Infection of Red Hybrid Tilapia with a Monogenean in Coastal Waters off Southern Jamaica

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In Jamaica, it appears that red hybrid tilapia (*Oreochromis* spp.) are comparatively unaffected by many of the parasitic infections associated with other farmed fish. However, recent observations indicate that under certain seawater culture regimens there is a possibility of infection with a parasitic flatworm, *Neobenedenia melleni* (Monogenea: Capsalidae).

THE PARASITE

Infection and Distribution

Neobenedenia melleni (MacCallum, 1927) Yamaguti, 1963 was originally described in 1927 from captive marine fishes in the New York Aquarium, where a number of spiny rayed species was found susceptible (MacCallum, 1927). The infection was observed to spread rapidly among this population, and death from heavy infections often occurred.

Naturally infected hosts in the Caribbean Sea include species of grouper, snapper, butterflyfish, and angelfish (Nigrelli, 1947). However, prevalence levels were low, and infection intensity was not observed to exceed 3 parasites per host. Consequently, *Neobenedenia* appears not to be a threat to these wild populations.

Structure

Adult *Neobenedenia* measure up to 6 mm in length (Figure 1). They are oval parasites characterized at the anterior end by disk-shaped adhesive and feeding organs, collectively called the prohaptor. The posterior of all monogeneans bears another attachment organ, the opisthaptor. This appears as a large, saucer-shaped sucker, which is armed with two pairs of strong hooklets, called hamuli. The structure assists in firmly anchoring the parasite to the fish epidermis.

The mouth and protrusile pharynx are located sub-terminally on the mid-ventral surface. *Neobenedenia* feeds on mucus and epidermal cells and displays extracorporeal digestion; the parasites deposit digestive enzymes released from the pharynx on to the fish surface and then suck up the resulting digest into the intestine.

Figure 1. Scanning electron micrograph of a juvenile *Neobenedenia melleni* attached to the epidermis (E) of tilapia. Note the prohaptor (P) and the well-developed posterior opisthaptor (O).

Life-cycle

This is direct in *Neobenedenia, i.e.,* only the fish host is involved (Figure 2). Diamond-shaped eggs are produced by hermaphroditic adults on mucus strings. The eggs may detach from the adult parasite and fall to the bottom and hatch, or they may remain caught up in the excess mucus produced by the fish and hatch close to the epidermis. It is likely that urea or ammonia excreted via the skin of fishes is a hatching stimulus for the enclosed larva (Kearn and MacDonald, 1976). In a few days tiny oncomiracidia are liberated, and these resemble ciliate protozoans in size and shape. The free-swimming life of an oncomiracidium is short [4 – 36 hours, depending on species (Paling, 1969; Paperna, 1963)], thus it quickly searches out and attaches to the host's epidermis through use of sticky cephalic glands and the developing opisthaptor. Swimming speeds of monogenean larvae range from 0.4 – 5.0 mm/sec (Paling, 1966; Kearn, 1967). Once attached, the oncomiracidium sheds its ciliated cells and develops into the adult. For an excellent review of the biology of the Monogenea, see Smyth and Halton (1983).

SEAWATER CULTURE OF TILAPIA

Tilapia, reared in freshwater for 12 – 14 weeks, were acclimatized in increasing concentrations of seawater, and, finally, removed to $2m^3$ mesh cages in open seawater in Morant Bay, southeastern Jamaica. Three cages, containing 100, 150, and 200 fish, respectively, were suspended from rafts 0.2 – 0.5 m above a muddy substratum for 4 weeks, during which time regular visits were made for feeding and growth assessment (Hall, 1992).

NEOBENEDENIA - TILAPIA INTERACTIONS

Following 3 weeks culture in Morant bay, fish in all 3 cages showed evidence of *Neobenedenia* infection; attached parasites numbered 200 - 300 in some hosts, and fish were irritable and visibly abraded as a result of injurious contact with the cage meshing.

Although parasites were widely distributed over the surface of the fish, heavily infected hosts were subject to a concentration of organisms around the mouth and on the corneae. This probably resulted in considerable impairment of vision of the affected fish and has serious implications for feeding efficiency as well as vulnerability to predators.

Scanning electron microscopy of the epidermis of infected fish revealed denudation of large areas of surface epithelium, predisposing the fish to surface irritation and 20 bacterial infections (Figure 3). Furthermore, migration and/or dislodgement of the parasite from the surface of the fish left distinctive imprints on the integument caused by impressions of the opisthaptor and hamuli.

