Recent Trends in Fish Diseases in Japan

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Abstract

Losses of cultured marine and freshwater fishes due to diseases averaged about 20,000 tons each year or 6% of the aquaculture production in Japan in 1980-1991. During this last decade, bacterial diseases have been responsible for most of the losses. Three trends are evident from epidemiological data. First, diseases caused by bacteria with multiple drug resistance are prevalent, and these are difficult to overcome by chemotherapy. Second, parasitic diseases and viral diseases that are practically impossible to cure are increasing. Third, some diseases seem to originate in juveniles (seed) imported from other countries. Further research should focus on: (1) improving dietary and environmental conditions, (2) giving the host animals resistance against disease through methods such as vaccination, and (3) developing diagnostic and disinfection procedures for epidemics. Active exchange of information is necessary to prevent, or alleviate the effects of, the spread of diseases through international export and import of juveniles.

Introduction

The loss of cultured fish due to diseases averaged about 20,000 tons each year in 1980-1991 (14,000-17,000 tons of marine fish and 3,000-4,000 tons of freshwater fish), or 6% of the aquaculture production in Japan (Fig. 1). The rate of loss has gradually decreased perhaps due to the development of better culture techniques and preventive measures against epidemics.

Epidemiological studies have been conducted at the Nansei National Fisheries Research Institute since 1981 to determine the trend of incidence of marine fish diseases and to search for correlations between the disease, host fish, culture environment, and pathogens. These studies were done with researchers of prefectural fisheries experimental stations. Cases of diseases reported to the Institute increased from about 1,000 in 1981 to 3,500 in 1993 (Fig. 2).

This paper describes the recent trends of prevalent fish diseases in Japan and discusses some underlying causes and related issues.

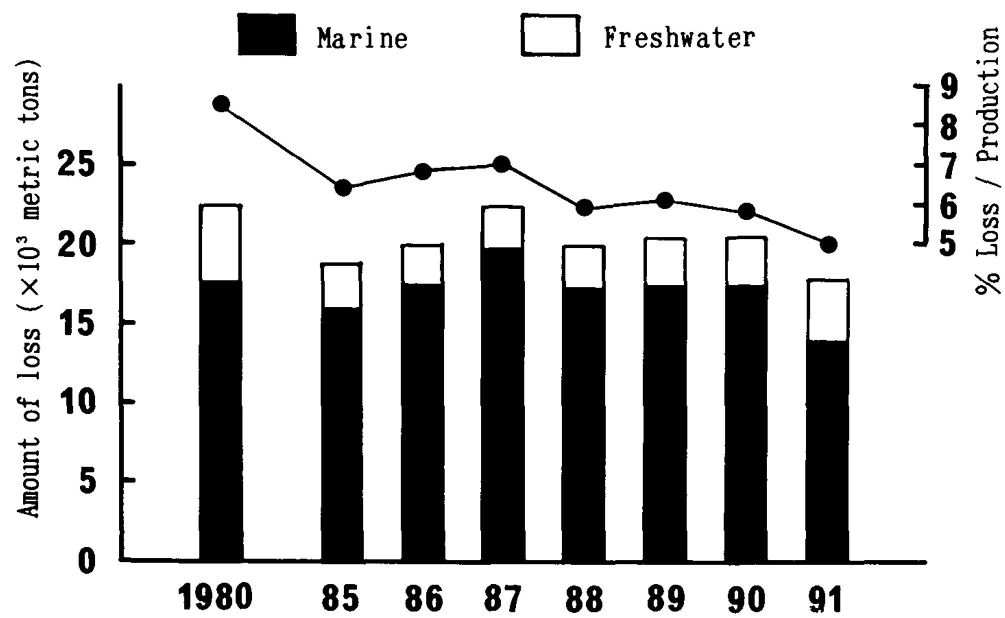

Fig. 1. Loss of aquaculture production in Japan due to diseases. Data from the Research Division, Fisheries Agency of Japan.

