STATUS OF FISHING CONDITIONS IN JAPAN IN RELATION TO RESPONSIBLE FISHERIES

by

Yoshihiro Inoue and Frank Chopin
National Research Institute of Fisheries Engineering, Ibaraki, Japan

Abstract

The presence of a large number of species that are low in quantity in Japan's coastal waters has resulted in the evolution of a food culture that has historically utilized most of the catch species and sizes that are caught in coastal trawls. This has resulted in a diverse range of species and sizes captured and amounts to 40% of total animal protein intake. Sustainable fisheries in Japan are necessary for preserving food culture as well as employment and income and great efforts are being made to conserve resources. Three strategies have been carried on for conservation of fisheries in Japan, are (1) Enhancement of Fish stocks, (2) Improvement of fishing grounds and (3) Improving the selectivity of fishing gears. Increasing mesh size and release of fish juveniles after capture has already been accepted by fishers. Fishers and scientists together have become a team in developing and testing selective fishing gears. Selectivity has been investigated on a practical basis with the aim to reduce fish discards and to release fish juveniles. However, unlike many western countries, guiding net panels and grids to improve selectivity have not been successful in Japanese coastal multi-species fisheries. The variations in size, shape, price and seasonally of species make development of selective fishing gears extremely complex. Our practical target is to promote live capture technology, improve utilization of species captured and refine catch records for investigation of fish stocks.

1. FOOD CULTURE AND THE ROLE OF FISH IN WESTERN AND ASIAN DIETS

It is important to understand that Asian and western countries obtain their protein sources differently. For example, like many Asian countries, Japanese take in protein from grain, meat and fish. About 50% of protein intake is taken from grain and 50% from animal protein. Of this 50%, around 40% are obtained from fish. However, in western countries, 70% or more protein are taken in from meat. Reliance on fish is very low at less than 10%[1,2] (Table 1). This difference has resulted in very different food cultures between Asia and western countries. In the Asian region, fish as food is very important as part of a balanced protein diet together with grain and meat. This food culture has evolved around availability of protein supplies from the land (mainly rice) and a rich diversity of marine life in the coastal regions. The primary taste lements for humans include sweet, salty, bitter and sour sensors. Additionally we can sense hot, umami and other taste sensations. An important role of fish has been to use it as a protein supplement for eating grain foods and to add seasoning and taste to other foods. These fish based seasoning are made from a diverse range of small mixed fish and shrimps that are found in the coastal waters. They are an integral component in the diet of many Asian countries as well as being a major source of employment and income for inshore and artisenal coastal fishing communities.

2. FISH FOOD CULTURE AND FISHING GEAR SELECTIVITY IN DIVERSE FISH WORLD

Fish harvesting and utilization practices vary considerably between countries and different regions of the world. Many of these differences are related to the species diversity found in coastal areas. Typically, warm water ecosystems support a diverse variety of marine flora and fauna. Conversely, many cold water ecosystems are characterized by a relatively low level of diversity with one or two species being dominant. These differences are well illustrated by reviewing the catches made by two Japanese vessels (Fig. 1) fishing in the northern cold coastal waters of Hokaido, Japan and around the warm coastal waters off Kyushu Island. Each vessel was around 30 m. long and had a total catch of 4000 m. tons in each region. The number of catch species in each region are markedly different, with only 27 species being captured in the cold northern area in comparison to the 126 species captured in the warm southern region. The diversity of coastal marine fauna and flora has been one of the main reasons why different food cultures have arisen in different regions of the world. For example, in the tropical coastal regions of SE Asia, the presence of a diverse range of marine plants and animals in the catch including sea weeds, ascidians, jelly fishes, squids, shrimps, pelagic and demersal fish has resulted in the development of a diverse fish food culture. This culture values a wide range of sizes of fish of the same species with markets being established for such delicacies as anchovy larvae, juvenile fish as well as adults. In many cases, the price for smaller sizes can be many magnitudes higher than for the adults. This harvesting approach could be generally described as a "catch all" strategy.

