AQUACULTURE EXTENSION MANUAL NO. 76 JULY 2024

Manual on Important Marine Parasites and Their Hosts in the Philippines

Gregoria Erazo-Pagador
Blan Jericho G. Caloyloy
Leobert D. de la Peña

Southeast Asian Fisheries Development Center
AQUACULTURE DEPARTMENT
Tigbauan 5021, Iloilo, Philippines
www.seafdec.org.ph

Aquaculture Extension Manual No. 76
July 2024

Manual on Important Marine Parasites and Their Hosts in the Philippines

Gregoria Erazo-Pagador
Blan Jericho G. Caloyloy
Leobert D. de la Peña

Southeast Asian Fisheries Development Center
AQUACULTURE DEPARTMENT
Tigbauan 5021, Iloilo, Philippines
www.seafdec.org.ph

Manual on Important Marine Parasites and Their Hosts in the Philippines

JULY 2024

ISSN 0115-5369

Published and printed by:

Southeast Asian Fisheries Development Center
Aquaculture Department

Cover design by Rex Delsar B. Dianala
Layout by Rossea H. Ledesma

For comments and inquiries:

Training and Information Division
SEAFDEC Aquaculture Department
Tigbauan 5021, Iloilo, Philippines

(63-33) 330 7030
(63-33) 330 7031
devcom@seafdec.org.ph, aqdchief@seafdec.org.ph
www.seafdec.org.ph

SEAFDEC Aquaculture Department Library Cataloging-in-Publication Data

Erazo-Pagador, Gregoria

Manual on important marine parasites and their hosts in the Philippines / Gregoria Erazo-Pagador, Blan Jericho G. Caloyloy, Leobert D. de la Peña. Tigbauan, Iloilo, Philippines : Aquaculture Dept., Southeast Asian Fisheries Development Center, 2024, ©2024.

26 pages : color illustrations. -- (Aquaculture extension manual, 0115-5369 ; no. 76).

Includes bibliographical references.

1. Fishes -- Parasites -- Handbooks, manuals, etc. 2. Fishes -- Parasites -- Control -- Handbooks, manuals, etc. 3. Host-parasite relationships -- Handbooks, manuals, etc. I. Caloyloy, Blan Jericho G. II. de la Peña, Leobert D. III. SEAFDEC. Aquaculture Department. IV. Title.

SH 175 E73 2024 MGO2024-02

Foreword

Aquaculture systems are fertile grounds not only for the growth of cultured species but also for other organisms that may grow alongside. Some organisms, like zooplankton that may serve as an added food source, may coexist with the target species in a symbiotic relationship. However, under certain conditions, other organisms that cause harm may thrive and lead to health problems for the cultured species and economic losses for the aquafarmer. Among these problematic organisms are parasites that proliferate at the expense of their hosts.

In face of this reality, the Fish Health Laboratory of SEAFDEC/AQD conducts parasite detection and identification as part of its diagnostic services. While the service supports the research projects implemented by SEAFDEC/AQD scientists and researchers, diagnostic requests from external clients such as the academe and private sectors are also catered to.

Hundreds of samples, mostly from marine fish species, are analyzed each year for parasites at the Fish Health Laboratory. With decades worth of data and experience, SEAFDEC/AQD has deemed it best to compile information on the most common marine parasites encountered by its diagnostic services into this manual.

To aid in the identification of marine parasites, diagnostic approaches as well as gross signs and symptoms of host species are included in this manual. More importantly, treatment and preventive procedures are detailed.

I commend the authors for their dedication and hard work in compiling this valuable resource. I am confident that this book will not only help those facing problems on parasite infestations, but also encourage farmers to avoid or minimize them in the first place by observing and implementing good aquaculture practices and biosecurity protocols.

DAN D. BALIAO
Chief, SEAFDEC/AQD

About the Manual

This manual gives basic information on some parasites of different infected fish submitted to the Southeast Asian Fisheries Development Center/ Aquaculture Department (SEAFDEC/AQD) Diagnostic Service Laboratory in Tigbauan, Iloilo, Philippines. It is intended as a reference for those working in aquaculture in the Philippines. It is also designed to be a valuable reference for students, researchers, and enthusiasts' eager to delve into the captivating field of parasitology and parasitic disease management.

Contents

1 Introduction

Parasites are animals that live on or in another organism, the host, causing it some harm. Parasites are a natural occurrence and are ubiquitous in the environment. They include protozoa, helminth, crustacean, and other invertebrates. Marine parasites in aquaculture can have significant implications for the health and productivity of cultivated marine species. This can result in significant economic losses, impacting the profitability and sustainability of fish and shellfish farming operations if not properly managed. In aquaculture settings, incidences of parasite infections are inevitable due to several key factors such as the high density of host organisms, water quality and environmental conditions, nutritional imbalances, stress, and crowding. Aquaculture systems often involve the cultivation of a high density of host organisms in confined spaces. The close proximity of individuals can facilitate the transmission of parasites, especially in systems with inadequate water exchange and limited space for natural dispersion. Moreover, aquaculture facilities situated in or near natural water bodies may be susceptible to the introduction of parasites through the movement of wild fish, birds, and other wildlife. Waterborne and naturally-inherent parasites can enter aquaculture systems, posing a risk to the cultivated organisms.

The economic implications of parasitic infections in aquaculture are diverse and can be attributed to various factors. Parasitic infections can impair the growth of cultured organisms, leading to slower growth rates and delayed market readiness. This results in increased production time and costs associated with feeding and maintaining the health of the affected stock. Severe parasitic infections can lead to increased mortality rates in aquaculture facilities. The loss of stock directly translates to financial losses for farmers who have invested in the production and maintenance of the affected organisms. Parasite-infected fish and shellfish may experience a decline in market value due to factors such as lower product quality, compromised appearance, and potential consumer concerns about parasitic contamination. This further reduces the profitability of the aquaculture products.

Thus, understanding the life cycles, transmission dynamics, and potential impacts of marine parasites on aquaculture species is essential for developing proactive management strategies. This includes a holistic approach that combines proper husbandry practices, regular health monitoring, biosecurity, Good Aquaculture Practices (GAqP) and the use of integrated pest management techniques to promote the sustainability and resilience of aquaculture operations.

2 Protozoan Infestations

Protozoans are the most commonly encountered fish parasites. They are single-celled organisms. They are so small that cannot be identified without using a microscope. They are free-living in the aquatic environment. They are the easiest to identify and are easiest to control. They are mostly found in the external surface of the fish.

Cryptocaryonosis/Ichthyophthiriasis/ White Spot Disease

Causative Agents: The marine ciliate *Cryptocaryon irritans* (60–450 µm diameter) and its freshwater counterpart *Ichthyophthirius multifiliis* (50–1,000 µm diameter) are the causative agents of white spot disease in freshwater and marine fish species, respectively.