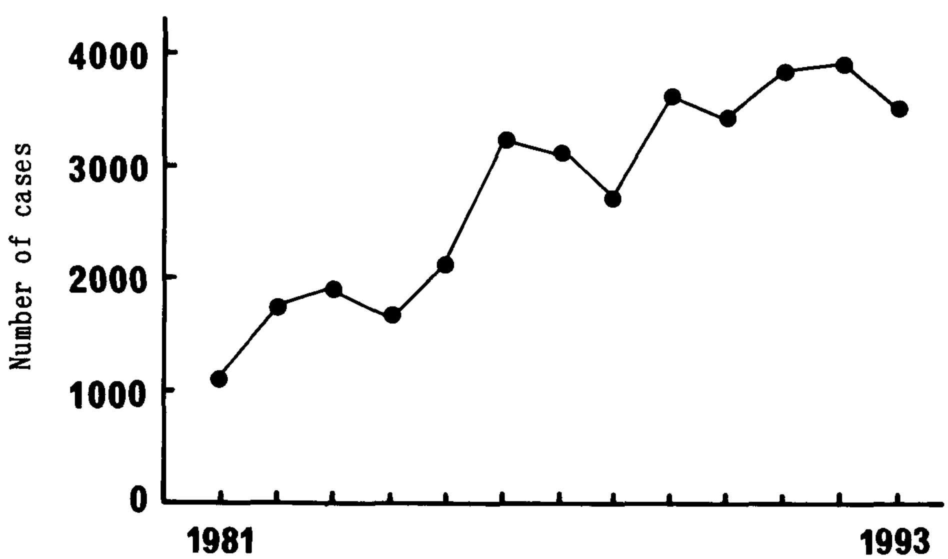

Fig. 2. Number of disease cases reported to the Nansei National Fisheries Research Institute from 1981 to 1993.

Trends of Prevalent Fish Diseases

Ishioka (1992) analyzed the species-specific sensitivity to diseases, the seasonal changes in incidence of diseases, and the relationship between fish size and prevalence of disease. Data from 1981 to 1990 showed that deteriorating environmental quality and poor fish health led to situations favorable to pathogens.

Losses of freshwater and marine fishes due to diseases in 1991 are shown in Tables 1 and 2 together with the percent incidence of various diseases. The carp *Cyprinus carpio,* tilapia *Oreochromis niloticus,* and red sea bream *Pagrus major* appear to be less susceptible to diseases. But the flounder *Paralichthys olivaceus* and the puffer *Takifugu rubripes* are highly susceptible.

Table 1. Loss of cultured freshwater fishes due to diseases in 1991. Data from Research Division, Fisheries Agency of Japan.

Species	Production (tons)	Loss (tons)	Loss (%)	Disease	Incidence (%)
	39,000	1,190	3.0	Edwardsiellosis	38.1
Eel				Gill disease	34.5
Anguilla japonica				Complication	3.7
				Gill necrosis	3.5
				Beko disease	2.7
				Others	17.5
Salmonids	20,000	1,230	6.1	Infectious hemato	
Oncorhynchus spp.				poeitic necrosis	39.9
				Saprolegniasis	21.6
				Vibriosis	8.3
				Bacterial gill disease	7.7
				Furunculosis	7.7
				Others	14.8
Carp	16,200	55	0.3	Gill necrosis	33.0
Cyprinus carpio				Parasitic disease	9.1
				Others	57.9
Ayu	13,900	1,370	9.9	Coldwater disease	46.1
Plecoglossus				Glugeosis	24.8
altivelis				Mycotic	
				granulomatosis	6.9
				Vibriosis	5.8
				Others	16.4
Tilapia	5,600	37	0.7	Streptococcosis	84.4
Oreochromis				Edwardsiellosis	12.4
niloticus				Gill disease	1.1
				Others	2.1

Table 2. Loss of cultured marine fishes due to diseases in 1991. Data from Research Division, Fisheries Agency of Japan.

