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# Fish Quarantine and Fish Diseases in Southeast Asia

## Report of a workshop held in Jakarta, Indonesia, 7-10 December 1982

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# FISH QUARANTINE AND FISH DISEASES IN SOUTHEAST ASIA

## REPORT OF A WORKSHOP HELD IN JAKARTA, INDONESIA, 7–10 DECEMBER 1982



COSPONSORED BY THE
UNDP/FAO SOUTH CHINA SEA FISHERIES DEVELOPMENT AND COORDINATING PROGRAM (PHILIPPINES) AND THE INTERNATIONAL DEVELOPMENT RESEARCH CENTRE (CANADA)

## Résumé

Le commerce du poisson vivant — alevins pour la pisciculture — augmente rapidement, attendu que les coûts de la pêche sont à la hausse et que les rendements diminuent. L'aquaculture moderne repose sur l'approvisionnement en alevins dont l'introduction, telle que pratiquée aujourd'hui, compromet la survie des espèces (souvent une seule par élevage) cultivées de façon intensive. Déjà, des épizooties signalées en Asie du Sud-Est sont attribuées aux nouveaux stocks et ces incidents risquent de se reproduire si les gouvernements de la région ne réglementent pas la circulation des poissons vivants afin de n'autoriser l'entrée qu'aux populations exemptes d'agents parasitaires ou pathogènes. Cette situation existant dans plusieurs pays, des experts en maladie des poissons d'Indonésie, de Malaisie, des Philippines, de Singapour, de la Thaïlande ainsi que des consultants du Royaume-Uni, du Canada et de l'Australie, se sont réunis à Djakarta, du 7 au 10 décembre 1982 pour examiner la question et faire part de leur expérience. L'Indonésie imposera incessamment une quarantaine à tous les stocks de poissons vivants importés ou transportés d'une île à l'autre, dans le pays. L'isolement est de 14 jours et comprend l'analyse d'échantillons en laboratoire pour détecter la présence de parasites, d'infections bactériennes, etc, ainsi que des symptômes ou signes pathognomoniques. La période de quarantaine, qui est de même durée en Australie, suffit à obtenir les résultats des laboratoires, à identifier la plupart des symptômes et des maladies et à garantir l'importation de sujets exempts de pathogènes humains. Singapour applique cette mesure à titre expérimental et les autres pays étudient divers moyens de contrôle. Cependant, la pénurie de personnel et de locaux pour effectuer les diagnostics et les traitements fait obstacle a l'établissement de services appropriés.



## Resumen

El tráfico de peces vivos —larvas para las operaciones de cría— aumenta rápidamente a medida que se elevan los costos de la pesca y disminuyen sus rendimientos. Este movimiento de peces es esencial para la acuocultura moderna, pero, bajo los procedimientos actuales, representa un serio riesgo para las grandes cantidades de pescado (a menudo una sola especie) que se cultivan en pequeñas áreas. En el Sudeste Asiático varios epidiontes pueden ser ya vinculados a la introducción de peces importados, y tales incidentes pueden volverse cada vez más comunes si los gobiernos de la región no toman medidas para controlar el tráfico de peces y asegurar que los cargamentos están libres de patógenos y plagas. Muchos de los países han reconocido el problema, e investigadores en enfermedades de los peces, procedentes de Filipinas, Indonesia, Malasia, Singapur y Tailandia, así como consultores del Reino Unido, Canadá y Australia se reunieron en Yakarta del 7 al 10 de diciembre de 1982 para discutir el problema y compartir experiencias. Ellos señalaron que Indonesia está en proceso de introducir la cuarentena obligatoria para todas las especies vivas de peces que se importen al país o sean transportadas entre las islas que lo conforman. La cuarentena es de 14 días durante los cuales las muestras del cargamento son sometidas a exámenes de laboratorio en búsqueda de parásitos, infecciones bacterianas, etc, y observadas en cuanto a signos y síntomas de enfermedades. La duración de la cuarentena, igual a la propuesta recientemente en Australia, asegura que no se importan patógenos humanos con los peces, que se obtienen los resultados de laboratorio y que los síntomas de la mayoría de enfermedades alcanzan a aparecer. Singapur está ensayando procedimientos de cuarentena y los otros países estudian las opciones de control. Sin embargo, la escasez de personal y la carencia de instalaciones para diagnóstico y tratamiento de las enfermedades constituyen una limitación seria al desarrollo de servicios apropiados.

# CONTENTS

# INDONESIA[1]

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Indonesia has a multitude of fishery resources, and fish is the main source of animal protein for human food. Because of its high productivity, aquaculture is considered the most feasible means to increase the supply of high-quality protein for food for the growing population.

About 4.4 × $10^5$ t of fish are produced at present from 1.4 × $10^7$ ha of open waters (natural lakes, reservoirs, rivers, swamps, etc.), brackish water, and fresh water. Of this total surface area, only 28% of the freshwater, 9% of the brackish-water, and 46% of the open-water resources have been utilized for fish culture, with freshwater-fish culture accounting for the highest production. Common carp (*Cyprinus carpio*), java carp (*Puntius javanicus*), nile tilapia (*Sarotherodon niloticus*), and giant gouramy (*Osphronemus gouramy*) are the economically important freshwater species being cultivated in the country. The low production from aquaculture, despite great potential, in Indonesia may be attributed to the insufficient supply of fry, environmental stresses, disease outbreaks, etc.

