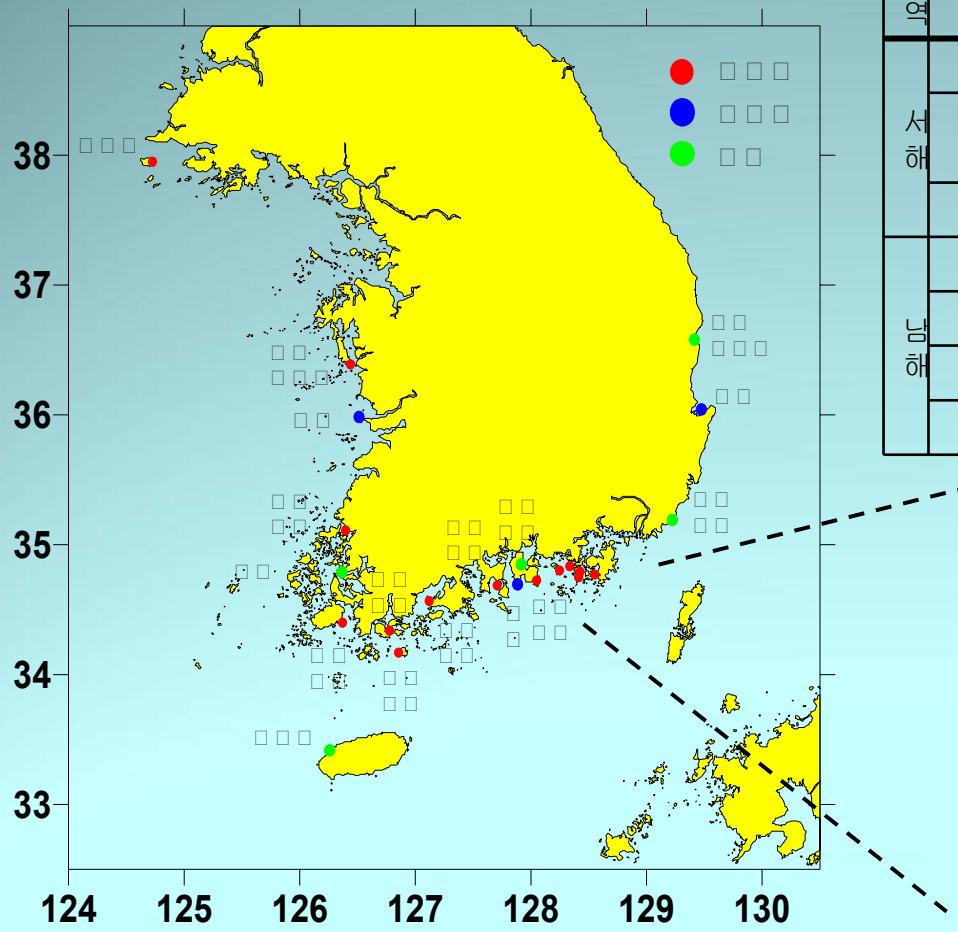
Experiment Items

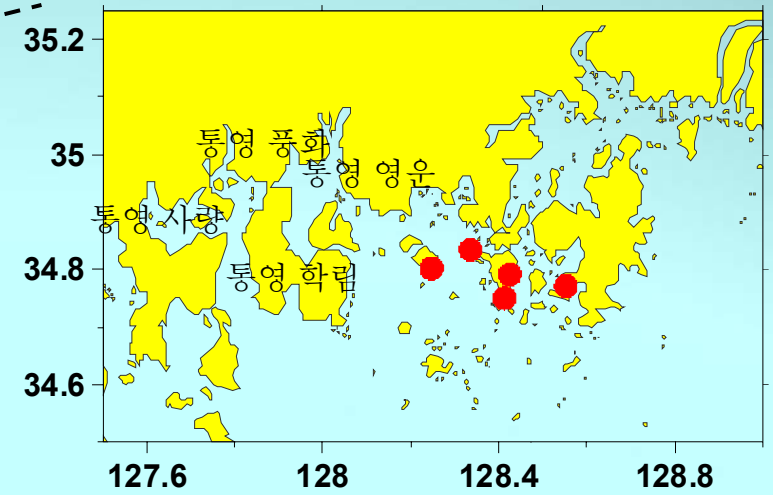
- Pathological inspection
  - Diagnosis on dead fish and dissection
  - Pathogen(Bacteria, parasite, virus)
  - Histo-pathological inspection(Liver, kidney, spleen)
- Environmental survey
  - WT, Salinity, DO and pH using YSI650XL (Hansan island, Geoje island)
  - WT data analysis **CORI monitoring**(Mireuk island)