Species Affected: *C. irritans* affects marine fish such as sea bass, grouper, and snapper. *I. multifiliis* affects freshwater fish such as catfish, carp, and tilapia.

Stages Affected: Hatchery and nursery phases of culture.

Gross Signs: The disease is called a "white spot" because of the presence of few to many whitish spots on the skin and gills of the affected fish. Aside from disease signs like loss of appetite, lethargy, and abnormal swimming behavior, infected fish also exhibit hemorrhages on the body surface, pale gills, increased mucus production and hemorrhagic exophthalmia in the eyes.

Effects on Host: The parasites cause severe epizootic disease especially in intensive culture systems and affects the hatchery and nursery phases of culture. The parasites may destroy the skin and gills.

Diagnosis: The parasites can be detected through microscopic examination (wet mount) of tissue taken from gill arch, fins, or the body surface of infected fish. Examination of mucus collected from the body surface and gill filaments of fish for round or oval ciliated parasites (**Fig. 1**) with horse-shoe shaped macronucleus for *I. multifiliiis* or round to spherical macronucleus for *C. iritans*.

Prevention and Control: *C. irritans* infestations in marine fish can be controlled and prevented by freshwater bath for 1 h for 2–3 days or a combination of 0.5 ppm $CuSO_4$ and 25 ppm formalin bath supplied with strong aeration for 5–7 days. On the contrary, in freshwater fish, raising water temperature to 30 °C for 6 h daily for 3–5 days, or treatment with 0.05% salt solution at 100 ppm formalin bath for 1 h for 2–3 days can prevent and control Ichtyophthiriasis. The water must be replaced daily during the treatment. The treated fish must be transferred to parasite-free water tanks at 3-day intervals.

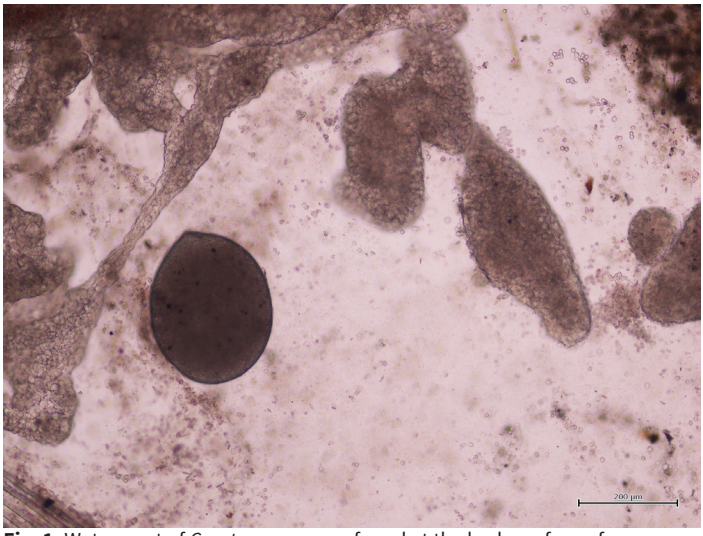


Fig. 1. Wet mount of *Cryptocaryon* spp. found at the body surface of grouper (scale bar = 200 µm)

Trichodiniasis

Causative Agents: *Trichodina* spp. (45–78 µm diameter, *Trichodinella* spp. (24–37 µm in diameter), and *Tripartinella* spp. (up to 40 µm).

Species Affected: Carps, tilapia, milkfish, sea bass, mullet, siganid, grouper, snapper, and catfish

Stages Affected: Hatchery, nursery, and grow-out phase of culture

Gross Signs: Affected fish are weak. Parasites infect mainly gills, body surfaces, fins and causes excessive mucus production on gills and body surface with frayed fins.

Effects on Host: Excessive numbers of parasites on the skin and gills of infected fish interfere with respiration. Infected fish have pale gills and rub their bodies against objects.

Diagnosis: The presence of the parasites in infected fish can be demonstrated by microscopic examination of wet mount preparation of gill filaments and scrapings from the skin. The parasite is circular in appearance and is very motile, often seen spinning and moving very quickly when viewed through the microscope. It appears as a saucer-shaped (**Fig. 2**) ciliated organism surrounded with several circular rows of cilia and supported with a circle of more centrally lying hooklets.

Prevention and Control: Trichodinid infestation can be prevented by salinity shock using 2–3% salt solution for 2–5 min for 3–4 days for freshwater fish or 100% freshwater bath for 1 h for 3 days for marine fish. In addition, short bath with 200 ppm formalin for 30–60 min for three days with strong aeration.

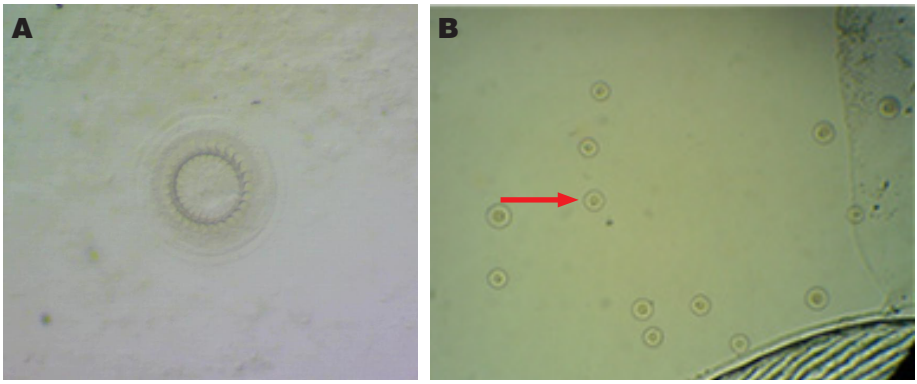


Fig. 2. (A) *Trichodina* sp. showing the structure of adhesive disc and denticles, (B) *Trichodina* sp. (arrow) from body surface of grouper at 400x magnification

Amyloodiniosis/Velvet Disease/White Spot Disease

Causative Agents: Amyloodinosis is a disease caused by the ectoparasitic dinoflagellate *Amyloodinium ocellatum* (15–70 x 80–350 µm). It is an obligate parasitic protozoan attached to the gill filaments or mostly on the body surface of the fish. These microscopic parasites are external with flagella for movement.

Species Affected: Rabbitfish, grouper, milkfish, mangrove red snapper, pompano, mullet, and catfish.

Stages Affected: Hatchery phase of culture, fingerlings, and broodstock

Gross Signs: *A. ocellatum* infestation is characterized by appetite loss, opacity of skin with whitish areas, and erosion of the caudal fin. The affected fish rubs its body against objects in the tank or bottom substrate, exhibiting darkening of the body and abnormal surface swimming characterized by spasmodic gasping. Heavily infested fish show white patches (**Fig. 3**) or dusty appearance ("velvet disease") on the skin with excessive mucus production.