During the last few years, fish farming in Indonesia has been widely promoted, particularly through national and regional intensification of aquaculture programs; one result of these efforts has been increased traffic of live fish, both between the islands within Indonesia and between Indonesia and other nations. In 1980, Indonesia exported 4.4 × $10^5$ t ornamental fish at a value of US$ 135 934. In the same year, it imported exotic food and ornamental fish, which, unfortunately, introduced serious disease agents into many regions of the country. The history of such introductions is long.

In 1932, serious epizootics of *Ichthyophthirius multifillis* occurred in west and central Java, causing great losses to fish farmers. The parasite was encountered first in aquaria at Bogor, probably introduced with ornamental fish from the United States and Europe.

In 1951, an epizootic of *Myxobolus pyriformis*, a sporozoan parasite, killed thousands of Java carp fry in Central Java (Sachlan 1952). The parasite, which was thought to be imported, has caused serious losses annually ever since. However, the infection is seldom found on common carp or other species. Like most other sporozoan parasites, *M. pyriformis* is very difficult to control because cysts form around the spores and protect them against chemical baths.

*Lernaea cyprinacea*, which was accidentally introduced into Indonesia from Japan in 1953, caused a serious epizootic in economically important fish species such as common carp, java carp, kissing gouramy, giant gouramy, etc. The parasite rapidly spread to other regions and destroyed about 30% of hatchery production in the main hatchery centres of Java, north Sumatra, and north Sulawesi. This means that, in Java, a total of 1.48 billion fish fry were lost during the epizootic, equivalent to 7.4 billion rupiahs (US$ 1 = 650 rupiahs). Studies of the biology, ecology, and control methods of *Lernaea* were carried out under the Fish Parasite Project, supported by the International Development Research Centre (IDRC) from 1975 to the present, and a number of effective control measures resulting from the studies have been recommended to fish farmers.

During the project, two new parasites belonging to the myxosporidian group were recorded in west Java, causing considerable losses of common carp fingerlings. One of the parasites, first detected in 1974 and identified as *Myxobolus* sp.,

[1]This paper is an edited version of two papers; the cooperation of the authors in agreeing to a single country report is gratefully acknowledged.

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produces tumour-like swellings on the gills of fish. The other parasite was recorded in 1978 and preliminarily identified as *Myxosoma* sp. The infected fish exhibited swollen body muscles. Both of these parasites appear to be confined to common carp, and, during epizootics in carp fingerlings, have resulted in mortalities as high as 60–90%. Information on how to control the parasites is limited, and, to date, no treatment has been successful. How they were introduced into Indonesia is unclear, but imports of common carp from Japan are suspected.

In late 1980, a large number of fish died in west Java from an outbreak of bacterial disease. The epizootic was the most serious ever recorded in Indonesia, with 125 t of common carp dying, including 30% of the existing brood stock. This loss not only adversely affected present production but also curtailed expansion of fish culture in the country. A particularly virulent strain of *Aeromonas* sp. is believed to have been the causal agent, probably introduced with imports of common carp from Taiwan.

Although curative measures are pertinent and essential, the Indonesian government is considering measures that emphasize prevention through quarantine, because preventive measures are more economical and effective than curative measures.

Aspects of fish quarantine, its organization, and certification procedures were discussed at a regional workshop on tropical fish diseases, held in Cisarua, Bogor, in November 1978. The workshop was hosted by the Indonesian Directorate General of Fisheries (DGF) and Agency for Agricultural Research and Development (AARD) in collaboration with IDRC.

## INSTITUTIONS FOR FISH-DISEASES STUDY AND TRAINING

The study of fish diseases in Indonesia is still in its infancy, and there is a lack of specialists and laboratory facilities for carrying out this work. For a number of years, however, institutions, such as the Inland Fisheries Research Institute (IFRI) and the faculty of fisheries, Bogor Agricultural University (BAU), have been carrying out some studies. The diagnostic laboratories available in these institutions provide modest support for parasitological and bacteriological examinations. IFRI, under the Ministry of Agriculture, has closely cooperated with the faculty of veterinary medicine, BAU, and the Animal Disease Research Institute, particularly for viral diseases. DGF collects information on fish diseases in the field, monitors fish mortalities and morbidities, and provides data to the laboratories. Since the 1980 epizootics, the laboratories now have become better equipped, particularly for bacteriological studies.

The first training course on fish diseases and parasites in Indonesia was held by Biotrop, the Regional Centre for Tropical Biology, in 1980; 12 people from the Asean were trained for 6 weeks in the identification and control of fish and shellfish diseases.