On the other hand, many cold water regions of the world where marine diversity is lower, markets have tended to evolve around a limited number of species where typically higher prices are paid for the largest individuals. Moreover, as can be seen from Fig. 1, the presence of a dominant species is very clear. Because a single species can dominate the catch, the status of the dominant stock is well reflected in the income of the fishers. The dominance of a single species and the preference for larger fish have played important roles in the development of many cold water fisheries and has often resulted in fishers capturing and discarding of juveniles of the dominant species together with juveniles and adults of other species. This harvesting approach could be generally described as a "throwaway" strategy.

In summary, many Asian fisheries, including those of Japan are characterized by utilization of the whole catch while in many western fisheries there is a high degree of discarding in shrimp trawl fisheries[3].

3. STATUS OF FISHERIES CONDITIONS IN JAPAN

Before the start of the last century, the Japanese population level had been stable for a very long time. However, over the last 100 it has rapidly increased to 120 million persons (Fig. 2). During this period Japan's fish catch amount rapidly increased to a peak of 12 million m. tons but, it has decreased to a level 7 million m. tons over the last 10 year period[2]. At the same time, there have been dramatic changes in the age of fishers in Japan's coastal fisheries and presently the labor to sort such diverse catches is in decline. Young fishers can find nicer work ashore and are attracted by high salaries such as in construction work. Fig. 3. Shows the fisher's population and their age construction. The number of fishers have decreased by about 30% in the last 10 years and it is similar to catch amount decline. Now, the average fishers age is 55years. In the near future (3 to 5years), the number of fisher will be around 200 thousand with an even higher average age. This aging fisher population finds it harder to carry out hard labor deck work including sorting the catch. Consequently, it has resulted in not sorting lower value species and is one reason for recent discarding of fish in Japan. It is also one of the reasons why fishers are interested in sorting devices such as BRD.

4. STRATEGIES FOR CONSERVATION OF FISHERIES

The Japanese population is very large and the importance of fish in the diet has created a big demand for fish for food. But rapidly declining catches and few young fishers are now major problems for Japan. Recognizing the importance of fish for food and as a source of income and labor, the Japan Government has established strategies for conservation of fisheries. These are:

a) To improve the condition of fishing grounds

b) To enhance wild stocks of commercial fishes

c) To improve the selectivity of fishing gears

4.1 Improvement of fishing grounds such as artificial reefs

Many kinds of artificial habitats were constructed around Japanese coastal areas for resource protection and enhancement, that are for seaweed, sea urchin, abalone, lobster and fish. These reef are used some time by hand collecting fisher, diving fisher, gillnet fisher, angling fisher, longline fisher, purse seine fisher and bottom trawl fisher.

4.2 Enhancement of wild fish stocks such as juvenile fish release

Many fish are raised from egg to the juvenile stage and then released to the sea. Over ninety fish species have been released already including clam, sea urchin, abalone, shrimp, flatfish and other round fishes. This activity is carried out by both fishers and government organizations (Fig. 4). Since many of these fishes are released into coastal fishing areas, there is now concern about the age of recapture of released fish by commercial fishers. For example, if release and survival rate is high, there is some probability of juveniles being recaptured by coastal fishers. Red sea bream and flounder have been released in the largest numbers, around 20 million juveniles. Every year the same number of fish are released and tried to increase number and species. For these two species in particular, the question about capturing released juveniles by trawls is now being considered, and it is a second reason why fishers involved in fish release are also interested in BRD.

4.3 Development of selectivity fishing gears such as BRD.

In Japan, many selectivity experiments have been carried out. Table 2 shows category of those works from the last 10 years since 1990 in Japan which amounts to 172 reports. These reports classified by 7 kinds of fishing methods, however, over 60% are based on trawl selectivity, 20% on gillnet selectivity and 10% on pot selectivity. Concerning selectivity methods, 60% or more were selectivity element experiments such as mesh size, hanging ratio. Very few attempts have been made to consider more complex gear structure experiments. Concerning the type of selection, almost all experiments investigated homo- selection such as selection fish from fish, shrimp from shrimp. Only a few experiments were based on hetero - selection such as shrimp from fish selection, crab from fish selection etc.