Infection levels followed a density-dependent pattern (Figure 4). Maximal mortality was observed in the cage containing the most (200) fish, while cages
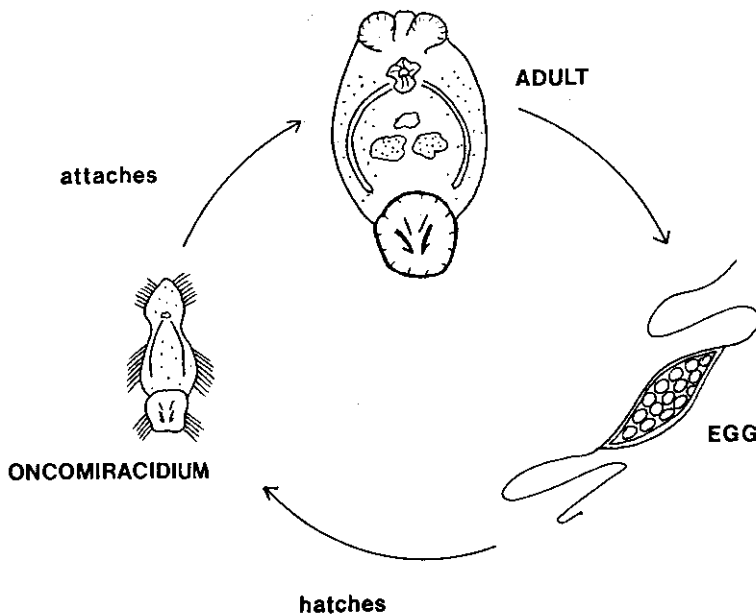
Figure 2 Life cycle of a typical oviparous monogenean such as *Neobenedenia melleni* (original).

accommodating fewer fish showed progressively smaller death rates (χ^2 = 256.9; df = 2; p < 0.0001).

DISCUSSION AND RECOMMENDATIONS FOR CONTROL

Fish cultured in seawater initially become infected through contact with oncomiracidia that hatch from eggs presumably deposited on the sea floor by parasites of healthy, wild populations of fish. Tilapia cultured in "open-work" cages, as in this report, represent effectively an unnatural, "captive" population and, consequently, are exposed to infection and reinfection pressures much in excess of those normally experienced by the normal hosts.

Thus, the dynamic host-parasite equilibrium that allows *Neobenedenia* and other fishes to coexist with only minimal pathology is interrupted. Effectively, too many parasite infective stages achieve success in contacting and becoming established within a small and spatially static population of tilapia.

Furthermore, the observation that *Neobenedenia* eggs may associate with

Figure 3. Scanning electron micrograph of surface of tilapia infected with
Neobenedenia melleni showing impressions on the epidermis imposed by the rim
(double arrow) of the opisthaptor and associated hamuli (single arrow). Note the
variable size of the impressions, resulting from parasitism by a range of age
classes. * = region of denuded epithelium.

the host for an undetermined period serves only to strengthen the force of
transmission of the parasite and result in even greater levels of morbidity.

A number of strategies exist for the potential control/eradication of
Neobenedenia in captive tilapia populations. However, it should be stressed that
the continued success of any control strategy is a function of our knowledge and
clear understanding of the biology of the host-parasite relationship, as well as
availability of adequate funding to allow the research.

1. Incubation of parasitized fish in a solution of 60 ppm formaldehyde for
   30 seconds results in dislodgement of both juvenile and adult
   Neobenedenia and subsequent recovery of most of the fish following
   transfer to a parasite-free environment.
2. Relocation of cages containing either uninfected fish or
   formaldehyde-treated, previously infected fish to a site with a slight
   (< 0.5 knots) current, in conjunction with re-elevation of cages to
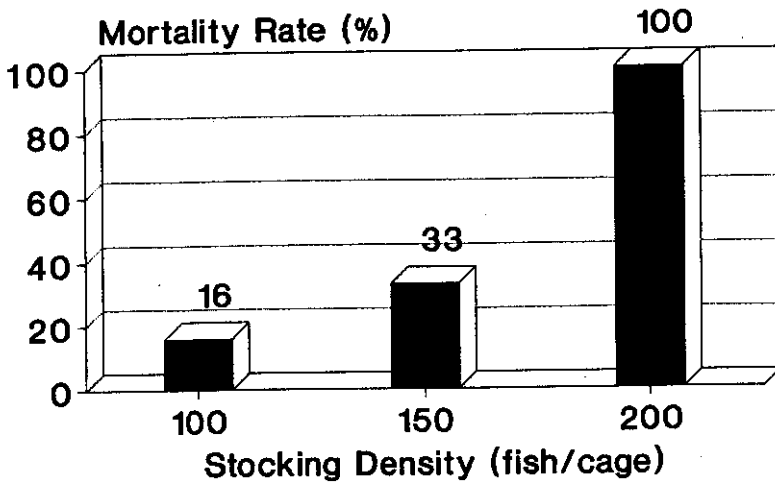   approximately 3 m from the sea bottom, allowed helminth-free culture

Figure 4. Parasite-induced Mortality Rate (4 weeks seawater culture).

for an indefinite period exceeding 14 weeks. This approach results apparently in absence of contact between oncomiracidia and tilapia; even if the infective stages are able to sense the fish above, in light of the slight current they presumably are unable to traverse the intervening distance and become established.

However, modified control strategies need to be implemented where tilapia are cultured in tanks supplied with fresh seawater.

3. Administration of anthelmintic agents in, *e.g.*, food or in the water supply, as prophylactic and/or chemotherapeutic measures.
4. Filtration of seawater using sand, or other means, to exclude parasite eggs and/or infective larvae from the water supply, thus interrupting host-parasite contact.

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