In 1974, Indonesia, through DGF, developed a fish-quarantine service at six main ports, and, since 1977, 86 staff from the provincial fisheries services have been trained in a 2-month fish-quarantine training course at Ciawi, Bogor. Training was made possible through the cooperative efforts of DGF, the Agriculture Agency for Education and Extension, BAU, and IFRI. Through the IDRC-funded, fish-parasite project, four people, representing IFRI, DGF, BAU, and the Animal Disease Research Institute, were trained abroad in practical fish bacteriology, parasitology, and virology and have since rejoined their institutes. Not a single fish pathologist is available at present for work in the fish-quarantine service.

## NATIONAL POLICY

Along with the recent increase in live-fish traffic in the country has come increased risk of introduction and distribution of fish pathogens throughout the country. Past and recent disease outbreaks among cultivable fish as well as wild fish have prompted the government to carry out a program in the control of diseases and protection of fishery resources through regulation and legislation. At present, the Fish Quarantine Service in Indonesia is being set up. An agriculture-quarantine law that covers plants, animals, and fish has been drafted by the government for endorsement by Parliament. A manual on fish quarantine, which has been circulated, serves as a guideline for quarantine officers at the fish-quarantine stations throughout the country.

Before the outbreak of *Lernaea* in 1974 (when DGF established the six fish-quarantine services within the provincial fishery services), fish quarantine was under the Animal Quarantine Service. Some laws had already been passed to protect fishery resources. For example, the Ministry of Agriculture Decree 214/Kpts/Um/V/1973 prohibited transfer or export of certain fishery products, including *Anguilla* elvers, *Chanos chanos* seedlings, the ornamental fish *Botia macracanthus* (longer than 15 cm), and the seedlings of

*Macrobrachium rosenbergii.* Also, imports of *Serrasalmus* sp. (piranha) had been prohibited (DGF Decree E.I.5/8/8/1973). More recently, seven dangerous species — *Vandelia* sp., *Lepisosteus* sp., *Silurus glanis, Esox masquinongy,* electric eel, *Tetraodon* sp., and *Serrasalmus* sp. — have also been declared illegal by Ministry Decree 179/Kpts/Um/3/1982 and are to be destroyed in any area where they already exist.

Since the outbreak of bacterial disease in west Java in 1980, all imports of live fish require a permit from the Ministry of Agriculture and are only allowed entry via the Jakarta airport (Ministry of Agriculture Decree 819/Kpts/Um/11/1980). The imported fish have to be treated and quarantined. To prevent the spread of communicable-disease agents from Java to other parts of the country, a Ministry of Agriculture Decree (425/Kpts/Um/6/1982) requires that freshwater fish from Java be quarantined before being shipped elsewhere.

## FISH DISEASES

In Indonesia, parasitic diseases have been imported since 1920 and are encountered more often than are bacterial diseases, which have only just begun to be reported. Sachlan (1974) reported the presence of 13 species of ecto- and endoparasites on fish fry and adult fish in the country. Most are ectoparasites, which commonly attack fish fry: *I. multifillis, Trichodina domerguei, M. pyriformis, Dactylogyrus* sp., *Gyrodactylus* sp., *Clinostomum* sp., *Argulus indicus,* and *L. cyprinacea.* Two species of fungus, i.e., *Saprolegnia* sp. and *Achlya* sp., were also noted as important.

However, since 1974, a number of new parasites have been found, mainly in west Java, including Glochidia of *Anodonta woodiana* (freshwater clam), *Myxobolus* sp., *Myxosoma* sp., *Ergasilus* sp., and *Henneguya* sp. Among these new parasites, *Myxobolus* and *Myxosoma* are highly pathogenic to fish. No fish mortalities have been associated with the other three. *Henneguya* sp. was first detected on the gills of giant gouramy in 1978 and *Ergasilus* sp. detected on the gills of nilem (*Osteochilus hasselti*) also in 1978. According to Sachlan (1978), the Glochidia were accidentally introduced from Taiwan.

Reports of bacterial diseases before 1980 were rare, but, during that year, *Aeromonas* sp. was isolated from diseased fish. These bacteria are known to be opportunistic pathogens and cause infections in fish with impaired resistance. Impaired resistance may have been caused by a virus, but a virus has yet to be detected. Thus, fish mortalities are being attributed to the bacteria.

There are four major communicable diseases causing great losses to the freshwater-fish culture industry today: myxoboliasis, myxosomiasis, lerneosis, and a bacterial disease. Their importance derives from the fact that a considerable effort has been made to control them, but with only partial success, while fish kills continue.

*Lernaea cyprinacea* is the causal agent of lerneosis. The parasite belongs to the crustacean group and is known as "anchor worm." It is one of the most important species because of its wide distribution and ability to exist on many species of fish. The adult stage (female) of the anchor worm protrudes from the body of fish and is difficult to control by chemical treatment. Some organophosphate pesticides such as Dipterex and Sumithion at 0.5 ppm are effective against the larvae. Sand-gravel filters, which remove the infectious stages of the parasite from the water supply, are commonly used to prevent infestation.

