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Lionfish in the Western Atlantic

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Lionfish (*Pterois volitans*) have been reported in shallow warm waters of the East Coast of the United States from Florida to New York and are now recognized as established in the Western North Atlantic. Todd Gardner (speaking for himself, Paula Whitfield, Stephen Vives, Matt Gilligan, Walter Courtenay, Carleton Ray, and Jon Haire) presented an update of reports and evaluations at the Marine Ornamentals '04 meeting in Honolulu, HI (March 1-4, 2004).

The presentation had previously been published by these authors in a series of NOAA reports, press releases, and an in-house biological evaluation. Gardner later summarized the reports to date as 6 lionfish at 3 locations in 2000, 34 lionfish at 12 locations in 2001, and 139 lionfish at 41 locations in 2002. Reports are still being compiled, but it's clear that a reproducing population is now expanding along the East Coast. The majority of reports have centered around dive sites off North Carolina, from which the fish seem to be spreading north and south.

All persons agree that an invasion has occurred and is successful. Beyond that agreement, the parties part company.

The first area of disagreement is the source of the lionfish. Gardner, reflecting the consensus of the other scientists on his team and of Richard Pyle of Honolulu, attributed the introduction to aquarium releases. No data were provided in support of this assertion, other than reference to a publication reporting an aquarium release by Dr. Walter Courtenay many years ago.

I telephoned Dr. Courtenay in Florida to inquire about this report. Dr. Courtenay had no direct knowledge of an aquarium release, but had been told of one by another person who also had not witnessed it, but assumed that it had occurred. Thus, that early (first) report of an aquarium release was anecdotal and not followed by an investigation. Yet all publications report this early Courtenay paper as the authority that lionfish were an aquarium release.

His conclusion had been echoed just last year in North Carolina when a reporter asked Dr. Frank Schwartz of the UNC-NC Marine Laboratory in Morehead City (a popular dive locale) where the newly reported lionfish might have come from, and he responded that he had heard it was an aquarium release in Florida resulting from a large outdoor tank being destroyed during a storm.

Photo by Alf Jacob Nilsen

Pterois volitans on the Great Barrier Reef

I telephoned Dr. Schwartz at the time to follow up on that report, but he said he had heard it at a meeting but could not recall who had provided that information. I then telephoned the biologists with the Florida Department of Natural Resources, since any release of that nature would have been reported to the state. Conversations with several offices all resulted in no knowledge of any release and the universal assessment that had it happened, they would know about it.

Gardner, Whitfield (a NOAA biologist stationed in N.C.), and many others have speculated that, because of some other reports of Pacific fishes on south Florida reefs, the likelihood of aquarium releases gains strength. The unsubstantiated suggestion of a large outdoor tank being destroyed during Hurricane Andrew and releasing a host of lionfishes seems to be the basis of the later speculation, yet there is no evidence that (a) it ever

Continued on page 2

Lionfish in the Western Atlantic

Continued from page 1

happened, (b) even a hundred lionfish would be a sufficient number of introduced fishes to establish a breeding population in the western North Atlantic, and (c) any other fishes were released and established as result of Andrew.

Gardner suggested that aquarists dump fish that grow too large, pointing to the occurrence of some Pacific angels (one species) and tangs in south Florida. Pyle in Honolulu also suggested that exotics could be introduced when aquarium fishes get too large and are released by their owners.

As to intentional releases, it is inconceivable that aquarists would release hundred dollar fishes that could be sold back to a pet store or provided to a public aquarium. As to accidental releases, the question must be raised that, if storm damaged outdoor tanks (or electrical failures) somehow led to the release of large expensive fishes, then why is south Florida also not inundated with far more common (in marine aquariums) fishes such as domino and banded damsels, clown fishes, wrasses, all kinds of Pacific gobies, and other inexpensive fishes? In fact, the only reports from south Florida include an expensive Pacific angelfish, yellow tangs (from Hawaii probably) and Moorish Idols (also from Hawaii).