Effects on Host: Heavy infestation can cause high mortality within half a day. The mortality rate of infected fish is related to the number of parasites per fish.

Diagnosis: Microscopic examination of gill filaments (**Fig. 5**) or skin scrapings can demonstrate the presence of brownish to yellowish, pear or ovoid-shaped parasites, attached singly or in clusters of 2–4 individuals (**Fig. 4**) in infected fish.

Prevention and Control: Measures to prevent and control amyloodiniosis include the use of sand filter, ultraviolet irradiation of rearing water, disinfection of culture facilities using lime, and quarantine of new stocks. In addition, freshwater baths can cause parasites to drop off from the skin and gills. Copper sulfate bath (0.5 ppm) for 3–5 days with strong aeration and daily water change may also be done. Short treatment with 200 ppm formalin for 1 h with strong aeration is also recommended.

Fig. 3. *Amyloodinium* spp. (red circle) in caudal fins of grouper (wet mount) showing white patches

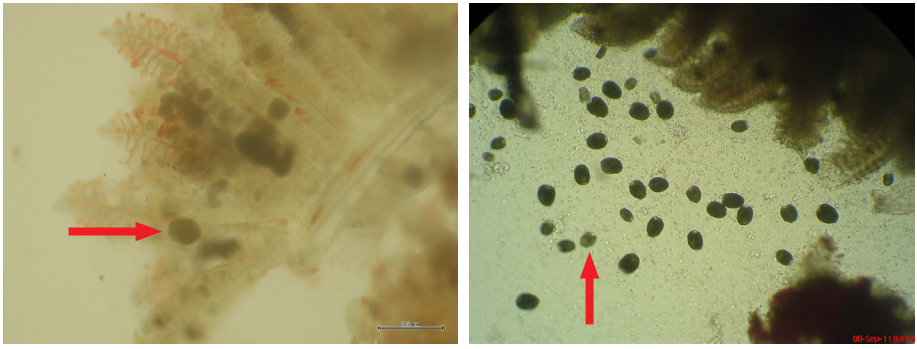


Fig. 4. *Amyloodinium* spp. (red arrow) in gills of pompano (wet mount) showing brownish to yellowish, pear or ovoid-shaped parasites, attached singly or in clusters of 2–4 individuals (scale bar = 200 µm)

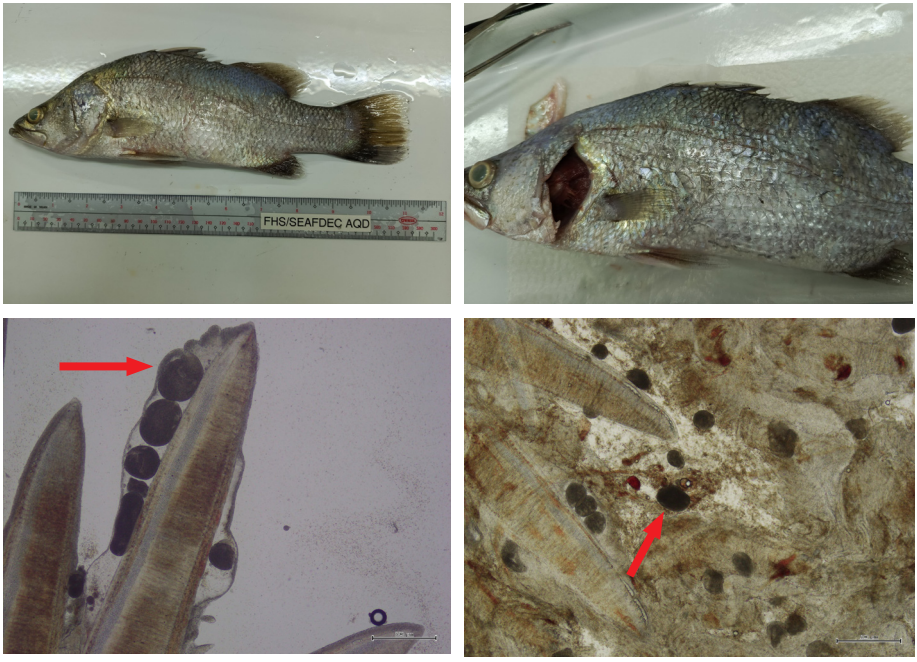


Fig. 5. *Amyloodinium* sp. (arrow, above) from gills of sea bass (top)

Metazoan Parasites

Metazoans are eukaryotic multicellular organisms. They belong to the kingdom Animalia. Metazoans are mostly bilaterally symmetrical. Sexual reproduction is the principal mode of reproduction in the majority of metazoans. They have cells specialized into tissues and organs that show division of labor and perform specific functions. They are macroscopic and generally can be seen by the naked eye.

3 Monogenean Infestations

Monogeneans are ectoparasitic flatworm, with posterior organ of attachment called haptor armed with hooks and/or suckers. Monogeneans have a direct life cycle and require a single host species for completion of their life cycle. These parasites are characterized by their high host-specificity, meaning that a monogenetic fluke species only parasitizes one species of fish. Monogeneans comprise skin and gill flukes infecting skin, gills, and fins of fishes.

Gill Flukes

Gill flukes are ectoparasitic and infection is a sign of high stocking density and poor water exchange. Gill monogeneans are 1–5 mm long flatworms that attach to the gills of fish

Causative Agents: *Pseudorhabdosynochus* sp. (**Fig. 6**), *Haliotrema* spp. and *Diplectanum* spp.

Species Affected: Sea bass, grouper, snapper, and rabbitfish

Stages Affected: Hatchery, grow-out, and broodstock stages

Gross Signs: Affected fish display abnormal swimming behavior near the water surface, loss of appetite, darkened body surfaces with frayed fins, and pale gills. Hemorrhagic lesions in the body surface are common in heavy infections.

Effects on Host: Heavy infestation may result to extensive damage to the gill epithelium and may affect normal respiration and could result in mortality. The parasites damage the host's tissues that can lead to secondary bacterial infection.

Diagnosis: Gross and microscopic examination of mucus from the gills for the presence of the parasite with posterior adhesive organs armed with hooks and spines.

Prevention and Control: Infested fish may be subjected to freshwater bath for 1 h for 3 days, 100 ppm formalin for 1 h for 3 days, and 150 ppm hydrogen peroxide for 30 min with strong aeration. Water quality must be managed carefully and overstocking must be avoided.

Fig. 6. *Pseudorhabdosynochus* spp. (circle) from the gill of infested grouper (scale bar = 200 µm)

SKIN FLUKES

The skin fluke is a flatworm parasite that lives on the skin of fish. The flukes use their posterior attachment organ opisthaptor to attach to fish skin. Skin flukes cause harm to the fish if they are present in large numbers over a short time due to their direct life cycle involving a single host. They are capsalid flatworms, oval in shape (**Fig. 7-A and Fig. 7-B**), and are attached on the body surface of the fish.

