

Scallop Culture and Its Supporting System in Mutsu Bay

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Mutsu bay is one of the major scallop culture fields located at a northern part of Japan where fishermen got 520 thousand tons of scallop, being worth 11,300 million yen (78 million dollars) in 1986. The fruitful result was brought after a few decade struggle to develop scallop culture techniques by the people concerned, and now, for stabilizing every year's production, the Aomori prefectural government has developed a remote survey system to catch the bay's on-time physical conditions and to advise fishermen on better ways of scallop culture work in the period. The administration is on the way to improve many fishing ports for keeping preferable conditions in the bay.

1. Introduction

People of Japan have been blessed with natural resources of fish from the waters around, and Japan has extended its fishery activities to the world. Recent increase of 200 mile exclusive zone has brought severe restrictions on its fishing activities in the foreign exclusive zones. Japanese people, as the result, have realized the waters around Japan are of the very precious stockyards of rich fishery resources. Japanese government is about to shift its fishery system from traditional but unstable "rely-upon nature fishery" to new and stable "resource management intensive fishery" like fish culture. Most of today's fish cultures have been done on enclosed coastal waters where fishermen can manage their products with ease and low cost. Some fishes are sensitive to water contamination in culture areas, then fishermen should pay attention to keep good water quality at their operation sites.

The authors report a case study of enclosed waters utilization in Mutsu bay, Japan, for local development by fish culture with better supporting systems.

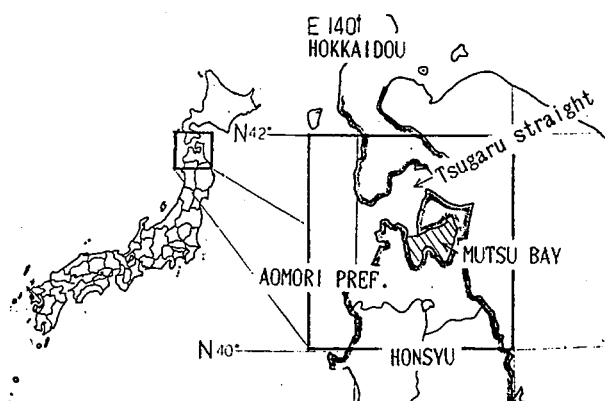


Figure-1 Aomori and Mutsu Bay

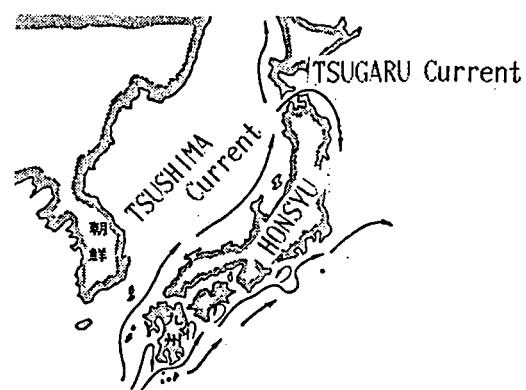


Figure-2 Ocean Current around Japan

2. Physical Conditions of Mutsu Bay

Mutsu bay is at the northern edge of Honshu, and administratively belongs to the Aomori prefecture (Figure-1). It has 1,660 km² of water area with 246 km coastline, and average water depth of 38m. The bay mouth is 10 km wide, and faces Tsugaru Strait. Some small rivers flow into the bay (Figure-3). The bay has rich natural circumstances surrounded with Shimokita, and Tsugaru regional parks, and Asamusi prefectural park. Aomori, the prefectural capital and some commercial cities face it. Inflow from the mouth is part of Tsugaru warm current separated from Tsushima warm current (Figure-2). The inflow circulates and flows out the bay as shown in Figure-3.