A second area of disagreement is whether this release could have been effected by transport of eggs or larvae through ballast water. I contacted an authority on ballast water releases, Dr. Stephan Gollasch of Hamburg, Germany. Dr. Gollasch replied he believed it unlikely that lionfish could have been transported through ballast water because the pump intake filter has a mesh size of 1 cm, and the pump impellers themselves would kill anything transported through the pumps. Dr. Gollasch also concluded that an aquarium release was a likely cause.

Further investigation revealed that many fishes have been transported by ballast water, most notably lately the perch called ruffe and a large goby in the Great Lakes. These fishes were not deterred by impellers or 1 cm mesh, so the argument that scorpionfish could not survive is not supported.

A Sea Grant report on ballast water introductions indicates that invertebrates can survive through multiple generations within the ballast tanks, which are partially filled and emptied periodically as a ship makes its way around the world's seas with varying amounts of lading. This constant introduction of food into the ballast tanks provides sufficient nutrition for many invertebrates, and there is no reason why the same process would not work to assure survival of benthic spawning gobies from Europe to America. That an egg-scattering percid like the ruffe also was transported indicates that this is not the sole manner in which a fish could be transported.

A Japanese report on the reduction of ballast water introductions recommended displacing the air over the ballast water with nitrogen. This inexpensive solution eliminates the oxygen reserve in the atmosphere and has the added benefit of reducing oxygenic corrosion in the ship. Purging the ballast tanks with nitrogen resulted in a 10 percent decrease in rusting. At the same time, the survivorship of larval crabs was reduced by 90 percent and that of polychaete worms by about 70 percent. The method was more cost effective than other forms of hypoxia and the use of biocides.

Finally, what would it take to introduce lionfish through ballast water?

A general principal in biology is that it takes a large founder population to establish an invasion. The idea of a few dozen grown fish surviving, finding each other, and breeding in the Atlantic ocean boggles the mind. Bigger numbers are far more reasonable, and that could only be provided by many thousands of eggs or larvae at one time, or multiple times in short order.

There are two ways that could occur. A ship (or more than one) could take on ballast water in a location and at a time that lionfish are spawning, so that the water is filled with seasonally high numbers of eggs. Second, the eggs could be clustered so a ship takes on not an egg at a time, but a cluster of thousands at a time. And that is what could happen with lionfish, which (like all members of the *Scorpaenidae*) produces eggs in large jellylike masses. If the water at the time of loading was filled with jellylike masses of eggs, the likelihood of a massive cargo of eggs in ballast water becomes reasonable. Add to these attributes that lionfish range into (and spawn) in shallow water, including water shallow enough to support a tanker, freighter, or warship.

It's interesting that the first reports of lionfish came from North Carolina, and they appear to be spreading from (and within) that central locus. North Carolina has large ports at Wilmington and Morehead City, with constant and large amounts of commercial and military ship traffic. With the large number of dive sites off Morehead City, N.C., the question remains whether the fish are really abundant here, or merely more often seen by the frequent and large number of divers.

A third area of disagreement is on the threat posed by lionfish in the North Atlantic. Much has been written about the poisonous spines, difficulty of finding antivenin, and the lack of predators.

In fact, only stonefish among the *Scorpaenidae* are potentially lethal and produce a toxin that should be treated with an antivenin. Lionfish stings are excruciatingly painful, but not deadly. The recommended treatment is immersion of the wounded limb in very hot water for at least 30 minutes. The toxic is a heat-labile protein that is inactivated by hot water, so no antivenin is necessary.

Is that the end of the story, and are we left to wonder? When I spoke with Dr. Courtenay and expressed skepticism about aquarium releases and my inclination to favor a ballast water origin, he offered another consideration. He stated that one well-known Florida biologist had evidence that some introductions might have been caused by dive guides as attractants to their local reefs. He stated that (blank) had evidence of plantings by dive operators that this biologists wanted to talk to Courtenay about, but Courtenay had never gotten around to it.

Intentional introductions by dive shop operators? I recalled Gardner mentioning that some dive shop operators would not show investigating NOAA biologists where the scorpionfish were located, apparently fearing the biologists would remove these important attractions.

I emailed and telephoned the biologist named by Dr. Courtenay in an effort to secure an interview. To date, my inquiries have gone unanswered.