CORI (Costal Oceanographic Real-time Information) monitoring system

13 aquaculture ground

해역	관측소명	양식생물	해역	관측소명	양식생물
서해	백령도	전복	남해	여수 신월	농어
	보령 효자도	우럭		남해 미조	돔,우럭
	함평 석성	돔,우럭		거제 가배	돔
남해	진도 회동	전복		통영 풍화	돔
	완도 신지	우럭		통영 학림	돔,우럭
	완도 청산	전복		통영 사량	돔
	고흥 용정	전복			

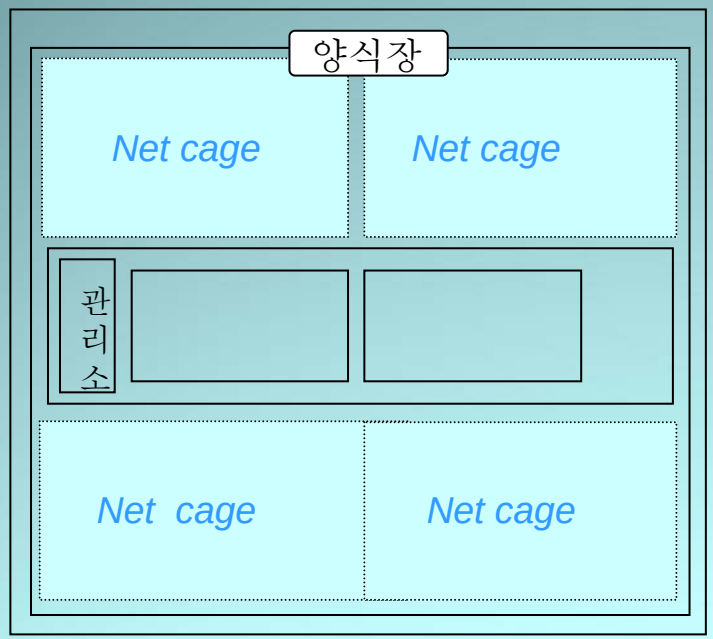


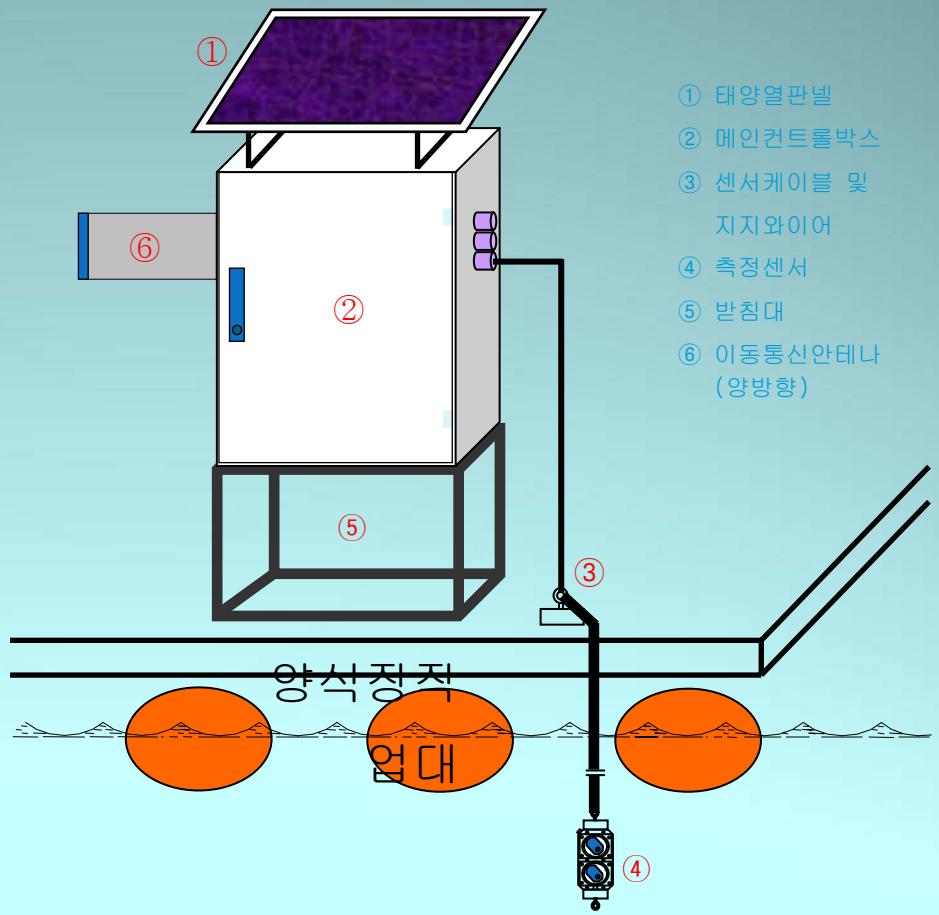


System construction

Setting system

- Culture ground



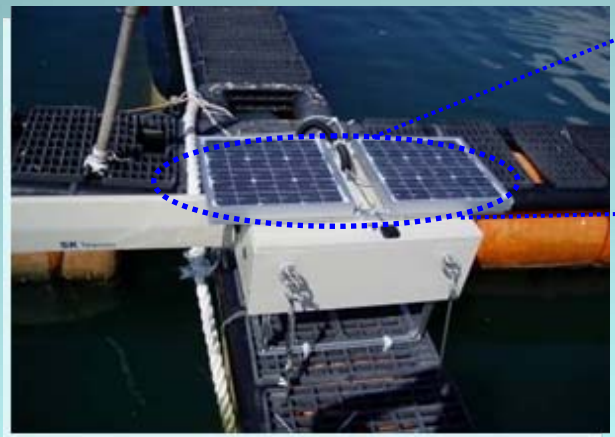


System construction

System construction

➢ Electric source decice

✓ Solar battery



HSLTF-25W

- SOLAR TYPE : 단결정 실리콘 태양전지
- FRONT COVER : 저철분 강화유리 (3.2T)
- CONNECTION : 36 Series
- SPECIFICATION : . P MAX : 25.5W
- VOC : 20.8V
- I SC : 1.55A