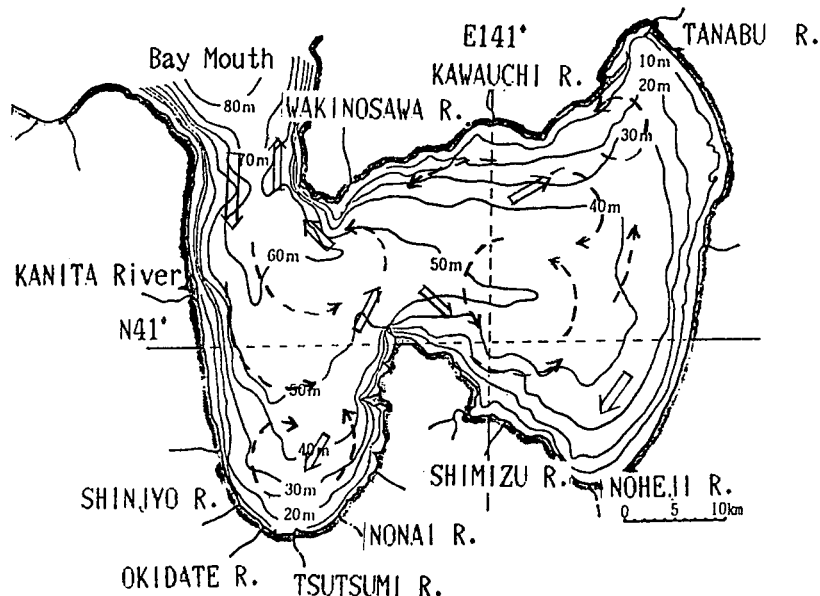


Figure-3 Water Depth and Rivers-inflow in Mutsu Bay

Surface temperature of the bay is approximately 3° C in February and 23° C in August. The salinity is 3.20 to 3.36 ‰ at surface, and 3.32 to 3.40‰ at 30m depth, similar to the 3.20 to 3.46 ‰ of Tsugaru current. Dissolved oxygen value will be of super-saturation from March to May, which may be an influence of phytoplankton [1]. Some data show that Mutsu bay still keeps its cleanliness though over 400 thousand people live around there.

3. Fishery in Mutsu bay

The bay has been used mainly for fishery except commercial harbor areas and ferry boat routes. Fish product in the bay is 69,000 tons, or 16,200 million yen (108 million dollars ; 150 yen/ dollar) in 1986, 10% in amount, or 16% by value in the total of Aomori prefecture's fishery product. The details of bay production are 52,180 tons, or 11,342 million yen (75 million dollars) of scallop, 5,010 tons of sardine, and 1,798 tons of Pacific cod. The figures show scallop fishery is a major industry reaches to 72.1 % in volume, and 66.8% by value of the total production in the bay [2].

In Mutsu bay, scallop fishery is classified into two types. One is "scallop-aquaculture" in which fishermen culture scallop in net cages, or on ropes clipped with plastic holders. In the latter method each shell should be made a hole drilled on it's ear. The other type is "seabed-sowing culture" where fishermen collect scallop larvae, and foster them artificially in net cages to a certain size, then liberate them onto grounds where juvenile scallops will be expected to grow of commercial size within a few years.

All the coastal waters excluding harbor areas and ferry routes are covered

with two types of fishery wrights, one is "common fishery wright" for shell collecting, small scale gill net, and other small scale fisheries, the other is "demarcated fishery wright" for aquaculture fishery on the designated areas. These fishery wrights are permitted to the fisheries cooperatives concerned, and fishermen belong to the cooperatives can do fishery activities on the designated waters. The scallop culture fields occupy some 90 % or 498 km² in the demarcated fishery wright area of 503 km² in Mutsu bay.

4. History of Scallop Fishery

Scallop fishery in Mutsu bay has a few hundred year history, dried scallop, in particular, was one of the important export commodities to China in those days. Scallop has a nature to fluctuate its production much affected by natural conditions so that many fishermen had tried to find a better way to stabilize and increase its production. In 1953, some fisheries cooperatives started "natural larva collection" which aimed to collect larvae and to discharge them onto the better sites. In 1955, they set out to begin "infant scallop breeding". In the latter work, scallop larvae were fostered to grow into juvenile scallops of a certain size then liberated onto fishing grounds. This system brought an increase of scallop production in Mutsu bay. In 1964, a fisherman invented a simple but revolutionary way of larva collection which is composed of cedar twigs loosely covered with a fine mesh plastic sack. The new method solved instability of larva collection by old ways, and brought a rapid increase of bay's scallop production [3].