Causative Agents: *Benedenia* sp. and *Neobenedenia* sp.

Species Affected: Pompano, grouper, snapper, and rabbitfish

Gross Signs: Excessive mucus production can be observed in infected fish as a form of defense mechanism. Fish rub their bodies against nets and other abrasive surfaces in the net cages to dislodge the skin monogeneans. Fish infected with monogeneans may become lethargic and show reduced swimming activity.

Effects on Host: Skin flukes mainly affect skin and result in poor appetite and erratic swimming behavior.

Diagnosis: The best method to confirm the presence of these flukes is gross and microscopic examination of mucus from the fish skin.

Prevention and Control: Implement strict biosecurity measures to prevent the introduction of contaminated equipment, water, or fish stocks into the aquaculture facility. Overcrowding stresses fish and creates ideal conditions for the rapid spread of parasites. Maintain appropriate stocking

densities to reduce stress and minimize the risk of infestations. Treatments include: freshwater bath for at least 10 min can dislodge or kill the parasites or 150 ppm H_2O_2 for 10–30 min, provided with strong aeration.

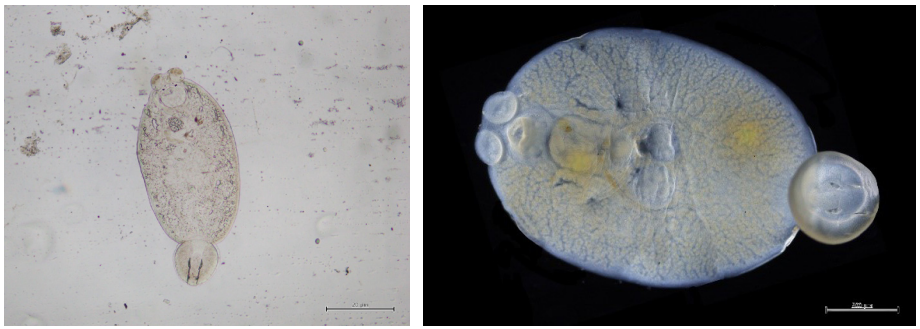


Fig. 7-A. *Benedenia* spp. in grouper (scale bar = 200 µm)

Fig. 7-B. *Benedenia* spp. in pompano (scale bar = 200 µm)

4 Digenean Infestations

Digeneans are mostly endoparasitic parasites that infest all types of fish tissues and organs. Digeneans have an indirect life cycle involving two or more intermediate hosts. These parasites are flatworms with 2 sucker-like attachment organs located at the anterior and ventral portions.

Causative Agents: *Gonapodasmius epinepheli*

Species Affected: Grouper

Gross Signs: Infested fish may exhibit reduced growth rates and weight loss. The parasites can compete with the host for nutrients, leading to stunted growth and smaller fish size. Abnormal behavior such as increased lethargy, swimming near the water surface or bottom, or erratic swimming patterns can be observed. If digenean parasites infest the gills, they can impair the fish's respiratory function. Infected fish may exhibit rapid gill movement, gasping at the water surface, or spending more time near aerated areas in an attempt to obtain more oxygen. In some cases, particularly when the liver is affected, fish may exhibit an enlarged abdomen or distended belly.

Effects on Host: Digeneans are parasitic flatworms belonging to the class Trematoda within the phylum Platyhelminthes. Digenean infestations can lead to various health issues in fish. Common symptoms include reduced growth, weight loss, changes in behavior, and in severe cases, organ damage. The presence of digeneans in the gills can impair respiratory function, while liver infestations may lead to organ enlargement and dysfunction.

Diagnosis: Gross and microscopic examination of the gills reveal opaque–white or yellow capsules (**Fig. 8**) attached to the gill lamellae. The capsules contain tubular, long, thread-like worms.

Fig. 8. Yellow capsule containing didymozoid digenean on the gill arch of grouper

Prevention and Control: The intermediate hosts (gastropod molluscs) which are potential carriers of the larval stage of the parasite should be eliminated from the culture facility.

5 Nematode Infestations

Nematodes are also called roundworms. They can affect marine and freshwater fish species. They are endoparasitic, reddish or black in color, with unsegmented bodies, usually 1–2 cm long. Nematodes are bilaterally symmetrical, coelomate elongate worms with cylindrical bodies tapering at both ends. The body is covered with a tough, resistant cuticle which is elastic and flexible. They have no particular attachment organ, and may be pointed at one or both ends. Sexes are separate, the females larger than the males. The adult stage is large enough to be seen with a naked eye. Those that parasitize fish require at least one intermediate host.

Causative Agents: *Philometracephalus* spp., *Anisakis* spp., *Procamallanus* (*Sprirocamallanus*) spp., *Raphidasaris* spp., *Contracaecum* spp., and *Echinocephalus* spp.

Species Affected: Rabbitfish, grouper, sea bass, catfish, snakehead, and goby

Gross Signs: Reddish or black, non-segmented roundworms (**Fig. 9**) attached to the affected fins, branchial cavity, muscle, parenchyma of digestive organs, and gonads

Effects on Host: May impair feeding, resulting in emaciation and growth retardation. When gonads are affected, atrophy arises and may lead to sterility of the host.

Diagnosis: Detection of parasite in infected fish include gross and microscopic examinations.

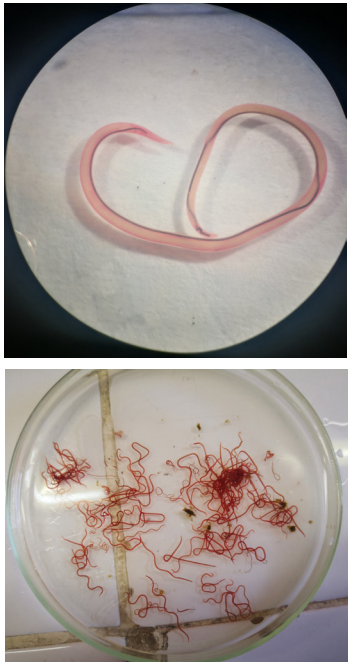


Fig. 9. Nematodes from the intestines of siganid (above) and viewed under the dissecting microscope (top)

Prevention and Control: There is no known treatment for nematodes. Prevention and control measures include avoidance of feeding with infected trash fish, elimination of immediate hosts (copepods), drying of pond bottom, and disinfection of culture facilities with quicklime to destroy nematode eggs and filtration of water.

6 *Acanthocephalan Infestations*

Acanthocephalans are thorny-headed worms or spiny-headed worms and are endoparasitic worms of fish.

Causative Agents: *Acanthocephalus* spp. and *Pallisentis* spp.