Myxoboliasis and myxosomiasis are caused by *Myxobolus* sp. and *Myxosoma* sp., respectively, which are both spore-forming Myxosporidia. These parasites are confined to young common carp, the former producing tumour-like swellings (spore-laden cysts) of spores on the gill filaments and the latter causing the body muscle to swell. Identification of these parasites is based on the morphology of the spore. The spores of *Myxobolus* are pyriform in shape, and the sporoplasm contains iodinophyllic vacuoles, whereas *Myxosoma* spores are oval and lack iodinophyllic vacuoles. Spores of both parasites contain two polar capsules. There is no satisfactory means to control the parasitism. Liming the pond with 100-200 $g/m^2$ and strengthening the fry with nutritious feed, to some extent, reduce the rate of infestation. Also, as is the case with *Lernaea,* fish reared in ponds with sand-gravel filtration systems seem to be protected.

A number of bacteria were isolated from infected fish during the disease outbreak of October 1980. Most of the pathogenic bacteria were identified as *Aeromonas hydrophyla* (IFRI 1980b) and *A. salmonicida* (Sumawidjaja et al. 1981). The disease caused death within 3-4 days. The first disease sign was a loss of appetite, followed by heavy loss of body mucus, hemorrhaging on the skin, damage to gills and fins, loss of equilibrium, and, finally, death. The clinical signs were similar to those for motile *Aeromonas* septicemia (MAS). Large common carp and brood stock appeared to be more susceptible to the disease than are fingerlings or fry. About 3 months after the first outbreak on common carp in Indonesia, the disease was suspected in mass mortalities of walking catfish (*Clarias batrachus*) in west and central Java. Some treatments have proved effective. Potassium permanganate ($KMnO_4$), at 20 ppm, as a bath, controls external lesions, but more effective control is provided by injections of Terramycin (oxytetracycline hydrochloride) at 25 mg/kg body weight. Terramycin can also be administered orally, incorporated in the feed daily for 7–10 days at a rate of 5–7 g/100 kg of body weight. This recommended treatment is being applied throughout Indonesia by the fishery extension service (DGF) to affected farms (IFRI 1980a).

Fish are examined for parasites, according to the methods outlined by Fernando et al. (1972). At least 25 specimens are sampled from each species of fish, and, although the preferred method is to examine live or fresh fish, in most cases, the samples have been preserved in 5% formalin or 70% alcohol, depending on the purpose of the examination. Identification keys by Bykovskaya-Pavlovskaya et al. (1964) and Hoffman (1967) are commonly used.

The procedures for identification of bacterial disease are those published by the American Fisheries Society (1975) and by Environment Canada (1977). Biochemical tests are based on Bergey's (1974) manual. Only simple, standard procedures are carried out, with serological testing seldom being done because of the lack of facilities and trained personnel.

Neither IFRI nor the faculty of fisheries at BAU has facilities for viral-disease studies, and the little that has been done to date has been accomplished through cooperation with the animal and veterinary laboratories in Bogor.

## Fish Quarantine and Certification

Quarantining live fish that are being moved from one area to another is an effective means of disease control. It has been required since 1974 in several airports, enforced by the fish-quarantine services of the provincial governments. However, before the serious disease outbreak in 1980, disease diagnosis by quarantine officers was normally through superficial examination and observation of fish behaviour. Lack of qualified personnel and laboratory facilities made proper diagnosis impossible. Now, in Jakarta, the fish-quarantine procedure, which has been adopted by the governor and formalized by Decree D.V. 7819/c/10/75, involves the inspection of species and issuance of health certificates for fish to be imported or exported through Jakarta international airport:

- All live fish must be accompanied by a health certificate (Appendix 1), issued by the governor of Jakarta;
- All fish must be quarantined during inspection;
- If dangerous (prohibited) species are found in the consignment, they must be seized as government property or used for research purposes; and
- If the fish are suffering from communicable diseases, they must be treated before being released. If the disease is impossible to treat effectively, the fish must be destroyed.

Importers and exporters not complying with this decree are subject to penalty.

The outbreak of disease in 1980 in west Java prompted a joint effort between IFRI and DGF to enable the fish-quarantine service in Jakarta to conduct more intensive and effective controls at the port of entry.

Would-be importers must request a permit (with quantity of fish and time limits specified) from Jakarta's fisheries service, which passes the request to DGF for approval. If DGF approves the request, the fish are placed in quarantine for at least 2 weeks and samples are examined at the IFRI laboratory. Imports of live fish must be accompanied by the special permit issued by DGF, and international trade is only allowed through the Airport of Halim Perdana Kusuma, Jakarta, where arriving and departing fish are inspected.

Fish are dispatched only after being declared free of parasitic and bacterial disease, for which a health certificate is issued by the fish-quarantine station.

IFRI accepted the responsibility for conducting postentry quarantine services at Pasar Minggu, Jakarta, and provides a diagnostic laboratory, fish-holding equipment, and personnel for disease examination; IFRI also carries out disinfection of imported fish at the port of entry and issues the fish-health certificates. There are two kinds of certificate issued by IFRI, i.e., one for disease-free fish (Appendix 2) and one for diseased fish (Appendix 3). Two fish pathologists from IFRI are involved in these quarantine activities, and they carry out the gross pathological examinations as well as the parasitological, bacteriological, and histopathological examinations, using standard procedures. The fish are held in isolation tanks and aquaria for a minimum of 2 weeks, after which they are released if they have not exhibited signs of disease. During quarantine, the physical, behavioural, and clinical manifestations of disease are observed. The fish, if necessary, are treated with chemicals and antibiotics, such as $KMnO_4$, formalin, malachite green, and Terramycin. The methods of treatment include immersion (dipping, short bathing — 1 h, and long bathing — 6–24 h), systemic treatment (injections and feeding with antibiotics), and swabbing. Immersion may be repeated two to three times at 3-day intervals (shorter intervals cause undue stress).