After prosperous scallop production in ten years, a large amount of abnormal scallops had been appeared, and most of them were dead simultaneously at a part of the bay. A similar scene was appeared again at the other site in the next year, finally in the following year, in 1977, it spread all over the bay. After the serious experiences, some improved measures were adopted, they were to foster healthy larvae, to improve culture facilities, to manage shell culture grounds profitably based on strict amount control of culture. By adopting these measures, production of scallop has been recovered year by year, 48,000 tons in 1975, 31,000 tons in 1980, and 52,00 tons in 1986.

5. Causes of Abnormal Death of Scallop

The normal mortality of scallop from of infant to commercial size is 40 to 60% in case of "seabed sowing culturing", and 5 to 10% in "aquaculture". An abnormal death is defined as a case when a mortality percentage of scallop is higher than the normal values. In recent surveys by the authorities, the causes of the death might be liberation of juvenile shell to unfit sites, invasion of polydra ciliata into the shell, barnacle insertion on the shell, abnormal high water temperatures on the site, overcrowded liberation and culture, liberation used too small size scallop, unsuitable management of infant scallop fostering, and mud-inflow to the sites by very heavy rains.

6. Capacity of Scallop Production in Mutsu Bay

Scallop is of Bivalvia living in cold salt water and fit to the circumstances of Mutsu bay very much. It will be expected higher productivity than other marine creatures at a higher stage in the food chain.

The bay will have a continuous scallop production limit at a certain amount. The primary production of Mutsu bay is estimated 70-100 gC/m³ /year, then feasible scallop production may be 87-178 thousand tons/year. Otherwise from the actual results of scallop production, seabed sowing culture limitation will be at 20-23 thousand tons, and scallop aquaculture maximum production may be, from the data concerned, 49-63 thousand tons/year on the maximum expanded area in future stage. The total amount of scallop production is 69-86 thousand tons/year on future expanded area. The figure is smaller than the previous value of 87-178 thousand tons/year so that it may show a reasonable value of the maximum attainable production [1].

7. Development of Fishing Ports in Mutsu Bay

For backing scallop culture, many basic facilities have been developed. Fishing ports, a major part of the basic facilities, have been constructed as modern and labor-saving stations including various on-land facilities based on the fishing port development plan from 1973 to 1982. The succeeding plans of these ports have been done to add required capabilities to enhance effective works for scallop culture (Figure-4).