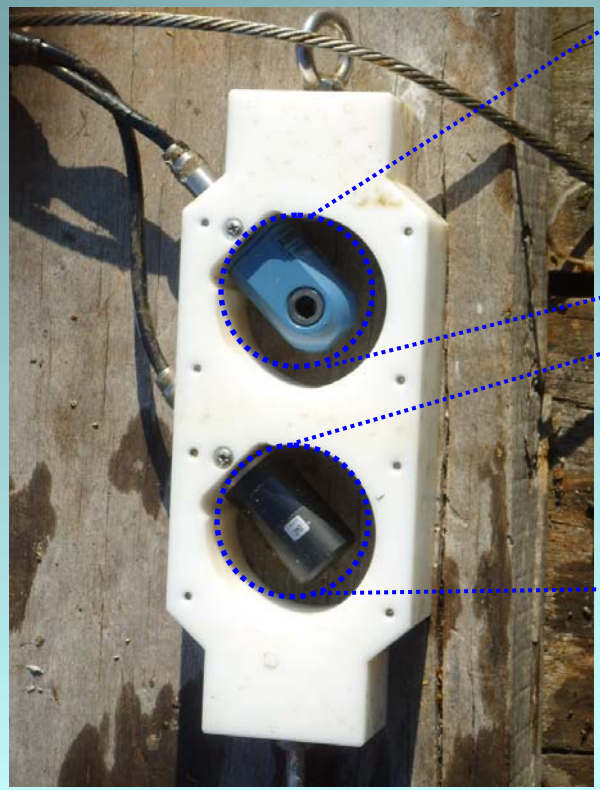
✓ Battery

Dc 12V 100AH

Dc 12V 40AH

System composition

➢ Sensor & sensor block



CT센서

✓ Conductivity
- 측정범위 : 0~7.5S/m(0~75mS/cm)
- 정 밀 도 : 0.0002S/m(0.002mS/cm)
- 측정오차 : ±0.0018S/m

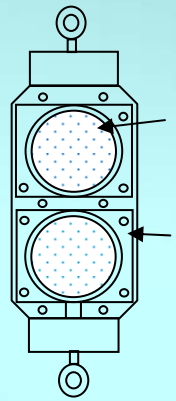
✓ Temperature
- 측정범위 : 0~36°C
- 정 밀 도 : 0.01°C
- 측정오차 : ±1°C

DO센서

측정범위 : 0~500μM (0-120%)

정 밀 도 : 1μM 이하(0.4%이하)

측정오차 : ±8μM 또는 5%이하



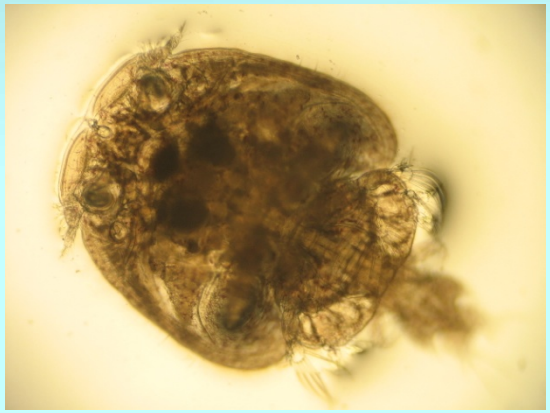
➢ 센서블럭의 장점
- 따개비 등의 이물질 부착 적음
- 측정 데이터 신뢰성
  CTD와 센서측정값의 동일
- 청소보수의 용이