Species Affected: Snakehead, catfish, eel, tilapia, tuna, and milkfish.

Gross Signs: The parasite attaches to the intestinal mucosa of fish. Affected fish have darkened emaciated bodies, causing necrotic hemorrhagic ulcers in the intestine of the fish, growth retardation, and mortality.

Diagnosis: The parasite can be observed by gross and microscopic examination of the intestine showing elongated and sac-like worms with retractile proboscis armed with spines (**Fig. 10**).

Prevention and Control: There is no known treatment for acanthocephalans. Prevention and control measures include disinfection of pond with quicklime, control of potential intermediate hosts, and quarantine of new and suspected stocks.

Fig. 10. *Acanthocephalan* sp. (above) from intestine of mackerel tuna (top)(scale bar = 200 µm)

7 Sea Lice Infestations

Causative Agents: *Lepeophtheirus spinifer* (adult male = 2.6–3.1 mm in total length; adult female = 5.8–6.9 mm in total length), *Caligus* spp. (**Fig. 11**)

Species Affected: Pompano, grouper, sea bass, snapper, and milkfish

Gross Signs: Infested fish may exhibit signs of irritation, overproduction of mucus, reduced feeding, and behavioral changes. Heavily infected fish swim sluggishly near the water surface or exhibit flashing behavior. Severe infestations can lead to open wounds, tissue erosion, deep ulcers, and subsequently secondary infections, weakening the fish and potentially causing mortality. Caligids are transparent and appear as white patches on affected tissue (**Fig. 12**).

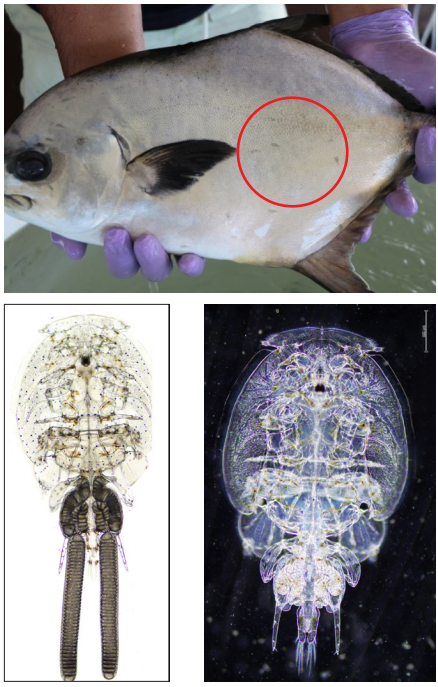


Fig. 11. Female sea lice (left) and male sea lice (right) on the body surface of pompano (top, red circle)

Effects on Host: Sea lice attach themselves to the skin (**Fig. 11**), scales, and fins of fish using specialized mouthparts. They feed on the host's blood, mucus, and skin tissues, causing irritation and potentially damaging the fish's skin and underlying tissues. The wounds they create at their site of attachment can promote secondary bacterial or fungal infections that may kill the fish. Heavy infection manifests as white patches on the site of attachment.

Diagnosis: The parasites are observed by gross and microscopic examinations of scrapings of mucus (**Fig. 12**) from possible infested areas.

Prevention and Control: Immerse the fish in a freshwater bath for 20 min, and H_2O_2 at a concentration of 150 ppm for 30 min supplied with strong aeration for all stages of fish.

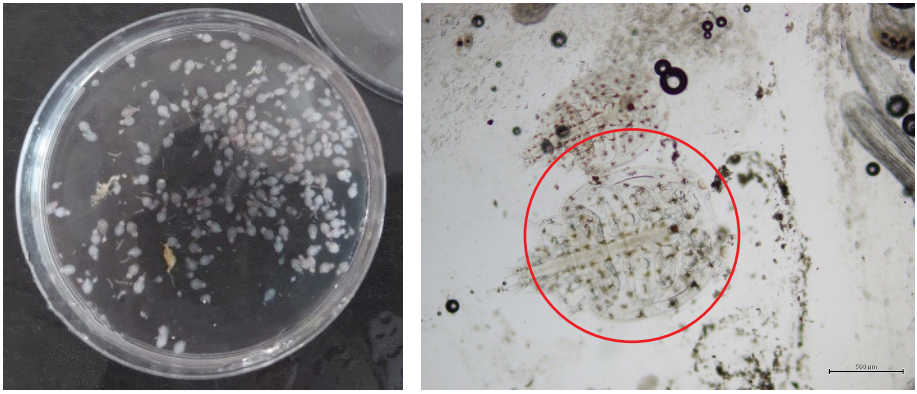


Fig. 12. Sea lice from scrapings of mucus of pompano (left) scale bar=500 µm, showing transparent and appear white patches viewed under dissecting microscope (right)

8 *Marine Leech Infestations*

Marine leeches are blood-sucking worms that appear as brownish-black external parasites (**Fig. 13-A**) that are 8–15 mm long. They have elongated muscular and cylindrical bodies narrowing at both ends which contain the anterior and posterior suckers used for feeding and attachment.

Causative Agent: *Zeylanicobdella arugamensis*

Species Affected: Grouper, snapper, sea bass, milkfish, and tilapia

Stages Affected: The parasite can affect nursery, grow-out, and broodstock stages of fish

Gross Signs: The leeches are attached in large numbers on the fins, lower jaw, under the operculum, eyes, and inside the mouth of the fish. The affected fish show frayed fins, hemorrhages, and swollen areas on the parasite's attachment and feeding sites.

Effects on Host: The parasites may be attached in heavy patches (several hundred) on the pectoral, ventral, anal, and caudal fins. Infected fish lose their appetite and swim slowly, usually near aeration. The parasite feeds on the host's blood and may result in anemia. Mortality may occur in heavily infected fish.

Diagnosis: The parasite can be detected by gross and microscopic examinations of infected fish.

Prevention and Control: Leech infestations may be prevented and controlled through the use of water filters, manual removal using wet cloth, disinfection and complete drying of facilities. A short bath may alse be done with 200–250 ppm formalin with strong aeration for 1 h and subsequent transfer of treated fish to a clean, parasite-free tank.