Species	Production (tons)	Loss (tons)	Loss (%)	Disease	Incidence (%)
Yellowtails	161,000	8,150	5.1	Streptococcosis	67.9
Seriola spp.				Pseudotuberculosis	18.1
				Jaundice	6.0
				Complication	3.1
				Nocardiosis	1.0
				Others	3.9
Red sea bream	60,300	1,540	2.6	Iridovirus infection	29.2
Pagrus major				Bivaginosis	11.2
				White-spot disease	6.1
				Vibriosis	5.8
				Edwardsiellosis	2.9
				Others	44.8
Flounder	6,500	1,090	16.7	Streptococcosis	25.6
Paralichthys olivaceus				Edwardsiellosis	22.3
				Benedeniosis	11.3
				Complication	6.5
				Ascites	5.5
				Others	28.8
Puffer	2,900	650	22.5	Kuchijirosho	27.7
Takifugu rubripes				Kuchigusarebyo	16.8
				White-spot disease	12.2
				Complication	5.5
				Trichodinosis	3.8
				Others	34.0
Horse mackerel	5,900	430	7.3	Vibriosis	53.6
Trachurus japonicus				Streptococosis	42.6
				Others	3.8

The trend of prevalence of fish diseases in 1993 is shown in Table 3. Bacterial diseases were most frequently reported in the yellowtail *Seriola quinqueradiata,* the purplish amberjack *S. purpurascens,* and the flounder. Parasitic and viral diseases were most frequent in red sea bream, the puffer, and the sea perch *Lateolabrax* spp.

With bacterial diseases, the prevalence of drug-resistant strains is the important problem. Parasitic and viral diseases are increasing; these are practically impossible to cure. In addition to these, some diseases originated from imported juveniles from abroad.

Table 3. Diseases reported among cultured fishes in 1993. Data from Nansei National Fisheries Research Institute.

Species	Number of cases reported	Frequency of disease (%)* A	B	c	D	E	F	G	H	I	J
Yellowtail *Seriola quinqueradiata*	1,428	48.2	6.7	26.2	5.2	0.0	1.7	2.2	6.6	0.3	2.9
Flounder *Paralichthys olivaceus*	644	12.1	0.0	0.0	6.5	24.5	19.6	14.4	4.2	0.2	18.5
Purplish amberjack *Seriola purpurascens*	470	28.3	1.1	20.4	7.5	0.0	8.3	17.0	3.8	1.5	12.1
Red sea bream *Pagrus major*	320	0.3	0.0	3.8	5.9	12.5	5.6	19.1	15.9	5.9	31.0
Puffer *Takifugu rubripes*	218	0.5	0.0	0.0	6.9	0.0	11.4	37.1	9.2	6.9	28.0
Striped jack *Pseudocaranx dentex*	110	19.1	0.0	7.3	12.7	0.0	10.9	9.1	10.9	6.4	23.6
Sea perch *Lateolabrax* spp.	51	3.9	0.0	0.0	0.0	0.0	7.8	13.7	47.1	0.0	27.5
Goldstriped amberjack *Seriola aureovittata*	47	51.0	2.1	23.4	4.3	0.0	0.0	12.8	2.1	0.0	4.3
Schlegel's black rockfish *Sebastes schlegeli*	24	16.7	0.0	0.0	0.0	0.0	41.7	20.8	0.0	0.0	20.8
Striped beak perch *Oplegnathus fasciatus*	22	13.6	0.0	9.1	4.6	0.0	0.0	22.7	13.6	4.6	31.8
Dark-banded rockfish *Sebastes inermis*	21	33.3	0.0	0.0	9.5	0.0	4.8	38.1	0.0	0.0	14.3
Black sea bream *Acanthopagrus schlegeli*	17	0.0	0.0	35.3	5.9	0.0	29.4	23.5	0.0	5.9	0.0
Seven-banded grouper *Epinephelus septemfasciatus*	17	0.0	0.0	0.0	5.9	0.0	0.0	11.8	0.0	0.0	82.3
Other fishes	94	9.6	0.0	10.6	19.1	4.3	20.2	11.7	4.3	1.1	19.1

* Diseases: A=Streptococcosis; B=Streptococcosis+Pseudotuberculosis (mixed infection); C=Pseudotuberculosis
F=Other bacterial disease; G=Parasitic disease; H=Viral disease; I=Nutritional disease; and J=Others

Prevalence of Drug-Resistant Bacteria

Among the bacterial diseases of cultured yellowtail, streptococcosis was responsible for the highest losses, and pseudotuberculosis ranked second (Table 2). Prevention of these diseases is therefore important for the successful culture of yellowtail. Multiple drug-resistant strains of *Pasteurella piscicida,* the causative bacterium of pseudotuberculosis, have been frequently isolated (Kim and Aoki 1993). The incidence of multiple drug-resistant strains of *Enterococcus seriolicida,* the causative bacterium of streptococcosis, has gradually increased in recent years (Fig. 3). Fish farmers now find it very difficult to overcome these diseases by chemotherapy.