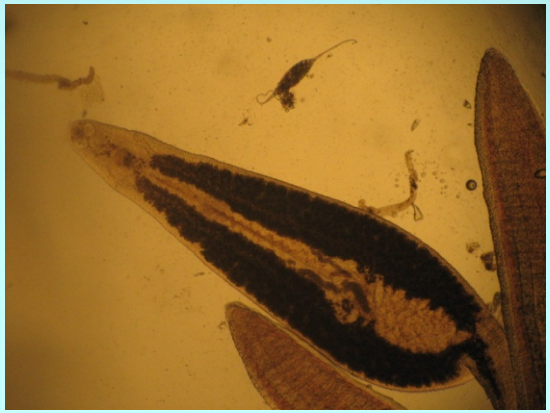
Pathological examination

Pathological examination

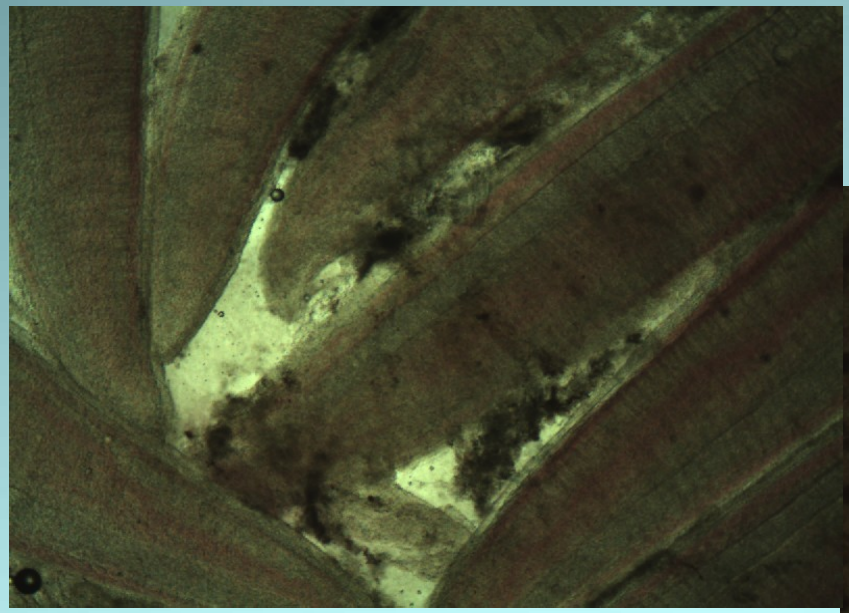
Pathogen		Infected rate(%)	part
Bacteria	Streptococcus sp.	3.8 ~ 35.4	Liver, spleen, Kidney
Parasite	Caligus	1.9 ~ 33.7	Body surface
	Microcotyle sp.	17.7~ 26.9	Gill