Testing of fishing gear selectivity is carried out locally by prefecture experimental stations and staff. Tests are mostly carried out aboard commercial vessels together with fishers to ensure a practical approach and fisher involvement. Projects include gear types such as trawl, crab pot, gillnet, set net, scoop net. Research and development includes investigation of increase in mesh size, using separators and modifying structures. Coastal trawl fisheries have the biggest trouble to fish selectively. There are about 20 thousands small trawlers under 15m length, working around Japanese coast. Fig. 5 is a typical BRD cod end for practical experiments on coastal trawls. Usually, ordinary mesh panels are used as the separator but BRD's with frames and hard grids have also been tried. Our aim for selection is to release the smallest shrimp, juvenile flat fish and sea bream. However, we also want to catch shrimp as well as small, flat shaped and round shaped fish at same time. We have checked the underwater towing shape of gear and fish behaviour around the separator using an underwater TV camera. Fig. 6 is a typical result of selectivity experiments. We want to release juveniles of these species of fish but the retention rates were variable by trials. Sometime good results were obtained but at, other times the gear was not selective[4]. We have noticed through video and catch results that marine fauna and garbage can disturb the operation of the separator and influence the selection process.

In a selectivity symposium held last year by the Japanese government the experiences collected by 82 scientists from 25 local experimental station around Japan were summarized[4]. Table 3 shows the results of dragged gear selectivity. The top line show fishing methods of seine, beam trawl and otter trawl. The Second line shows the selection type. For example, if we only want size selection or simple species selection, it is not so difficult. When size and species selection is aimed same time, it is difficult to achieve. Furthermore, size - species selection and garbage separation at the same time is considered the most difficult problem. An analysis of the dynamics of discarding also show that many of the catch species can be discarded depending on size, season, fish price or sorting labor power. The bottom two lines show the selectivity results. The selectivity success ratio is a measure of how much fish was released during fishing trials. The results are wide and variable. Also, subjective estimates of the survival ratio of fish after release also have a wide range and are variable. In summary, our work to date shows just how difficult selectivity fishing by dragged gears is in Japan's coastal warm water fisheries.

4.4 Fishers practical techniques for better fishing life.

In a general sense, the most important point about fishing is to reduce the level of biological waste such as discards etc. As already stated, it is very difficult to achieve multi-species selection. Another strategy is to develop techniques for capturing fish live. In this strategy, the fishers and buyer have many possibilities for utilizing live fish. For example, fishers may:

a) Send their fish to high value live fish markets

b) Hold the fish alive in cages and wait for favorable market price situation

c) Increase the size and weight of juveniles by cage feeding

d) Fish captured live can be released to the sea alive with reduced discard mortality

Our fishers are interested in reducing the level of discards and discarded fish mortality are carrying on their own practical selection on deck[5,6)]. Fig. 7 shows the results of how mortality of discards can be reduced by reducing the time fish stay on the boat and also by the catch wet. Our fishers have tried two methods to reduce discard mortality: (1) Using a water bath on deck and (2) Sprinkling the catch with water as it is sorted on deck. In case of the water bath, flat fish survival increased by a factor of 3 times compared to selection in air. Also, mantis shrimp mortality decreased by more than one third compared to selection in air.

There are several fishing methods which allow certain fish species to be captured alive including handlines and pots. Japanese fishers are now developing fishing strategies that allow them to capture, transport and maintain fish alive using other fishing gears. For example, set nets for jack mackerel and yellowtail and purse seines for sardine, mackerel and jack mackerel. This strategy by fishers demonstrates that keeping the fish alive by "Caring for the catch" gives fishers a great practical opportunity and choice as to how to best utilize fish.

5. CONCLUSION

We have tried to show how complex it can be to establish multi-species fisheries on a sustainable basis. The importance of fish in Japan as a source of food, income and labor has required a multidisciplinary approach to maintain catches and the fishing economy. In terms of Responsible Fishing Technology we have identified three principle strategies for reducing biological waste in commercial fisheries.

Firstly, advance live capture and release techniques: There is a need to reduce the level of discards or to find ways of maintaining the fish alive throughout the capture, hauling and sorting process. This is because of the increasing needs for fish protein for human food supply and because of the biological waste that occurs when fish are discarded dead. We have already shown how difficult it is to develop selectivity fishing gears in multi-species fisheries. To reduce discards, Japanese fishers have released juveniles alive after capture and on deck selection by keeping the fish in water or under a water spray. Our next aim is to improve techniques for maintaining fish in good condition and survival probability after release is high. The technical problem is "How can we keep fish alive during gear retrieval and on board sorting?" When Japanese fishers release fish after sorting, fish are more active if they have not been in contact with other organisms and garbage. For this to be achieved, we must try to divide fish from marine fauna and garbage during the capture process.