So we could have ballast water introductions. And we could also have dive operators purchasing marine fishes for specific release to enhance their dive sites. But as to a pet industry or amateur aquarist release? I think NOAA is all wet.

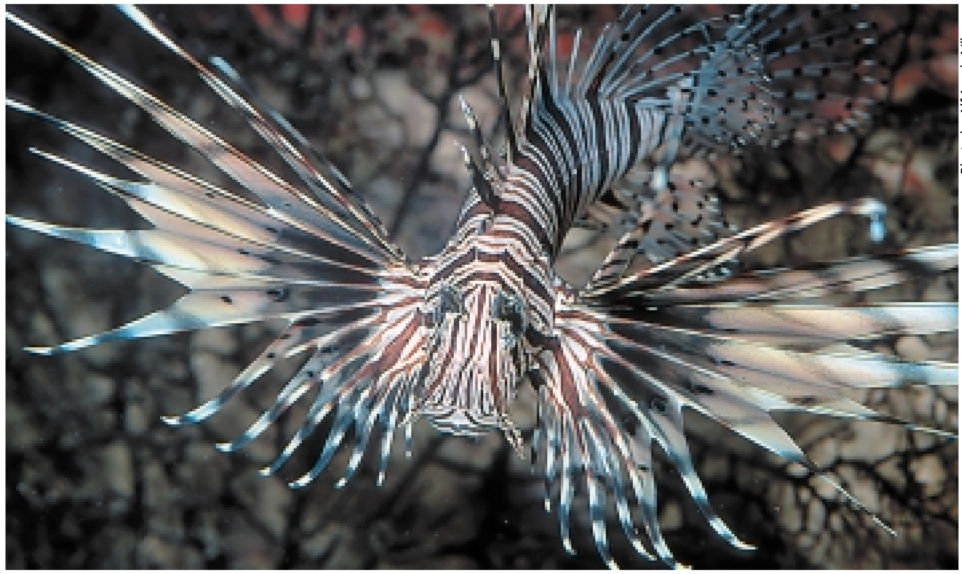

Photo by Alf Jacob Nilsen

Pterois volitans is native to the Indo-Pacific from Australia up to Korea.

Future Events and Conferences

IMAC 2004. June 4-6, 2004. Chicago, IL. More information at www.theimac.org

MACNA XVI. Sept. 10-12, 2004. Boston, MA. More information at www.masna.org

6th Annual International Aquarium Congress. Dec. 5-10, 2004 Monterey, CA USA. More information at www.iac.2004.org

Internationales Meerwasser- Symposium. Mar. 11-13, 2005 Luenen, Westfalen, Germany. More information: www.meerwassersymposium.de

Marine Ich, *Cryptocaryoniasis*

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Of the two most common "scourges" of marine reef fish diseases, the most prevalent is saltwater ich or white-spot disease or "Crypt" while the other is the dinoflagellate *Amyloodinium* or "velvet". As far as biological causes of captive mortality go, "Crypt" is the hands-down winner. All too regrettable, as this protozoan can be eliminated by simple pH-adjusted freshwater bath protocols along the course of the supply chain from collection to hobbyists' and institutions' tanks.

Causative Organism:

Amongst the most myth-ridden subjects of marine aquarium keeping, "marine ich" must be near the top. Some folks (in print no less) have stated that the cause of this disease is bacterial, viral or directly environmental! The causative organism of marine ich is a ciliated protozoan (single-celled animal) known to science as *Cryptocaryon irritans*.

Direct observation of the responsible micro-organism is possible with any medium power microscope; the adult size being up to about 0.5 mm in diameter. Remove some body slime from an infested fish by skimming a microscope slide along its side from the direction of head to tail, and smear this onto the surface of another slide. You might improve contrast by staining the slide specimen with a drop of methylene blue. Adult ich appears as a roundish blob with a larger four-lobed macronucleus. The outside of the cell is covered by numerous small "hairs" (cilia).

Life Cycle:

Cryptocaryon irritans is a parasite with a direct life cycle, i.e., requiring no intermediate host like an invertebrate to complete its life cycle. The time per generation is temperature dependent; ranging from a few days for tropical to a week or more in cold water tanks. If one considers the possibility of "resting stages", marine ich can wait weeks to months before seeking out fish hosts.