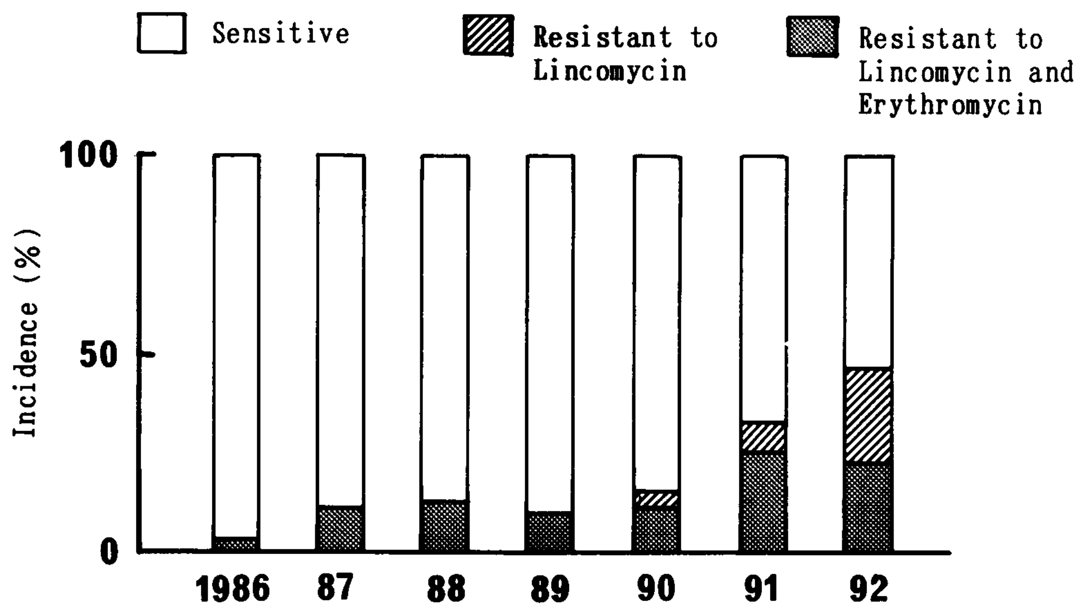

Fig. 3. Incidence of drug-resistant strains of *Enterococcus seriolicida* from 1986 to 1992. From Ehime Prefecture (1993).

The epidemiological surveys show a close relation between the increase of multiple drug-resistant strains and the indiscriminate use of chemotherapeutic agents in yellowtail culture. In an experiment to lower the drug resistance of *Enterococcus* bacteria, the drug macrolide was withheld for several months, after which the sensitivities of isolated bacteria to erythromycin were determined. The results showed that the incidence of drug-resistant strains became very low after drug use was stopped (Fig. 4).

Thus, we have to establish the proper use of chemotherapeutic agents in fish farms to prevent an increase in drug-resistant strains.