Because the range of species shapes and sizes are large, separating out a few species is not a simple selection problem but a truly complex problem that needs more sophisticated technology than simple mechanical sieving. The complexity of the multi-species selectivity problem requires the skill and experience of the regional fishing technologists to share information and data on a regular group basis.

Second, Developing diversity of food after catch: Historically, food culture patterns, the multi-species nature of the warm coastal seas and capture technologies have been in balance. We have captured diverse species as well as adults and juveniles. Rather than discard them, we have developed a food customs that are able to utilize a large proportion of the catch. The combination of fish meat and grain proteins is diverse as well as healthy for a balanced diet according to food scientists. This is a successful catch utilization strategy providing over fishing does not occur. We believe that in multi-species fisheries careful consideration should be given to improving the utilization of capture species for human consumption.

Thirdly, recording precise catch data and involving fishers: With the increased demand for fish protein for human food supply and the food utilization strategies used in the Asian region, it is important to have good records of fish catch and a measure of the impacts of fishing on the marine environment. We need to find ways of using fishers knowledge about nature and fishing and combining it with information gathered by fishing technologists and scientists. Often fishers are able to sense changes in fisheries conditions well before these changes are measured by scientists.

6. REFERENCES

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7. ACKNOWLEDGEMENTS

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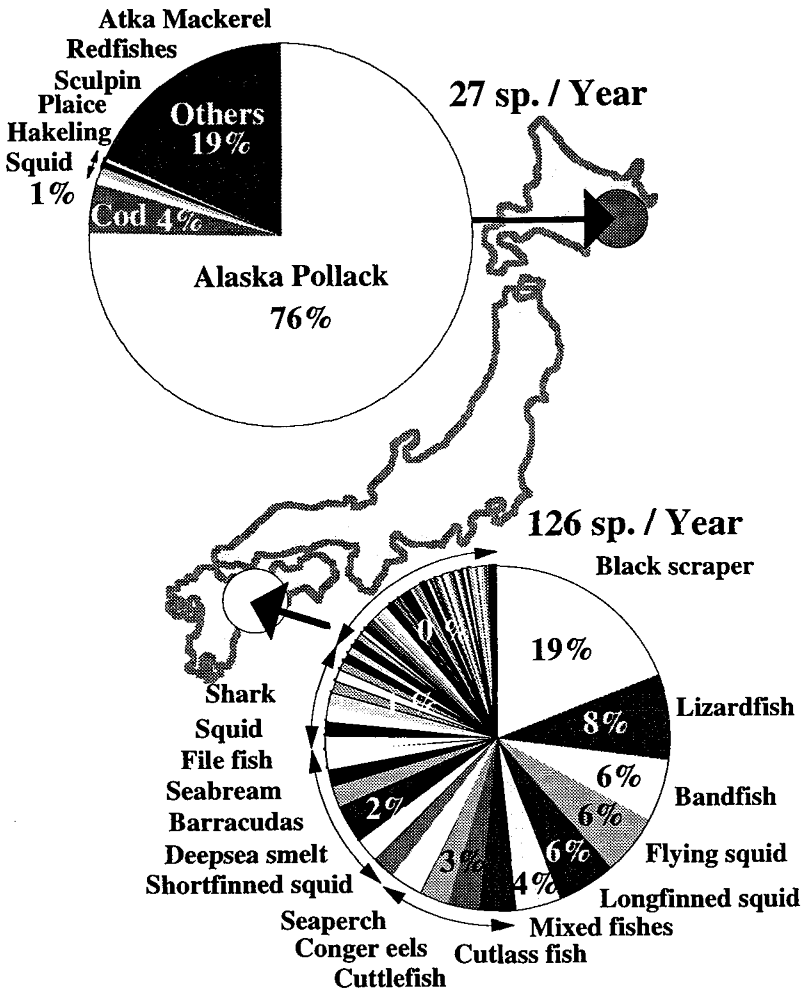