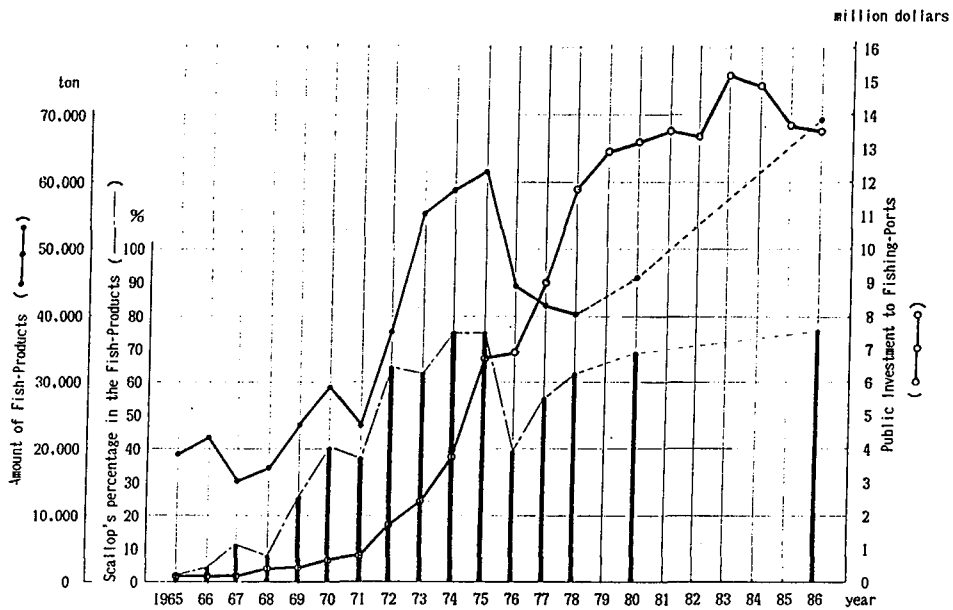


Figure-4 Amounts of Fish Product and Fishing Ports Investment in Mutsu Bay

8. Required Facilities in Fishing Port for Scallop Culture works

Figure-5 shows a typical procedure of scallop culture works. At the first stage of scallop culture development, slip ways were required for easy shell landing. At present, additional jetties to help an easier work for removing harm-creatures and foreign materials from shells with water jet are required where culture ropes or culture cages are hanged directly on these facilities. And from the view point to decrease labor-force, cleaning machines, waste disposal facilities, and sewage processing plant should be introduced adding to ordinary facilities for berthing boats in these ports (Table-1).

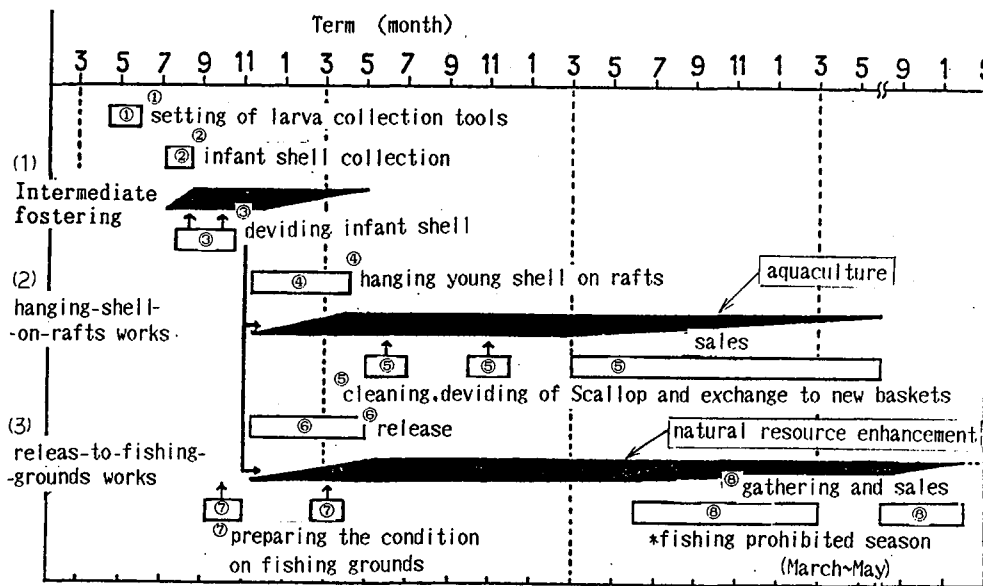


Figure-5 Process of Scallop Culture and Enhancement Works



(Upper Left)
 Photo-1 Collected Scallop Larvae
 (Upper Right)
 Photo-2 Scallop landing and Weighing
 (Left)
 Photo-3 Scale-off Works require
 a Place for Its Exclusive
 Use in Port

Fishing Port

Required Facilities

A. (On the sea side)

1. Anchorage for fishing boats.
2. Anchorage for aqua-culture tools.
3. Tentative anchorage for shell culturing works.
4. Live shell and fish stocking facilities.
5. On-the water working site.
6. Breakwater protecting working site.
7. Clean salt water inducing facilities.
8. Wharfs for fishing boats.
9. Jetties for cultured shell maintenance.

B. (On land side)

1. On-land stations for survey buoys.
2. Artificial larva collecting facilities
3. Slipways for fishing boats.
4. Slipways for aquaculture facilities preparation.
5. Working sites for aquaculture facilities.
 maintenance and cultured shell's maintenance.
6. Cultured shell sorting facilities.
7. Meat-removed shell processing facilities.
8. Accessible roads and enough parking spaces.
9. Stock and processing space for removed cobbles,
 mud, and starfish from the shell growing sea-bed.
10. Scallop processing plants.
11. Sewage processing plant and pipelines.
12. Fishermen's training facilities.