In summary, fish-quarantine activity includes:

- Fish identification (Table 1), carried out either in Pasar Minggu or at IFRI in Bogor, although other institutes may be consulted.
- Fish-disease identification (Tables 1 and 2), carried out either in Pasar Minggu or at the laboratory of fish diseases at IFRI, Bogor.
- Treatment and disinfection of fish for which diseases or parasites are detected. Plastic bags or holding containers for fish transportation are carefully disinfected or are destroyed.

During 1980–82, the bacterial and parasitic disease agents detected at IFRI laboratory were those already known to be present in the country (Djajadiredja 1982). Only one case of imports of prohibited fish species (10 specimens of piranha from Singapore) was detected. These fish were seized by the government, then killed, and preserved in formalin. However, in the same year,

**Table 1.** Procedures used in the identification and treatment of fish diseases found during quarantine (2 weeks–1 month) at Pasar Minggu, Jakarta.

| Disease agent | Method of examination | Treatment |
|---|---|---|
| *Ichthyophthirius* | Microscopy | Bathe (12–24 h) in malachite green (0.1 ppm), formalin (25 ppm) |
| *Trichodina* | Microscopy | Bathe (1 h) in formalin (0.25–0.33 ppt) |
| *Costia* | Microscopy | Bathe (1 h) in formalin (0.25–0.33 ppt) |
| *Glossotella* | Microscopy | Bathe (1 h) in formalin (0.25–0.33 ppt) |
| *Scyphidia* | Microscopy | Bathe (1 h) in formalin (0.25–0.33 ppt) |
| *Epistylis* | Microscopy | Bathe (1 h) in formalin (0.25–0.33 ppt) |
| *Myxobolus* | Microscopy | Destroy fish carrying the parasite; increase quarantine time for those suspected of being infested |
| *Myxosoma* | Microscopy | Destroy fish carrying the parasite; increase quarantine time for those suspected of being infested |
| *Thelohanellus* | Microscopy | Destroy fish carrying the parasite; increase quarantine time for those suspected of being infested |
| *Plisthophora* | Microscopy | Destroy fish carrying the parasite; increase quarantine time for those suspected of being infested |
| *Henneguya* | Microscopy | Destroy fish carrying the parasite; increase quarantine time for those suspected of being infested |
| *Hexamita* | Microscopy | Incorporate cabarsone in food (0.2%) for 4 days |
| *Lernaea* | Microscopy | Bathe in organophosphates (0.1 ppm) for duration of quarantine or dip in organophosphates (1%) for 2–3 min |
| *Argulus* | Microscopy | Reverse salinity of bath |
| *Achteres* | Microscopy | Bathe (1 h) in formalin (0.25–0.33 ppt) |
| *Salmincola* | Microscopy | Bathe (1 h) in formalin (0.25–0.33 ppt) |
| *Ergasilus* | Microscopy | Bathe (1 h) in formalin (0.25–0.33 ppt) |
| *Gyrodactylus* | Microscopy | Bathe in organophosphates (0.1 ppm) for the duration of quarantine or dip in formalin (1%) for 2–3 min |
| *Dactylogyrus* | Microscopy | Bathe in organophosphates (0.1 ppm) for the duration of quarantine or dip in formalin (1%) for 2–3 min |
| *Clinostomum* | Microscopy | Destroy fish carrying the parasite; increase quarantine time for those suspected of being infested |
| *Diplostomum* | Microscopy | Destroy fish carrying the parasite; increase quarantine time for those suspected of being infested |
| *Diphyllobothrium* | Microscopy | Bathe (1 h) in formalin (0.25–0.33 ppt) |
| *Ligula* | Microscopy | Bathe (1 h) in formalin (0.25–0.33 ppt) |
| *Echynorhynchus* | Microscopy | Bathe (1 h) in formalin (0.25–0.33 ppt) |