The cycle starts with a stage feeding (called trophonts) on its fish host. They embedded below the epithelium (upper living skin layers) of host fishes, under copious amounts of mucus, not affected by chemical treatments.

Next is the Protomont stage when ich leaves the fish, drops to the bottom and forms a resting/developmental cyst (tomont) stage persisting for 3-30 days. For about a day at 78° F reproduction occurs by binary fission; that is, by each cell dividing into two, possibly producing two hundred individuals (then called theronts). These encysted stage individuals are not affected by chemical treatments.

Next, after 3-7 days, as tomites or theronts they break out of the cyst (typically at night, when reef fishes are often "sitting on the bottom") and swim into the water in search of a host fish. Ich must find a fish host within several hours to a day or two at elevated temperatures or die. If the parasite is lucky (and its host fish not so) it will find a host and burrow into its skin or gills. This "free-living"

Continued on page 4

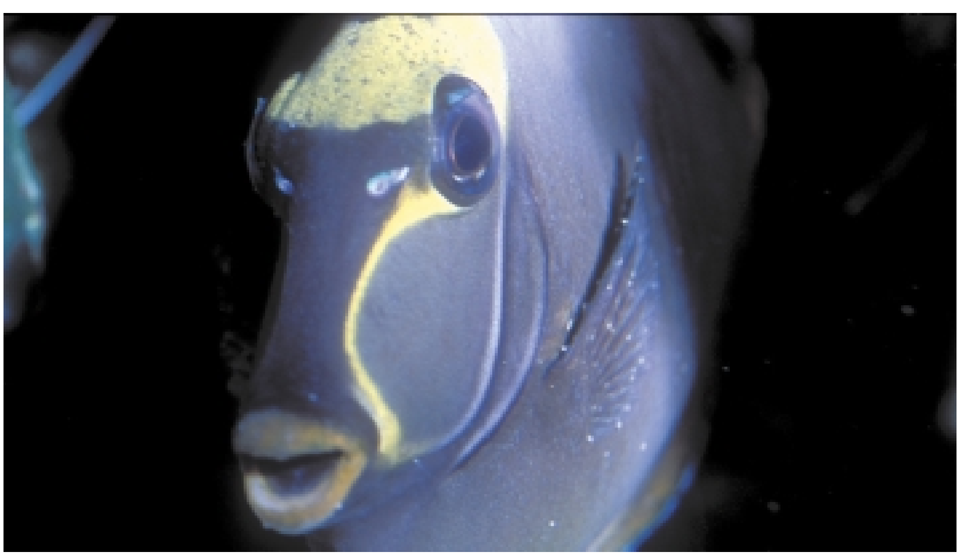

Photo by Robert Fenner

A Naso tang exhibiting the typical signs of a Crypt infection

Marine Ich, *Cryptocaryoniasis*

Continued from page 3

swimming stage is the opportune moment for chemical treatment.

Treatments:

You'd think that being such common a potential killer there would be a simple standard operating procedure for its treatment. Guess again. The state of development of the hobby and huge turnover of hobbyists (more than 100% per year) dictate that the non-science aspects (faith, intuition...) hold sway in allowing nonsense "remedies" to persist. Investigate your options thoroughly.

Prevention:

You'll be ready to pre-pay for that "pound of cure" for sure once you've had an encounter with Crypt. But I hope you will instead avoid having to treat your fishes at all for this external parasite by following simple quarantine practice. Some fish-groups, like Surgeons and Rabbitfishes, are "ich magnets" being much more susceptible to infestations. However, virtually all marine fishes, including sharks and moray eels, can become hosts given virulent exposure and/or impugned environmental circumstances.

This being stated, the single best way for you to not have to deal with marine ich (or most all biological diseases of livestock) is to employ a few-week (2-3) isolation/quarantine regimen. This period of time will give your new fish (and non-fish) livestock a chance to "rest up", and show signs (if any) of disease development. Some folks advocate pre-emptive chemical treatment for saltwater ich, I don't. Better to do your best to acclimate new livestock, keep them separate and administer treatments only if definite signs of parasites are evidenced.