Fig. 1 Landed species in cold coastal water and warm coastal water

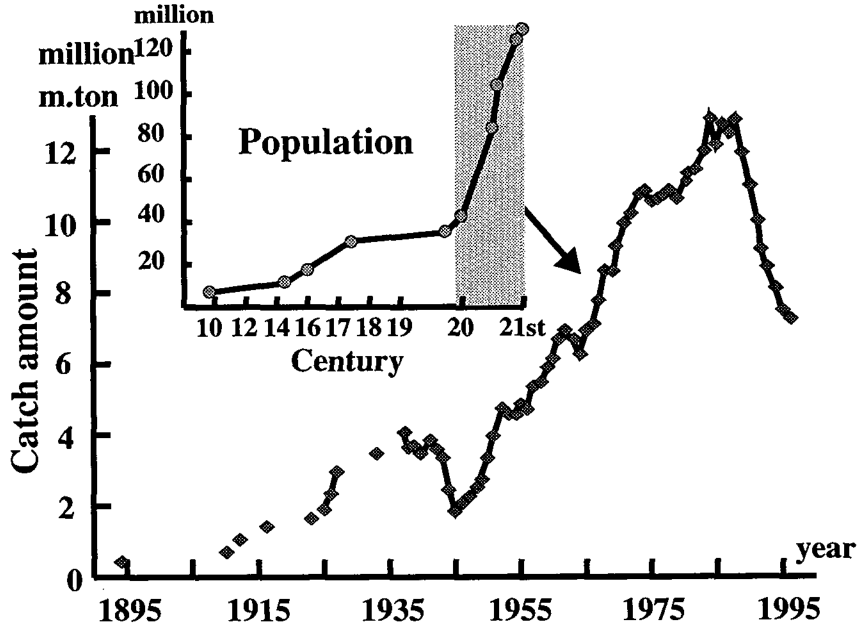

Fig. 2 Trends in Japanese population and catch

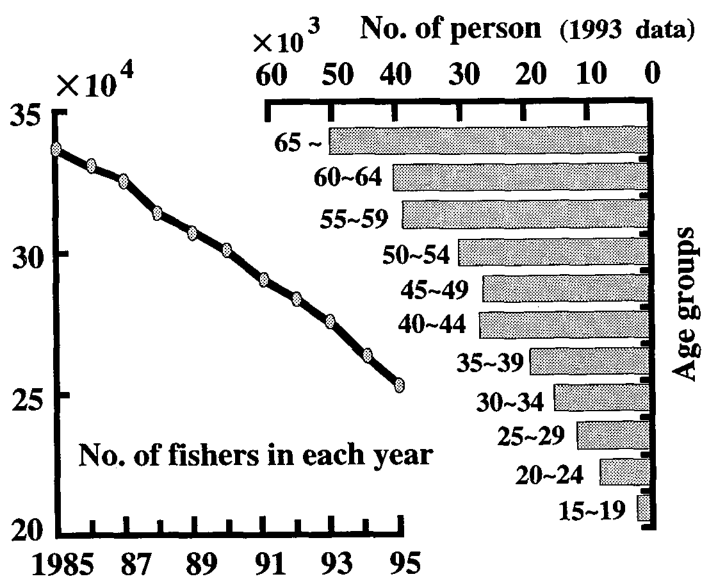

Fig. 3 Age construction and no. of coastal fishers in Japan

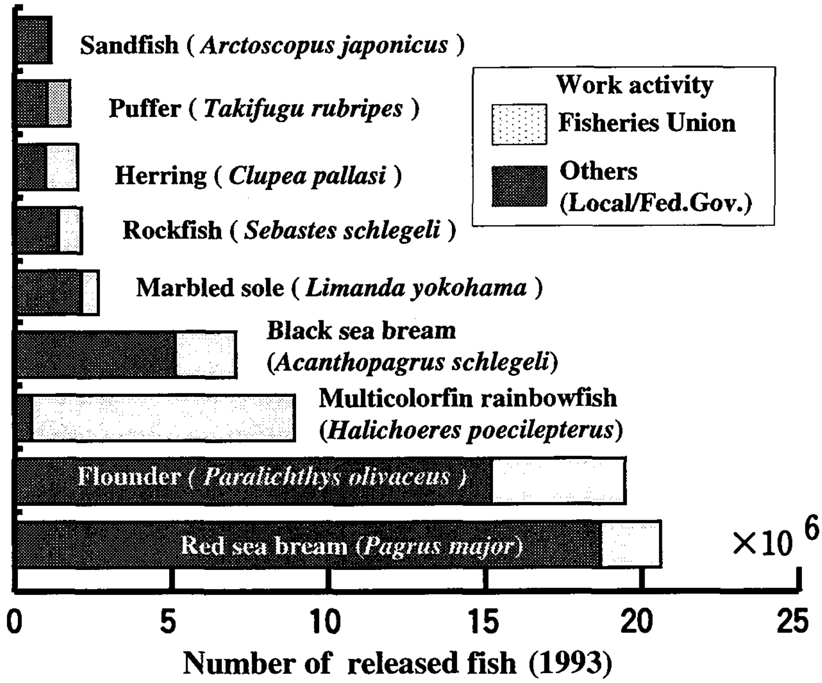

Fig.4 Examples of wild stock enhancement

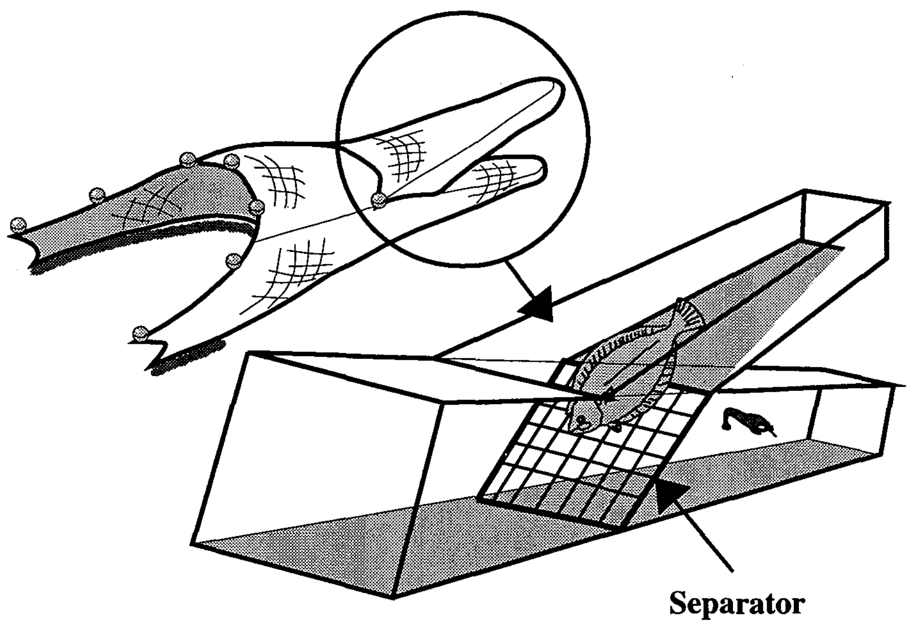

Fig.5 Basic BRD for coastal trawlers in Japan

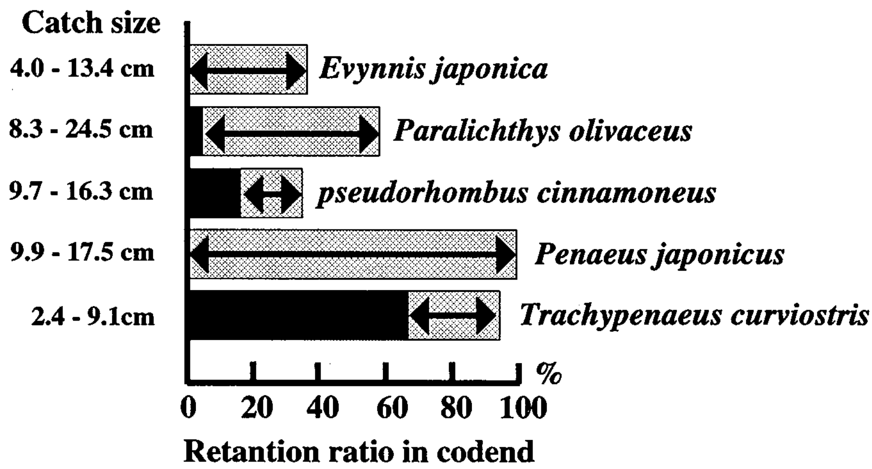

Fig. 6 Variable selection results

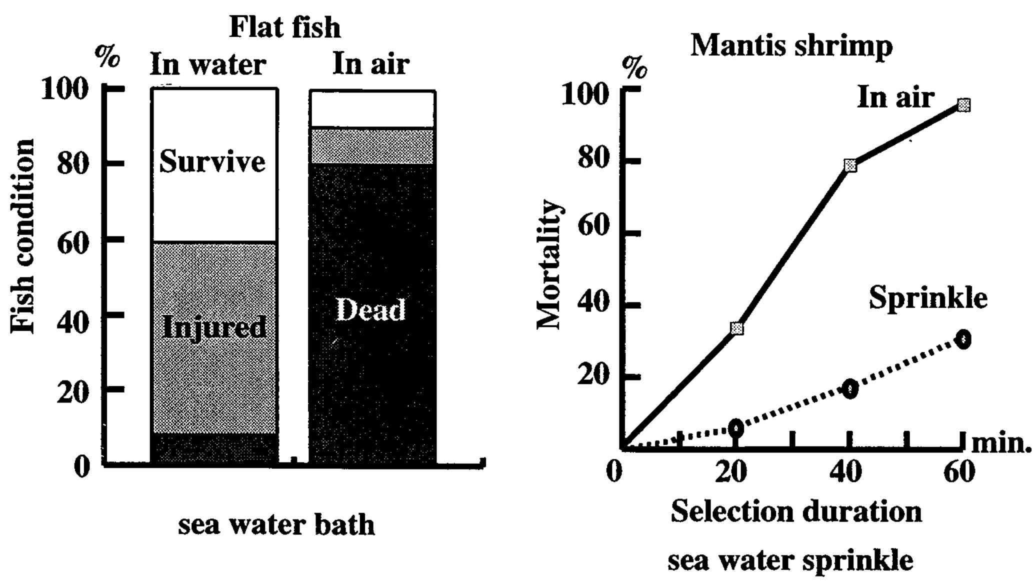

Fig.7 Fishers practical selection for reducing released or discarded fish mortality

Table 1 Protein supply per person per day in each country

Country	Grain protein	Animal protein	Fish / Animal protein ratio
Japan	48.7 %	51.3 %	41.8 %