*continued*

*Table 1 concluded*

| Disease agent | Method of examination | Treatment |
|---|---|---|
| *Phomphorinchus* | Microscopy | Bathe (1 h) in formalin (0.25–0.33 ppt) |
| *Camallanus* | Microscopy | Bathe (1 h) in formalin (0.25–0.33 ppt) |
| *Saprolegnia* | Microscopy | Dip (1 min) or bathe (1 h) in malachite green (67 ppm or 1–2 ppm, respectively) or swab lesions directly with malachite green (1%) |
| *Achlya* | Microscopy | Dip (1 min) or bathe (1 h) in malachite green (67 ppm or 1–2 ppm, respectively) or swab lesions directly with malachite green (1%) |
| *Ichthyophonus* | Microscopy | Destroy fish carrying fungus; increase quarantine time for those suspected of being infested |
| *Branchiomyces* | Microscopy | Destroy fish carrying fungus; increase quarantine time for those suspected of being infested |
| *Aeromonas* | Culture | External infection: bathe (0.5 h) in $KMnO_4$ (15–20 ppm); systemic infection: incorporate daily into food (g/day, 50 kg body weight) conventional sulphonamides (5–10 g); nitrofurans (5 g); potentiated sulphonamides (2.5 g); or antibiotics (3.5 g) for 10 days |
| *Pseudomonas* | Culture | External infection: bathe (0.5 h) in $KMnO_4$ (15–20 ppm); systemic infection: incorporate daily into food (g/day, 50 kg body weight) conventional sulphonamides (5–10 g); nitrofurans (5 g); potentiated sulphonamides (2.5 g); or antibiotics (3.5 g) for 10 days |
| Mycobacteria | Culture | External infection: bathe (0.5 h) in $KMnO_4$ (15–20 ppm); systemic infection: incorporate daily into food (g/day, 50 kg body weight) conventional sulphonamides (5–10 g); nitrofurans (5 g); potentiated sulphonamides (2.5 g); or antibiotics (3.5 g) for 10 days |
| Corynebacteria | Culture | Destroy fish carrying bacteria; increase quarantine time for those suspected of being infected |
| *Columnaris* | Culture | External infection: bathe (0.5 h) in $KMnO_4$ (15–20 ppm); systemic infection: incorporate daily into food (g/day, 50 kg body weight) conventional sulphonamides (5–10 g); nitrofurans (5 g); potentiated sulphonamides (2.5 g); or antibiotics (3.5 g) for 10 days |
| *Flexibacter* | Culture | External infection: bathe (0.5 h) in $KMnO_4$ (15–20 ppm); systemic infection: incorporate daily into food (g/day, 50 kg body weight) conventional sulphonamides (5–10 g); nitrofurans (5 g); potentiated sulphonamides (2.5 g); or antibiotics (3.5 g) for 10 days |
| Myxobacteria | Culture | Bathe (1 h) or dip (1 min) in furanace (0.5 ppt) or $CuSO_4$ (0.5 ppt) |
| *Edwardsiella* | Culture | Destroy fish carrying bacteria; increase quarantine time for those suspected of being infected |
| Infectious pancreatic necrosis | Clinical signs | Destroy fish exhibiting symptoms; increase quarantine time for those suspected |
| Channel catfish virus | Clinical signs | Destroy fish exhibiting symptoms; increase quarantine time for those suspected |
| Spring viremia of carp | Clinical signs | Destroy fish exhibiting symptoms; increase quarantine time for those suspected |
| Infectious dropsy | Clinical signs | Destroy fish exhibiting symptoms; increase quarantine time for those suspected |
| Viral hemorrhagic septicemia | Clinical signs | Destroy fish exhibiting symptoms; increase quarantine time for those suspected |
| Viral hematopoietic necrosis | Clinical signs | Destroy fish exhibiting symptoms; increase quarantine time for those suspected |
| Swim bladder inflammation | Clinical signs | Destroy fish exhibiting symptoms; increase quarantine time for those suspected |

**Table 2.** Imported fish identified at Pasar Minggu after 1980, their origin, the disease agents detected, and treatments.