Table 1 Requirements on Fishing Ports for Developing Scallop Fishery

9. Future Prospect of Fishery Management on Mutsu Bay

The first priority issue on Mutsu bay is to reserve the present environment of the bay for keeping its capability to produce a large amount of scallop, and to provide hatching and nursery grounds of major fishes like salmon, cod, flatfish, and squid. The second issue is how to maximize the productivity of the bay. Scallop culture technics have been refined year by year, but a total management system of the bay have not be completed yet though fishermen concerned have succeeded to earn fame that Mutsu scallop is of very fresh, high quality, and demand-fitting.

10. Utilization of Remote Buoys

A four year survey done by Aomori prefectural administration confirmed the usefulness of remote buoys to forecast a time for scallop larva collection, to warn a time for avoiding disasters by abnormal water conditions. The information is very useful to culture scallop[1]. This system is composed with five remote buoys, a on-land relay station and a base station. By directions from the base, remote buoys can survey the every-one-hour data of water temperature, salinity, dissolved oxygen, current velocity and direction which are transmitted to the base through the rely station. The base station makes hourly, daily and monthly reports processed with a computer system.

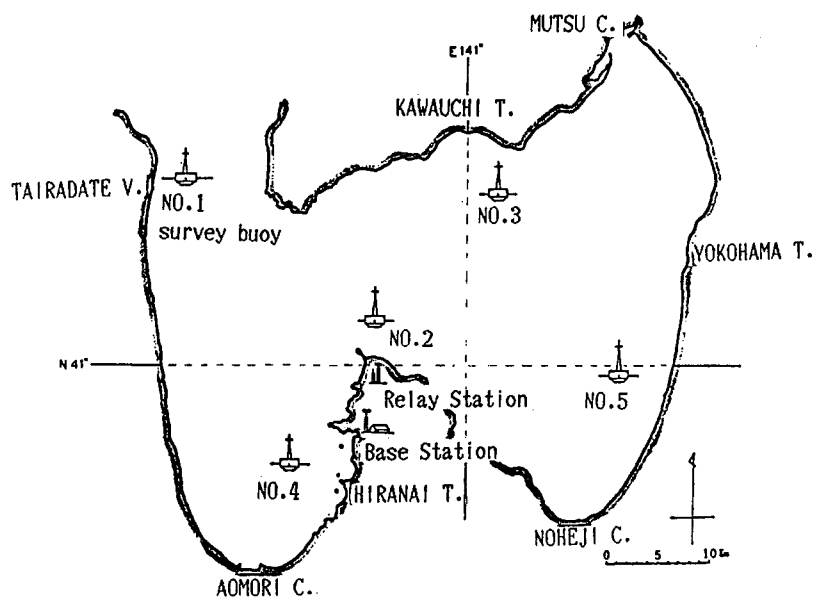


Figure-6 Sites of Survey Buoys

Adding these data, researchers investigate following items;

- (a) Rapid water temperature down in Autumn,
- (b) Seasonal transition of mother shell's maturity,
- (c) Induction rate of hatching,
- (d) The time of cherry tree coming into blossom,
- (e) Accumulated water temperature over than 4° C degrees at Moura point,
- (f) Appearance of larvae especially of over 200 u size,
- (g) Situations larvae attached.

11. Conclusion

Mutsu bay is a typical example changed the waters as a rich fish production site after long-year efforts and serious experiences. And now the fishermen, the people living around the bay, and administrations concerned are doing their efforts to preserve Mutsu bay as a preferable fishing ground and to highten the value of the bay products. They are;

- (1) controle of scallop culture amount by the fishermen themselves,

- (2) promotion of "keep the bay and rivers clean concious" of the people,
- (3) provision of sewage and garbage treatment facilities for the culture fishery to process contaminated water and trash,
- (4) development of scallop stocking, processing and distributing facilities,
- (5) enhancement of distributing and selling system to highten the evaluation of the bay scallop products in the market.

The future fishing ports in the bay, in particular, should consider to accept facilities concerning above items.