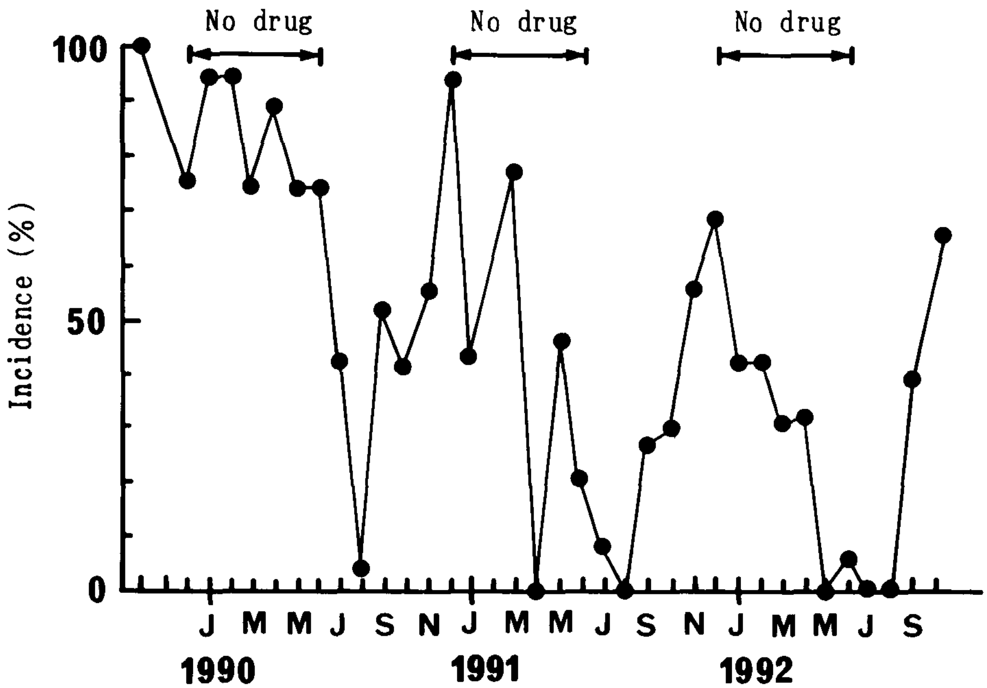

Fig. 4. Incidence of macrolide-resistant strains of *Enterococcus seriolicida* in a yellowtail farm where administration of the drug was stopped during the three periods shown by the bars on top. From Fukudome (1993).

Increase in Parasitic and Viral Diseases

Parasitic and viral diseases are on the rise (Fig. 5). The parasitic diseases include benedeniosis and heteraxinosis in yellowtail, white-spot disease and bivaginosis in red sea bream, benedeniosis and trichodinosis in flounder, and white-spot disease, heterobothriosis, and trichodinosis in puffer (Table 2). White-spot disease, caused by the ciliate *Cryptocaryon irritans,* was first reported as an aquarium disease, became prevalent in many fish farms, and killed many fish species in recent years. Dense populations of fish in farms lead to very high numbers of parasitic animals.

In 1990, a new viral disease caused by an iridovirus affected the red sea bream in Shikoku Island (Inouye et al. 1992). Since 1991, this viral disease had spread to many red sea bream farms in western Japan and many fish died. Artificial infection experiments showed that the iridovirus is not so virulent. The fact that many red sea bream were killed by the iridovirus suggests that the fish were primarily weakened by some physiological or environmental factor.

Viral and parasitic diseases are difficult to cure with drugs. Only one pesticide, now used against the monogenetic trematode *Benedenia seriolae* parasitic on yellowtail, is legally allowed for marine fish. Thus, drastic changes are expected in the way fish farms are operated.