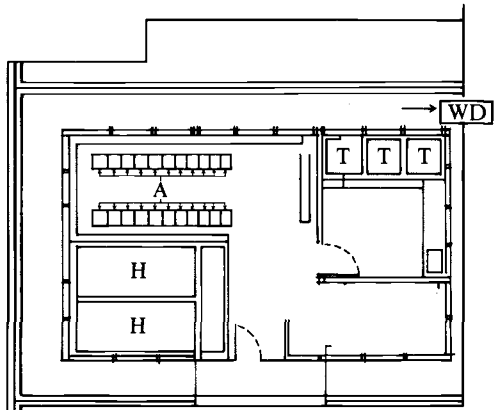
| Origin of shipment | Species of fish | Disease agent (problem) | Quarantine period (days) | Treatment[a] | Results[b] |
|---|---|---|---|---|---|
| Japan | Crucian carp | — | 10 | $KMnO_4$ (20 ppm, 0.5 h) | + |
| Thailand | Catfish (*Pangasius* sp.) | — | 15 | $KMnO_4$ (20 ppm, 0.5 h) | - |
| Singapore | *Symphysodon discus* | *Trichodina* sp. | 15 | $KMnO_4$ (20 ppm, 0.5 h) | - |
| Singapore | Catfish (*Pangasius* sp.) | *Trichodina* sp.; *Ichthyophthirius* sp. | 16 | $KMnO_4$ (20 ppm, 0.5 h) | - |
| Ujung Pandang | Rainbow | *Gyrodactylus* sp. | 16 | $KMnO_4$ (20 ppm, 0.5 h) | - |
| Jambi | Botia (*Barbus* sp.); *Labeo bicolor* | *Epistylis* sp.; *Trichodina* sp. | 15 | $KMnO_4$ (30 ppm, 0.5 h) | - |
| Singapore | Grass carp; *Barbus* sp.; *Labeo* sp.; *Pangasius* sp. | *Pseudomonas* sp. | 15 | Nitrofurans (10 mg/kg body weight) in food | - |
| Menado | *Forcipiger* sp.; *Centropyge* sp.; *Paracanthurus* sp.; *Amphiprion* sp. | *Aeromonas* sp.; *Pseudomonas* sp. | 13 | Terramycin (50 mg/kg body weight) in food | + |
| Japan | Fancy carp (*Cyprinus carpio*) | (injured) | 23 | Terramycin (50 mg/kg body weight) in food | + |
| Singapore | Guppy (*Poecilia* sp.) | *Dactylogyrus* sp. | 10 | Formalin (25 ppm, 24 h) | + |
| Singapore | *Pangasius* sp.; *Labeo* sp.; *Policentropsis* sp. | *Gyrodactylus* sp; *Trichodina* sp. | 16 | Formalin (25 ppm, 24 h) | + |
| Singapore | *Hypessobrycon* sp.; *Pangasius* sp.; *Symphysodon* sp.; *Labeo* sp. | *Trichodina* sp.; *Saprolegnia* sp. | 18 | Formalin with malachite green (25 ppm, 0.15 ppm, 24 h) | + |
| Singapore | *Symphysodon* sp.; *Gnathonemus* sp.; *Serrasalmus* sp. | *Ichthyophthirius* sp. | 14 | Formalin with malachite green (25 ppm, 0.15 ppm, 24 h) | + |
| Singapore | *Symphysodon* sp. | *Ichthyophthirius* sp. | 15 | Formalin with malachite green (25 ppm, 0.15 ppm, 24 h) | + |
| Thailand | *Pangasius* sp. | *Saprolegnia* sp.; *Dactylogyrus* sp. | 15 | Formalin with malachite green (25 ppm, 0.15 ppm, 24 h) | + |
| Singapore | *Labeo* sp.; *Barbus* sp.; *Pangasius* sp.; *Danio* sp. | *Saprolegnia* sp. | 17 | Malachite green (0.15 ppm, 24 h) | + |
| Thailand | *Pangasius* sp. | *Saprolegnia* sp. | 16 | Malachite green (0.15 ppm, 24 h) | + |
| Singapore | *Cyprinus carpio* | *Saprolegnia* sp. | 12 | Malachite green (0.15 ppm, 24 h) | + |
| Taiwan | *Rana catesbiana* | (swollen) | 15 | Terramycin (25 mg/kg body weight) injection | - |
| Singapore | *Pangasius* sp.; *Labeo* sp. | *Trichodina* sp.; Trematoda | 15 | Formalin (25 ppm, 24 h) | + |

[a]Bath, unless otherwise noted.
[b]+ = fish recovered; - = no recovery.

another prohibited species, electric eel, was reported to have been illegally introduced.

The species to be quarantined are live food and ornamental fish, both marine and freshwater. Imports consist mostly of ornamental fish such as discus, neon tetra, botia, and *Pangasius* sp.; carp are the main food fish. Commodities other than fish — crustaceans, molluscs, reptiles, amphibians, aquatic mammals, coelenterate and aquatic plants — may shortly also come under the quarantine regulations.

The fish-quarantine services are located in Jakarta, Medan, Den Pasar, Pontianak, Jambi, and Palembang, of which only three are still functioning as ports of entry. Since 1980, imports of live fish have only been allowed entry through




Scale 1 cm = 1 m

A = Aquarium tank

H = Holding tank

T = Treatment tank

WD = Water disposal tank

*Fig. 1. Floor plan of pilot-scale quarantine station.*

Halim airport in Jakarta so that live-fish traffic from outside the country can be carefully controlled.

The quarantine unit is generally provided with both fresh (groundwater) and salt water (seawater). After being used, the water is flushed into underground storage or septic tanks.

It is important to note that quarantine stations should be established not far from ports of entry. The site of the station must be isolated, located far from fish-culture centres, and must have limited contact with the outside world. Most essential is that the effluent must not reach public waters. The effluent must be disinfected and released via an underground septic system.

Fish holding can be done indoors or outdoors. A series of small tanks of 0.40–1.00 m wide and 1.00–2.00 m long is needed. These tanks can be made of concrete, fiberglass, or glass. Larger tanks of approximately 6–20 $m^3$ capacity are also needed to hold large numbers of fish. Each tank must have its own water supply and a drainage device. It is also necessary to supply each tank with one or more nozzle for air supply (Fig. 1). Besides fresh water, it is advisable to have a series of tanks supplied with seawater. Based on the experiences gained at Pasar Minggu, the quarantine station must be capable of holding 200 000 fish. The station should also have a well-equipped laboratory, with facilities for fish identification, disease diagnosis, treatment of diseases, etc:

In the establishment of the quarantine service, factors such as regulation and legislation, personnel, laboratory facilities, location, etc. have to be considered. Because Indonesia consists of many islands, having only one port of entry is not realistic, from an enforcement point of view. A more effective operation would be based on:

- Legislation and regulations issued and enforced for all interisland or international fish traffic;
- Fish quarantine for all live-fish traffic, coordinated by the central government;
- Complete laboratory facilities for disease diagnosis at the ports of entry, with fish-health specialists using uniform procedures for fish examination;
- As many ports of entry as possible with the available laboratory facilities and trained personnel;
- Disease inventories and records of distribution throughout the country as a step toward defining efficient and effective diagnostic procedures for quarantine services; and
- Coordinated action by institutions, such as customs, other quarantine services, etc., with input from research institutes and universities, particularly in identifying unknown disease agents.