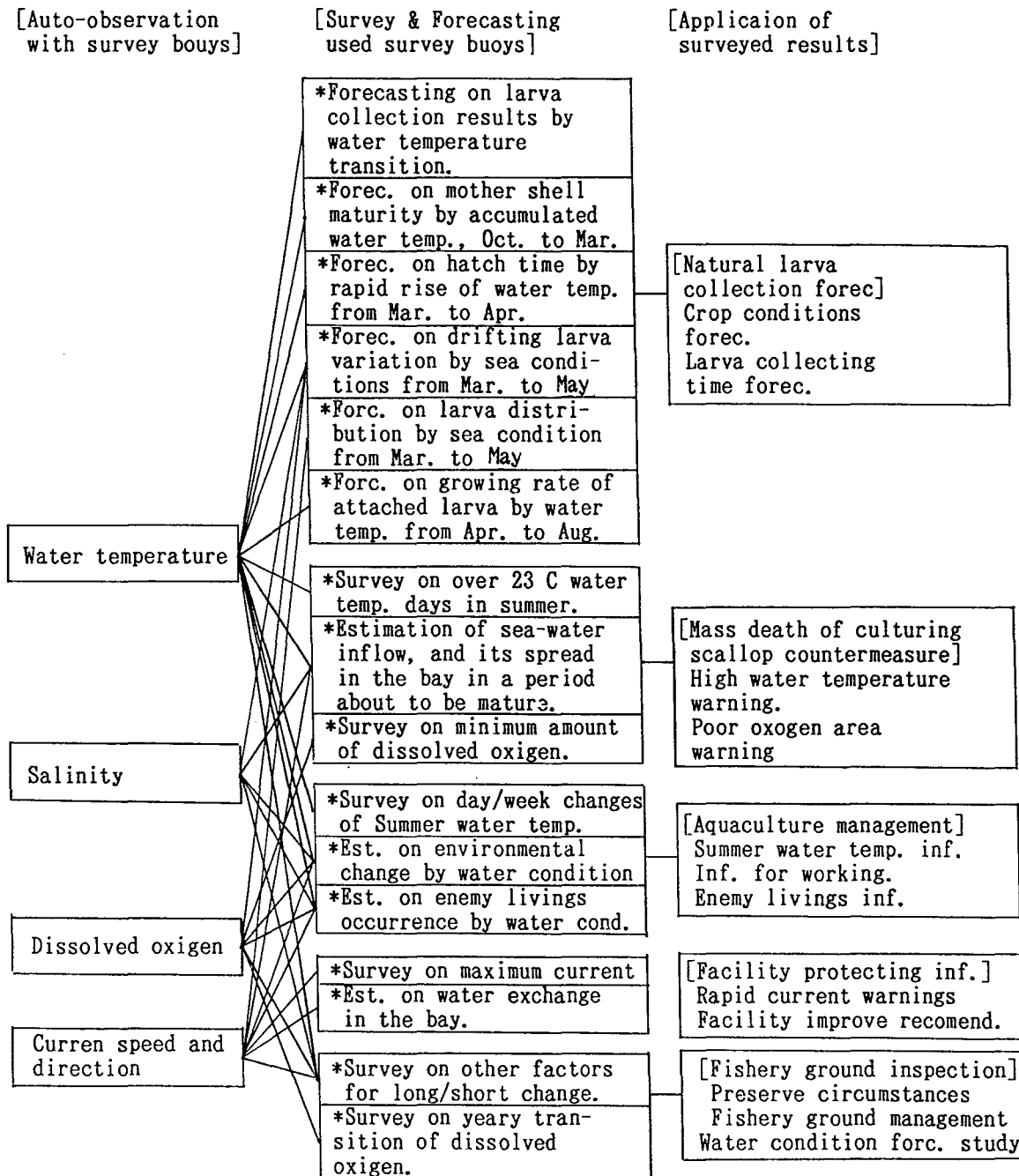


Figure-7 Application of Remote-survey Apparatus for Scallop Fishery

(References)

- [1]. Fishery Department, Aomori Prefecture, "Basic Survey on Fishery Development on Mutsu bay", Mar., 1976, Aomori Pref. (in Japanese).
- [2]. Fishery Dept., Aomori Pref., "Basic Survey on Integrated Development of near-shore and offshore waters", Mar., 1989, Aomori Pref. (in Japanese).
- [3]. Fishery Dept., Aomori Pref., "History of Researches for Scallop Fishery on Mutsu Bay", Feb., 1982, Aomori Pref. (in Japanese).