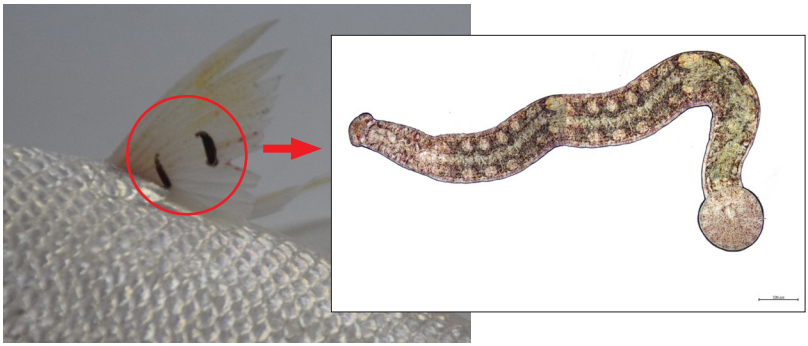


Fig. 13-A. Leech (red circle) found on the dorsal fin of milkfish (scale bar = 200 µm)

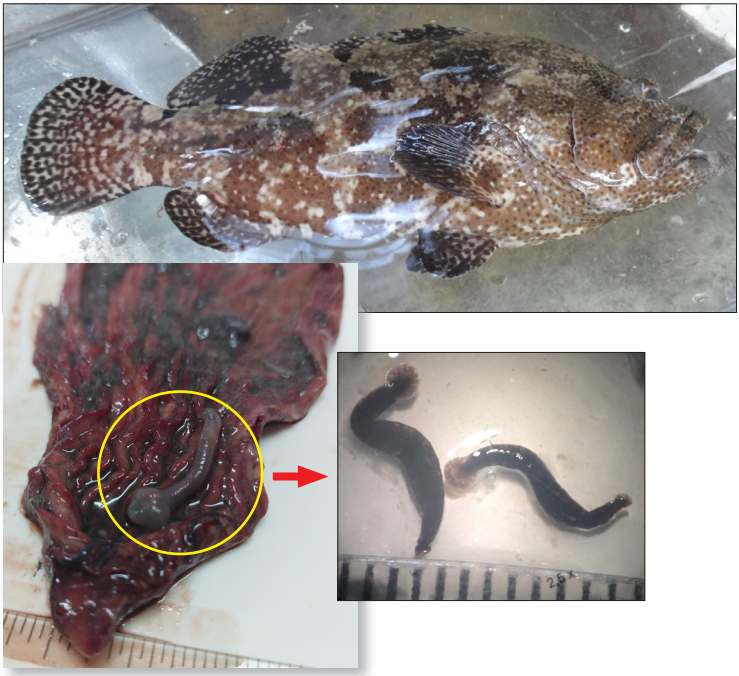


Fig. 13-B. Marine leech (*Z. arugamensis*) (yellow circle) found in gastrointestinal tract of grouper (*Epinephelus fuscoguttatus*) broodstock (top)

9 *Shell-boring Polychaetes*

Shell-boring polychaetes are a group of marine annelid worms that have the unique ability to bore into the shells of various mollusks, including clams, oysters, and other bivalves. One type of shell-boring polychaete is the *Spirorbis* sp. that infects abalone, marine mollusks belonging to the family Haliotidae. *Spirorbis* worms could attach their calcareous tubes to the shells of abalones or other hard surfaces in their habitat.

Causative Agents: *Spirorbis* is a genus of small, tube-dwelling marine polychaete worms. These worms construct calcareous tubes that resemble tiny spiral shells, giving them their distinctive appearance. The spiral tubes provide protection for the worm, and the worm can retract into the tube when threatened.

Species Affected: *Haliotis asinina*

Stages Affected: Juvenile stages and broodstock

Gross Signs: Heavy spirorbid fouling cause brittle and cracked shells of abalone

Effects on Host: Shell-boring polychaetes can have significant impacts on the health and survival of mollusks. By weakening the structure of the shells through boring activities, they may increase the vulnerability of mollusks to predation, environmental stress, and disease. These polychaetes obtain nutrients by ingesting organic matter within the shell, as well as by absorbing dissolved nutrients from the surrounding environment. They may feed on detritus, bacteria, and other microscopic organisms present within the confines of the shell.

Diagnosis: Heavy infestation of *Spirorbis* sp. on the shells of abalone may interfere with the respiratory pores of the abalone, eventually leading to suffocation and mortality.

Prevention and Control: No known chemical treatment has been explored but mechanical removal through scraping of *Spirorbis* from shells is commonly practiced.

Fig. 14. *Spirorbis* sp. (yellow circle and line) infecting abalone (*Haliotis asinina*)

10 Appendices

Preparation of 200 ppm formalin in 1-ton water

Calculations:

200 ppm formalin

M1V1 = M2V2

$$V1 = \frac{M2V2}{M1}$$

$$V1 = \frac{(200\ ppm)\ (1{,}000\ L)}{1{,}000{,}000\ ppm}$$

V1 = 0.2 L

V1 = 200 mL

*200 mL of formalin is needed to prepare
1 ton of 200 ppm formalin solution

Procedure:

- Slowly pour 200 ml of formalin in 1 ton of seawater near the aeration line
- Provide strong aeration
- Immediately siphon out formalin-treated water after the prescribed treatment period and replenish with new, clean seawater
- Discard formalin in a safe place

Preparation of 25 ppm formalin in 1-ton water

Calculations:

25 ppm formalin

M1V1 = M2V2

$$V1 = \frac{M2V2}{M1}$$

$$V1 = \frac{(25\ ppm)\ (1{,}000\ L)}{1{,}000{,}000\ ppm}$$

V1 = 0.025 L

V1 = 25 mL

*25 mL of formalin is needed to prepare
1 ton of 25 ppm formalin solution

Procedure :

- Pour slowly 25 ml of formalin in 1 ton of seawater near the aeration line
- Provide strong aeration
- Immediately siphon out formalin-treated water after the prescribed treatment period and replenish with new, clean seawater
- Discard formalin in a safe place.

Preparation of 100 ppm formalin in 1-ton water

Calculations:

100 ppm formalin

M1V1 = M2V2

$$V1 = \frac{M2V2}{M1}$$

$$V1 = \frac{(100\ ppm)\ (1{,}000\ L)}{1{,}000{,}000\ ppm}$$

V1 = 0.1 L

V1 = 100 mL

*100 ml of formalin is needed to prepare
1 ton of 100 formalin solution

Procedure :

- Pour slowly 100 ml of formalin in 1 ton of seawater near the aeration line
- Provide strong aeration

- Immediately siphon out formalin-treated water after the prescribed treatment period and replenish it with new, clean seawater
- Discard formalin in a safe place.

Preparation of 150 ppm hydrogen peroxide in 1-ton water

Calculations:

150 ppm hydrogen peroxide

M1V1 = M2V2

$$V1 = \frac{M2V2}{M1}$$

$$V1 = \frac{(150\ ppm)\ (1{,}000\ L)}{1{,}000{,}000\ ppm}$$

V1 = 0.15 L

V1 = 150 mL

*150 ml of hydrogen peroxide is needed to prepare
1 ton of 150 hydrogen peroxide solution

Procedure:

- Pour slowly 150 ml of hydrogen peroxide in 1 ton of seawater near the aeration line
- Provide strong aeration
- Immediately siphon out hydrogen peroxide-treated water after the prescribed treatment period and replenish it with new, clean seawater
- Discard hydrogen peroxide in a safe place.