PUBLICATION INFORMATION

SeaScope® was created to present short, informative articles of interest to marine aquarists. Topics may include water chemistry, nutrition, mariculture, system design, ecology, behavior, and fish health. Article contributions are welcomed. They should deal with pertinent topics and are subject to editorial reviews that in our opinion are necessary. Payments will be made at existing rates and will cover all author's rights to the material submitted.

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Photo by Robert Fenner

Shrimp such as Lysmata amboinensis can help control Crypt.

Environmental Influences:

All diseases are to a degree environmentally mediated. That is, the physical, chemical and social make-up, foods/feeding and a myriad of other factors directly and indirectly dispose an organism to disease. Many systems teeter on being just about parasite free, though possessing latent infestations of parasites. With slight changes in water quality, nutrition or social interaction, this balance can be tipped either way.

After Observing Infestation:

Many products have been advanced as being efficacious in treating for Crypt, some in combination with others. In general the more effective treatments are more potentially toxic and their mis-use is likely a source of mortality than the actual parasites they're being used to eliminate. Be aware that there are a few commercial "reef safe" remedies (pepper-sauce, garlic...) on the market that are unreliable to put it mildly. Rather than saving fish lives these persistent "cures" kill-off hobbyists by the droves. Avoid them by getting on the internet and converse with fellow hobbyists regarding what works and doesn't.

Temperature effects:

As with freshwater ich, it's advised to raise your system's temperature to speed up the life cycle of Crypt while you're treating for it. If your livestock can handle it, increase your water temperature to the mid 80's°F along with whatever other treatment regimen you employ.

A) Hyposalinity, lowered specific gravity. Some people advocates a specific gravity as low as 1.009. This can work if your fishes are not too challenged already or the pathogen too virulent, however it will not effect a permanent system cure. Know that most common measures of specific gravity are temperature specific and that most non-fish livestock will not tolerate the lower limit (14-16 ppt salinity) necessary to kill off the parasites. Therefore, your fishes will have to be separated from your non-fish livestock if you're using hyposalinity as a treatment mode. And there are exceptions and variations to consider using hyposalinity. Cartilaginous fishes (sharks, rays) cannot be treated in this fashion... and such osmotic changes need to be made gradually (over days).

B) Ionic copper solutions, chelated and not. Copper is an old-time, but proven method, of eliminating *Cryptocaryon*. Solutions come in two varieties, bound up with a "carrier" molecule (chelated) and "free" (as in copper sulfate solutions). Both types have their benefits and shortcomings. Chelated copper "lasts longer" in marine water, cutting down the frequency of administration, whereas free copper is more available, readily effective. Note that you need to use a test kit for either type of copper used and that there are different test kits. Whichever format of copper is utilized it should be tested for and, if necessary, administered twice daily. Testing with adjustment of the copper levels assures that a "physiological dose", sufficient concentration (0.15-0.25 ppm over 7-10 days) of cupric ion is present to kill the tomite/theront stages.

C) Metronidazole (aka Flagyl), Quinacrine Hydrochloride, Quinine Sulfate. These treatments are not effective consistently.

D) Formalin or formalin/malachite or formalin/copper mixtures. Can be useful for initial infestations, treating large numbers of specimens, but the biocide formalin is dangerously toxic in the hands of the uninitiated. If used, shy on the low concentration, utilize extra aeration/circulation and closely watch your fishes and biological filtration.

In Closing:

Pandemics of saltwater ich have waxed and waned during the entire history of the captive marine hobby. It is likely that these infestations account for a large percentage of hobbyist attrition. This is regrettable and avoidable by simple quarantine procedures and adherence to a reliable treatment protocol. Isolation of fish livestock, hyposalinity and elevated temperature, administration of copper medication with testing will cure all but the most entrenched cases.

Related Articles on WWM:

http://www.wetwebmedia.com/dips_baths.htm, Net et al. dips to prevent spreading communicable diseases

http://www.wetwebmedia.com/quaranti.htm, Quarantine procedures

Photo by Robert Fenner

Naso lituratus with a rampant infestation of Crypt