Korea	66.7 %	33.3 %	60.0 %
China	80.8 %	19.0 %	19.7 %
Indonesia	86.3 %	13.7 %	59.0 %
India	86.0 %	14.0 %	12.5 %
Denmark	21.8 %	78.2 %	18.5 %
W. Germany	32.8 %	67.1 %	4.4 %
U.K.	47.2 %	52.8 %	7.3 %
France	30.6 %	69.3 %	6.8 %
Italy	49.6 %	50.4 %	7.0 %
U.S.A.	31.3 %	68.7 %	3.4 %

1986-88 data

Table 2 Category and contents of selectivity reports since 1990 in Japan

Fishing Methods	No.of reports	Type of experiment			Type of selection		
		Element Exp.*1	Structure Exp.*2	Theory	Homo-Selection*3	Hetero-Selection*4	Theory
Purse seine	3	3	0	0	3	0	0
Trawl	105	66	33	6	75	23	7
Dredge	4	0	4	0	4	0	0
Gill net	37	30	6	1	36	1	0
Long line & Angling	3	3	0	0	3	0	0
Pot	15	4	9	2	15	0	0
Set net	5	3	0	2	5	0	0
Total	172	109	52	11	141	24	7

*1: Such as mesh size, hanging ratio

*2: Such as BRD

*3: Such as fish selection from fish

*4: Such as shrimp selection from fish

Table 3 The results to date of selectivity fishing experiments on dragged gear types.
Results.of a selectivity symposium in October 1996. 82 scientists and technical staff from 25 Experimental Stations.

Fishing Methods	Seine	Beam Trawl	Otter Trawl
Selection Types	Size, Species, Size & Species	Species, Size & Species Size & Species & garbage	Species, Size & Species Size & Species & garbage
No.of species in catch /yr.	50 - 64	10 - 140	30 - 80
Cumulative no. of Discard Sp.	51	140	70
Selectivity Success ratio*1	40 - 80 % *2	0 - 80 %	20 - 80 %
Survival ratio after release*2	0 - 100 %	20 - 80 %	30 - 100 %

*1 : Researcher opinion based on results

*2 : Not clear, further experiments necessary