Preparation of 250 ppm hydrogen peroxide in 1-ton water

Calculations:

250 ppm hydrogen peroxide

M1V1=M2V2

$$V1 = \frac{M2V2}{M1}$$

$$V1 = \frac{(250\ ppm)\ (1{,}000\ L)}{1{,}000{,}000\ ppm}$$

V1 = 0.25 L

V1 = 250 mL

*250 ml of hydrogen peroxide is needed to prepare
1 ton of 250 ppm hydrogen peroxide

Procedure :

- Pour slowly 250 ml of hydrogen peroxide in 1 ton of seawater near the aeration line
- Provide strong aeration
- Immediately siphon out hydrogen peroxide-treated water after the prescribed treatment period and replenish it with new, clean seawater
- Discard hydrogen peroxide in a safe place.

Preparation of 0.5 ppm CuSO4 in 1-ton water

Calculations:

0.5 ppm $CuSO_4$

1 ppm = 1mg/L

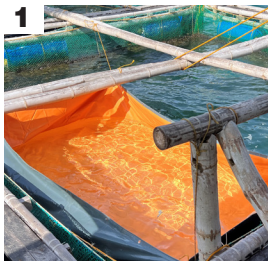
$$0.05\ ppm\ CuSO_4 = \frac{0.5\ mg}{1\ L}$$

$$For\ 1\ ton:\ \frac{0.5\ mg}{1\ L}\ x\ 1{,}000\ L = 500$$

*dissolve 500mg of $CuSO_4$ to 1 ton of water

Guidelines for Freshwater Bath Treatment of Pompano Broodstock Infected with Sea lice

1



Set-up a canvass (1 x 0.5 x 1 m) filled with freshwater and aeration in the floating cages.

2

Collect the pompano broodstock and directly transfer it to the canvass. Set-up a timer for 20 min of freshwater bath treatment with aeration.

3

Monitor the pompano during immersion period to note signs of distress.

4

After 20 min, return the treated pompano to their respective cages with newly changed net.

5

Add 30 grams of chlorine powder to one ton freshwater to make 30 ppm chlorine for disinfection of the treatment water.

6

Dispose the wastewater away from the cages.

7

Repeat the process of freshwater bath treatment of pompano broodstock if the fish show gross signs of sea lice infestation (lesion, exopthalmia)

11 References

Cruz-Lacierda E.R. (2010). Chapter 2. Parasitic diseases and pests, pp. 10-38. In: Health Management in Aquaculture; 2nd edition. Lio-Po., G.D., Inui, Y. (eds.). SEAFDEC Aquaculture Department, Iloilo, Philippines. 316 p.

Kojima, H. & M. Imajima. 1982. Burrowing polychaetes in the shells of abalone *Haliotis diversicolor aquatilis* chiefly on the species of Polydora. Bull. Japan. Soc. Sci. Fish. 48:31–35.

Oakes, F. R. & R. C. Fields. 1996. Infestation of *Haliotis rufescens* shells by sabellid polychaete. Aquaculture 140:139–143.

Kuris, A. M. & C. S. Culver. 1999. An introduced sabellid polychaete pest of cultures abalone and its potential spread to other California gastropods. Invertebr. Biol. 118:391–403.

Lleonart, M., J. Handlinger & M. Powell. 2003a. Spionid mudworm infestation of farmed abalone (*Haliotis* spp.). Aquaculture 221:85– 96.

Lleonart, M., J. Handlinger & M. Powell. 2003b. Treatment of spionid mud worm (*Boccardia knoxi* Rainer) infestation of cultured abalone. Aquaculture 217:1–10.

Simon, C. A., M. G. Bentley & G. S. Caldwell. 2010. 2,4-Decadienal: exploring a novel approach for the control of polychaete pests on cultured abalone. Aquaculture 310:52–60.

Simon, C. A., H. Kaiser & P. J. Britz. 2004. Infestation of the abalone, *Haliotis midae*, by the sabellid *Terebrasabella heterouncinata*, under intensive culture conditions, and the influence of infestation on abalone growth. Aquaculture 232:29–40.

Simon, C. A., A. Ludford & S. Wynne. 2006. Spionid polychaetes infesting cultured abalone *Haliotis midae* in South Africa. Afr. J. Mar. Sci. 28:167–171.

12 Glossary

Acute - a rapid onset of disease with a short, but severe, course

Aetiology - the science that deals with the cause of disease

Ameliorate - cause to become better, resolve

Anaemia - a deficiency in the number of red blood cells, or haemoglobin

Anorexia - severely underweight

Ascites - an effusion and accumulation of serous fluid in the abdominal cavity

Asymptomatic carrier - an individual infected with a disease agent, but not exhibiting any signs of disease

Asymptomatic - Showing no symptoms; no visible signs of a disease condition

Atrophy - abnormally small size of cells or tissues

Benign - harmless

Cataract - damage or injury to the lens of the eye that results in the lens becoming cloudy and opaque

Caudal peduncle - the region of body to which the caudal fin is attached

Chronic - occurring over a long period of time, with gradual or consistent mortality rate; also recurring

Commensal - living in close association with another species without an apparent effect on each other

Cyst - an enclosed sac formed by a thin membranous tissue that usually contains a small amount of fluid and single or multiple parasite larvae

Definitive diagnosis - a diagnosis which confirms the identity of the causative agent responsible for a disease

Detritus - organic debris

Distal - away from the point of reference or attachment

Ecto - commensal organisms on the host's surface; living together with no harm to either

Emaciation - becoming lean, wasting away

Epizootic - a disease affecting a population

Exophthalmia - "pop eye," a condition characterised by protrusion of the eye in fishes

Exotic - of foreign origin, not native or endemic

Fluke - a parasitic flatworm with a complex life-cycle (also called a trematode)

Foci - the size or distribution of changes to a tissue as limited to a small area, pertaining to, or emanating from a focus

Granuloma - a chronic inflammatory response with nodular aggregations of macrophages (phagocytic cells)

Granulomatous - a type of cellular reaction associated with a chronic lesion

Haemocyte - a blood cell of an invertebrate

Haemolymph - blood of an invertebrate

Haemorrhage - the escape of blood from vessels

Hematopoietic - tissues that produce red blood cells

Histopathology - the study of microscopically visible changes in diseased tissue

Histozoic - tissue invading; usually pertaining to parasites

Horizontal transmission - transmission of disease from animal to animal by cohabitation or via water

Host - an animal or plant that harbours and provides sustenance for another organism (a parasite)

Hyperaemia - an excess of blood in a body part

Hyper-osmotic - high concentration of salts/compounds in the body compared to the environment

Hyperplasia - abnormal increase in the number of normal cells in tissue or an organ