* Virus was not detected experimented rock fish

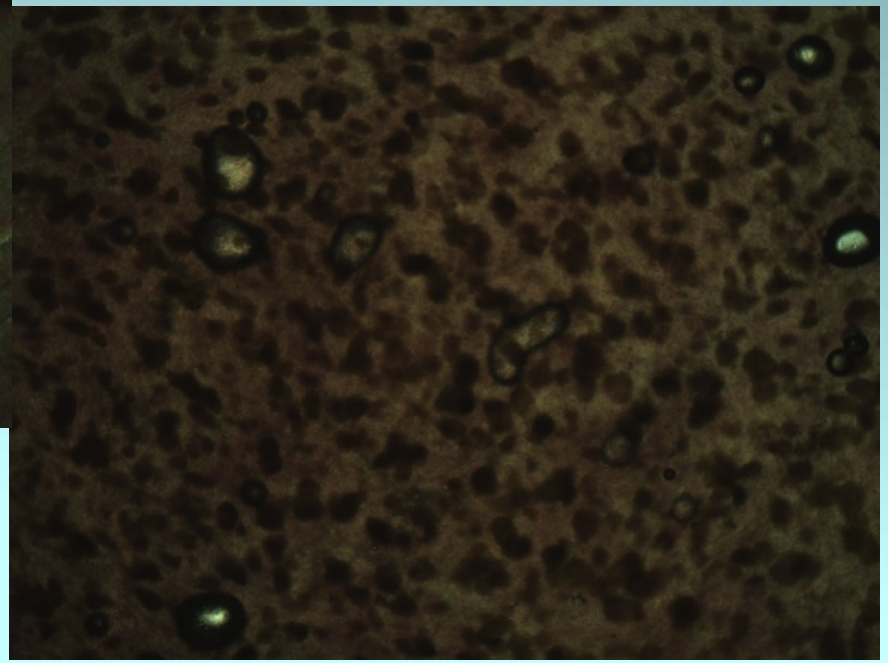




Histo-pathological examination

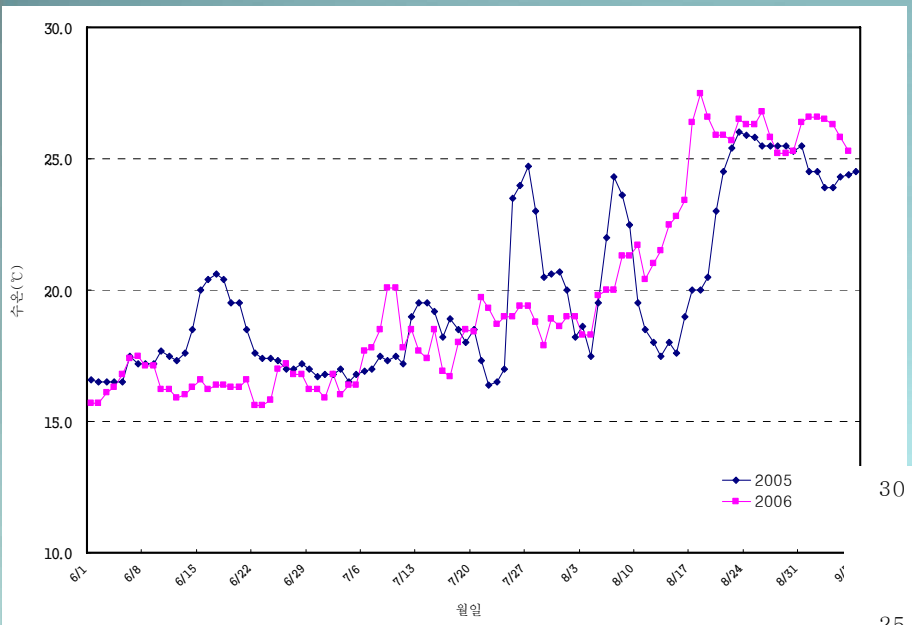


Gill



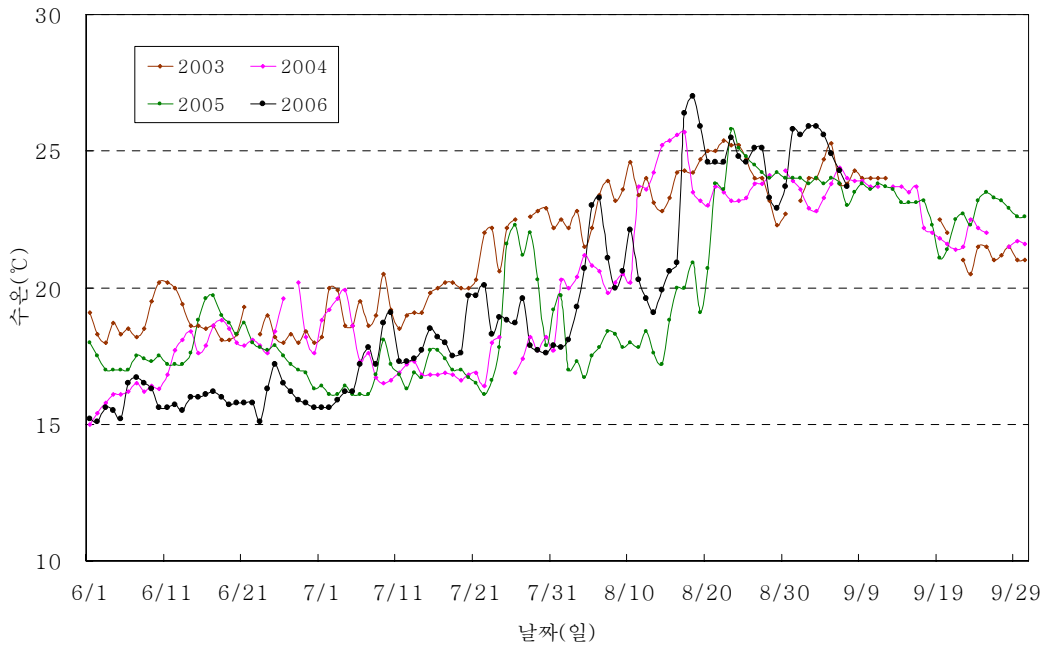
Spleen

Variation of Water Temperature in Fish Farms



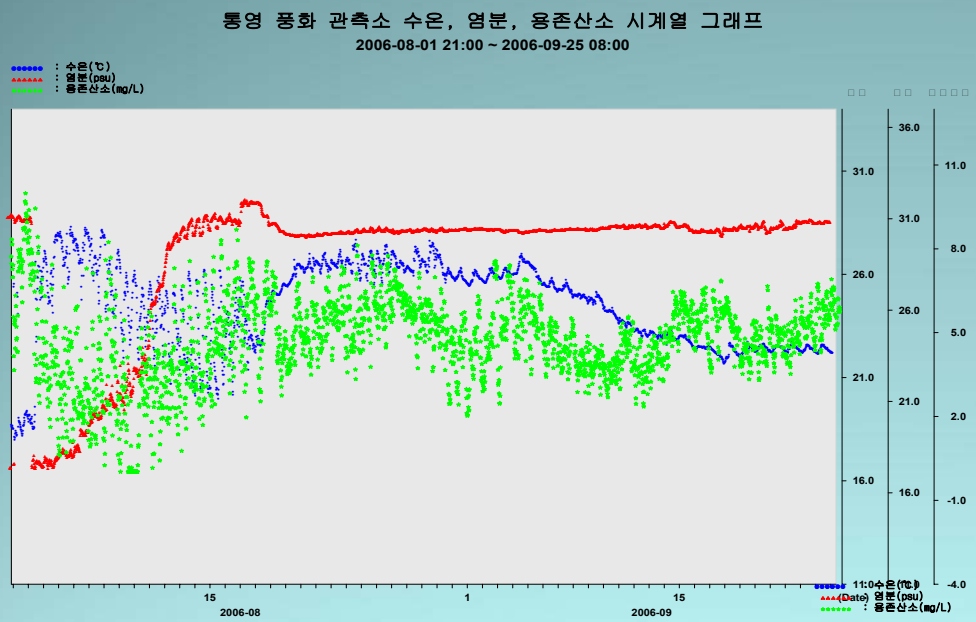