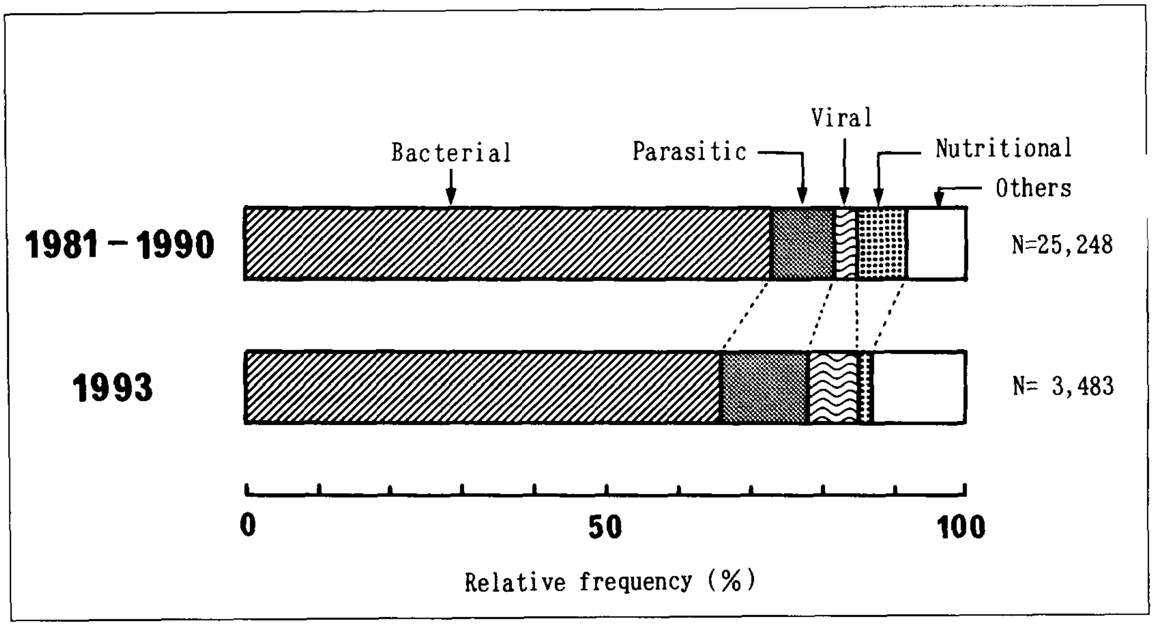

Fig. 5. Disease groups observed in cultured marine fishes. The frequencies of parasitic and viral diseases in 1993 have increased over those in 1981-1990. Data from Nansei National Fisheries Research Institute.

Diseases from Abroad

The amounts of fish and shrimp juveniles imported from abroad have increased as cultured species have become more diverse. The species imported from abroad by the prefectures in western Japan in 1992 are shown in Table 4. Some of these species come from Taiwan and the Philippines. The imported juveniles of sea perch, purplish amberjack, the seven-banded grouper *Epinephelus septemfasciatus,* and the dark-banded rockfish *Sebastes inermis* make up much of the production of these species in Japan.

Imported stocks may have been the origin of some diseases, for example, epitheliocystis in red sea bream (Ototake and Matsusato 1987) and neobenedeniosis (caused by *Benedenia girellae)* in flounder. In 1993, mass mortality of cultured kuruma shrimp *Penaeus japonicus* occurred in many farms in western Japan due to rod-shaped nuclear virus (Takahashi et al. 1994, Inouye et al. 1994). Mass mortality occurred in all the shrimp farms that had imported the juveniles from China. The disease was transmitted horizontally from the imported shrimps to many shrimp farming areas (Nakano et al. 1994).

Imported fishes may easily become diseased due to the new environmental conditions. To avoid the risk of invasion of unknown pathogens in the future, juveniles for culture should be supplied from within the country. Unfortunately, import of juveniles will probably continue in response to the demand for cultured fish. Thus, there is an urgent need to take preventive measures against potential epidemics due to imported fish.

Table 4. Species of juvenile fish imported for culture in Japan in 1992. Data from Nansei National Fisheries Research Institute.

Species	Importing country
Pagrus major	Hongkong, Taiwan, China
Acanthopagrus schlegeli	China
Lateolabrax spp.	Hongkong, Taiwan, China
Seriola quinqueradiata	Hongkong, Taiwan, China, Korea
Seriola purpurascens	Hongkong, China, Korea, Viet Nam
Seriola aureovittata	Korea
Epinephelus septemfasciatus	Korea
Epinephelus malabaricus	Philippines
Epinephelus awoara	Hongkong
Hexagrammos otakii	China
Sebastes inermis	Korea
Paralichthys olivaceus	Korea
Stephanolepis cirrhifer	China
Penaeus japonicus	Taiwan

Conclusion

Incidence of fish diseases depends on the condition of the host fish and the environment and on the presence of pathogens. Therefore, further efforts should be made to improve the dietary and environmental conditions to give the host animals resistance against disease. Activation of the defence mechanisms of the host animals through vaccination or immunomodulation should be investigated more intensively. To solve the problem of spread of diseases through international transfer of juvenile stocks, we need active exchange of information on fish diseases and the development of diagnostic, disinfection, and quarantine procedures.

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