## FUTURE ACTIVITIES

Steps should be taken to formulate plans and policies for long-range activities in disease control through the quarantine system. Some activities that need to be considered now are:

- Finalizing the fish-quarantine law, which is now at the ministry level, and, when enacted, will back up the quarantine services, providing a basis for enforcement;
- Finalizing the establishment of a fish-quarantine organization, which would make one agency responsible for quarantine measures;
- Drafting a technical manual of uniform, effective, and practical procedures for identification and diagnosis of disease in aquatic animals;
- Developing an adequate training program locally for competence in diagnostic procedures, supported by overseas training for fish-health specialists where possible;
- Upgrading fish-quarantine services with appropriate diagnostic laboratories and

qualified personnel, both at the headquarters and at the ports of entry;

- Establishing a national recording centre for disease data and encouraging exchange of such information through periodic meetings of fish pathologists and fish-quarantine specialists from national and international agencies; and
- Defining an effective institutional mechanism for quarantine activities.

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## APPENDIX 1: FISH-HEALTH CERTIFICATE, FISHERIES SERVICE

PEMERINTAH DAERAH KHUSUS
IBUKOTA JAKARTA
DINAS PERIKANAN
I N D O N E S I A

JAKARTA CAPITAL CITY GOVERNMENT
FISHERIES SERVICE
I N D O N E S I A

KETERANGAN KESEHATAN

HEALTH CERTIFICATE

No.

Nama barang
This is to certify that ______________________

Jumlah
Number ______________________

Jumlah dan model kemasan
Number and type of packaging ______________________

Kode Kemasan
Code of packaging ______________________

Nama pemilik
Owned by ______________________

Alamat
Address ______________________

Dikapalkan dengan
To be shipped by ______________________

Tanggal pengapalan
Date of shipment ______________________

Negara tujuan
Destination ______________________

Telah diperiksa pada tanggal
Has been inspected on ______________________

Berdasarkan pemeriksaan, ikan-ikan tersebut diatas ternyata sehat dan tidak menunjukkan tanda-tanda penyakit menular.

Examination indicates that the fish in this shipment are not suffering from infectious or contagious diseases and are healthy.

Jakarta, ..................

KEPALA DINAS PERIKANAN DKI
CHIEF OF FISHERIES SERVICE:

______________________

## APPENDIX 2: QUARANTINE SERVICE CERTIFICATE FOR HEALTHY FISH

DEPARTMENT OF AGRICULTURE
AGENCY FOR AGRICULTURAL RESEARCH AND DEVELOPMENT
RESEARCH INSTITUTE FOR INLAND FISHERIES

FISH HEALTH CERTIFICATE FORM A
No. ____________

Country/city of origin of shipment ______________________________

Country/city of destination of shipment __________________________

Name and addresses of shipper ___________________________________

To be shipped by ________________________________ No. __________

Date of shipment from country/city of origin _____________________

Date of arrival at country/city of destination ___________________

Species, size, and number of fish _______________________________

The undersigned certifies that on the basis of parasitological examination and inspection, the fish constituting the present shipment have been found to be free from:

Ichthyophthirius, Costia, Trichodina, Dactylogyrus, Gyrodactylus, Lernaea, Argulus, Ergasilus, Saprolegnia, Achlya

Furthermore, based on observation during ___________(quarantine period), the fish showed no clinical evidence of bacterial, viral, or myxosporidian diseases or other contagious diseases.

Issued in ________________
on (date of issue)__________

Director:

____________________

Fish Health Inspector:
1. ____________________
2. ____________________

## APPENDIX 3: QUARANTINE SERVICE FORM FOR UNHEALTHY FISH

DEPARTMENT OF AGRICULTURE
AGENCY FOR AGRICULTURAL RESEARCH AND DEVELOPMENT
RESEARCH INSTITUTE FOR INLAND FISHERIES

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FISH HEALTH CERTIFICATE FORM B
No.___________

Country/city of origin of shipment ______________________________

Country/city of destination of shipment ______________________________

Name and addresses of shipper ______________________________

To be shipped by ______________________________ No.___________

Date of shipment from country/city of origin ______________________

Date of arrival at country/city of destination ______________________

Species, size, and number of fish ______________________________

The undersigned certifies that on the basis of parasitological examination and inspection during ___________ (quarantine period), the fish in this shipment were found to be unhealthy and show clinical signs of disease, namely: ______________________________

______________________________

______________________________

______________________________

______________________________

Issued in ______________
on (date of issue) ___________

Director:

______________

Fish Health Inspector:
1. ______________

2. ______________