Geoje island around fish dead station (June to Sep, 2005~2006).

Geoje island around fish dead station (June to Sep, 2003~2006).

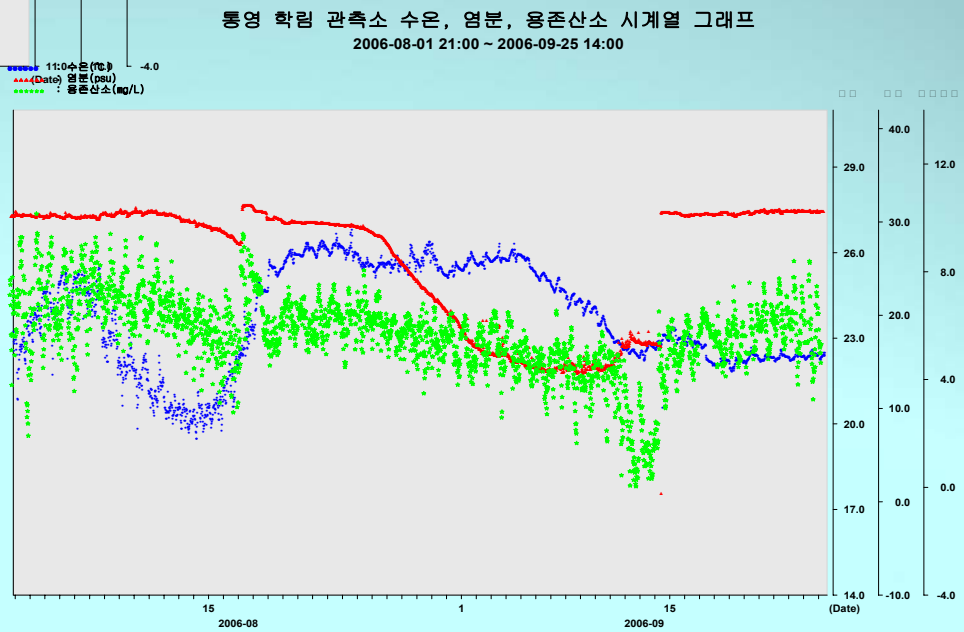


Discussion

Variation of Water Temperature in Fish Farms by CORI Monitoring System



Automatic CORI monitoring record



Conclusions

- The main cause of the mass mortality of Rockfish during summer season in 2006 may be a physiological weakness induced by rising of water temperature abruptly ranged 3～6.4℃ in the investigated fish farm.

- The rising of sudden water temperature in a short time periods may be induced by the broke down of thermo-cline by typhoon, Wookong.