Hypertrophy - increase in the size of cells or tissues

Hyperventilating - rapid and abnormal increased respiratory activity

Hypoxia - deficiency of oxygen

Idiopathic - occurring without known cause

Inflammation - a local protective response to injury or damage which serves to destroy, dilute, or wall off both the injurious agent and the injured tissue

Invertebrate - an animal that does not have a backbone. This includes snails, worms, clams and insects

Latent infection - an infection that does not produce visible or clinical signs of disease

Lesion - a localised area of pathological change in structure of an organ, tissue, or cell

Life cycle - a series of different stages of development of an organism. Life cycles can involve one or more than one host

Meninges - membranes which cover the nervous tissues of vertebrates

Metazoan - a multicellular organism

Moribund - in a dying state

Moribund - near death

Morphology - the science of the form and structure of organisms

Necropsy - a medical examination of the fish after death involving dissection

Necrosis - the death of tissues or cells within a living body

Obligate - characterised by the ability to survive only in a particular environment

Oedema - the excessive accumulation of fluids in tissue spaces

Opisthaptor - the posterior attachment organ of a monogenean worm (phylum Platyhelminthes), usually armed with various hooks, suckers and/or clamps

Osmoregulatory - control of ionic concentrations to facilitate normal cellular function

Pallor - pale or faded

Parasite - an organism which lives on or inside another organism (the host), deriving nutrition from the host to the detriment of that host

Pathognomonic - characteristic of a particular disease

Pathology - the study of structural and functional changes caused by disease

Peracute - extremely rapid onset (of disease)

Petechiae - pin point haemorrhages

Phagocyte - an inflammatory cell capable of ingesting bacteria, foreign particles and other cells

Piping - the act of fish gulping or gasping at the water surface

Polymorphic - occurs in more than one morphological form

Prepatent - period early in a disease process when disease cannot be detected

Presumptive diagnosis - a tentative or provisional identification of the cause of a disease based on limited information

Prophylactic - defending or protection from disease

Protozoa - a one-celled organism that may be parasitic on fish or other animals

Roundworm - a worm-like parasite, usually large enough to be seen with the naked eye (also called a nematode)

Scoliosis - lateral, abnormal curvature of the spine

SEM - scanning electron microscopy

Septicemia - systemic disease in the blood associated with pathogenic organisms or their toxins; often bacterial toxin

Sessile - attached, not mobile

Subacute - onset and course of disease over a time span intermediate between acute and chronic

Symbiont - an organism which lives on or in another organism in a relationship from which both organisms derive benefit from the association

Systemic - affecting the body as a whole (versus only affecting skin or gills)

Tapeworm - a flat, segmented parasitic worm, usually large enough to be seen with the naked eye (also called a cestode)

TEM - transmission electron microscopy

Theront - the free swimming, infestive stage of *I. multifiliis*

Tomite - the small ciliated stage that is released from the cyst stage in *I. multifiliis*

Trophont - the feeding stage of *I. multifiliis* under gill and skin epithelium

Ulcer - a local defect on the surface of an organ or tissue caused by damage and loss of dead tissue, can be haemorrhagic

Vertical transmission - transmission of disease from adults to offspring through the egg or sexual fluids

Zoonotic - diseases of animals which can also infect humans

Acknowledgment

The authors are grateful to all the staff of the Fish Health Section for providing pictures of the fish parasites described in this manual and to Igang Marine Station for their technical assistance during the freshwater bath treatment of sea lice-infected pompano. The editing assistance of the Development Communication Section staff and the comments and recommendations of the Publication Review Committee are also greatly acknowledged. The authors also thank SEAFDEC/AQD Chief Dan D. Baliao for supporting the publication.

About the Authors

Ms. Gregoria Erazo-Pagador is an Associate Scientist at AQD. She obtained her B.S. in Biological Sciences at the West Visayas State University in Iloilo City in 1985, and M.Sc. in Tropical Fish Health at the Universiti Putra Malaysia in 1997. Her research interests are on fish histology, fish parasitology and molluscan parasites.

Mr. Blan Jericho G. Caloyloy was a Technical Assistant assigned at SEAFDEC/AQD's Research Division from 2021 to 2023. He earned his Bachelor of Science in Fisheries degree from the University of the Philippines Visayas in 2019. He is also a registered fisheries technologist of the Professional Regulatory Commission.

Dr. Leobert D. de la Peña has been with SEAFDEC/AQD from 1987. He is currently a scientist and the head of the Research Division. He earned his M.Sci. and Ph.D. (Fish Pathology) degrees from the Hiroshima University Graduate School of Biosphere Sciences in Japan.

ABOUT SEAFDEC

The Southeast Asian Fisheries Development Center (SEAFDEC) is a regional treaty organization established in December 1967 to promote fisheries development in the region. The member countries are Brunei Darussalam, Cambodia, Indonesia, Japan, Lao PDR, Malaysia, Myanmar, Philippines, Singapore, Thailand, and Viet Nam.

The policy-making body of SEAFDEC is the Council of Directors, made up of representatives of the member countries.

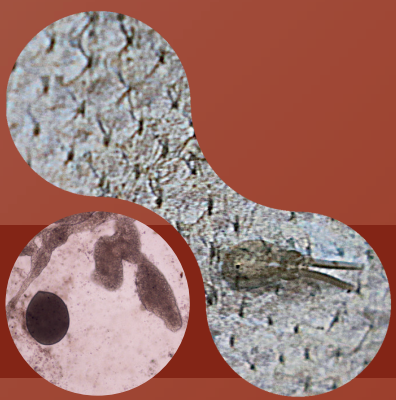
SEAFDEC has five departments that focus on different aspects of fisheries development:

- The Training Department (TD) in Samut Prakan, Thailand (1967) for training in marine capture fisheries
- The Marine Fisheries Research Department (MFRD) in Singapore (1967) for post-harvest technologies
- The Aquaculture Department (AQD) in Tigbauan, Iloilo, Philippines (1973) for aquaculture research and development
- The Marine Fishery Resources Development and Management Department (MFRDMD) in Kuala Terengganu, Malaysia (1992) for the development and management of fishery resources in the exclusive economic zones of SEAFDEC member countries, and
- Inland Fishery Resources Development and Management Department (IFRDMD) in Palembang, Indonesia (2014) for sustainable development and management of inland capture fisheries in the Southeast Asian region.

AQD is mandated to:

- Conduct scientific research to generate aquaculture technologies appropriate for Southeast Asia
- Develop managerial, technical and skilled manpower for the aquaculture sector
- Produce, disseminate and exchange aquaculture information

AQD maintains four stations: the Tigbauan Main Station and Dumangas Brackishwater Station in Iloilo province; the Igang Marine Station in Guimaras province; and the Binangonan Freshwater Station in Rizal province. AQD also has an office in Quezon City.



www.seafdec.org.ph