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Chapter 5

Predators and pests of captive corals

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ABSTRACT
Coral keeping as a hobby and for exhibits in public aquariums has exploded in popularity over the last decade. Due to this increase, more corals are being imported from all over the world and being traded amongst coral enthusiasts. With this increase in new coral collecting sites and more aquaculture and mariculture operations, many new parasites and predators of corals are being introduced and spread between persons and groups. This paper will first focus on the many predators of corals that can inhabit captive coral systems. A summary of the more common and currently important predator species will be covered, including *Acropora* eating flatworms, nudibranchs and ciliates along with their control and hopeful eradication. The second focus will be placed on the various pests, that act as irritants but rarely lead directly to coral mortality.

I. PREDATORS AND PARASITES

ACROPORA EATING FLATWORMS

In the last decade of coral keeping, the success of keeping stony corals from the genus *Acropora* has grown significantly, along with pests and parasites of the genus. One of the more recent and common parasites of *Acropora* is a type of flatworm that can decimate colonies of *Acropora* in a short time. In the experience of the author, two types of flatworms have been found, and others may exist. One type is fairly benign and only in high numbers can act as an irritant and keep the coral polyps from expanding. The other flatworm, which is larger and an egg layer, is much worse as it actually consumes tissue and can easily decimate large colonies in a short time. Both of these flatworms can be extremely hard to see when they are on coral tissue. They seem to incorporate zooxanthellae from their prey and then sequester them in a pattern that matches the corallite pattern of the coral. While the coral is in the water, detection is nearly impossible. Signs of an infestation include pale coloration, little or no polyp extension, "bite" marks on the coral, and loss of tissue beginning at the base. If there is tissue loss, there maybe eggs laid on the newly denuded skeleton. Eggs are very small, but are laid in small clusters of 20-40 eggs and are brownish in color.

Once it is established that the coral is infested, realize that the eradication of these creatures is not easy. First, figure out which corals are affected. Not all species of *Acropora* seem to be appetizing. In the author's experience, corals that produce a lot of mucous show resilience to this predator as no flatworms were ever found on these colonies. If the infestation is caught early and damage is minimal, or if removing colonies to quarantine tank is impossible, a natural means of eradication can be tried. Various small wrasses, *Pseudochromis* sp., pipefish, dragonets (*Synchiropus* sp.) and coral crabs have all been mentioned as potential predators of the flatworms. If this biological approach fails, the next step would be some type of chemical treatment. No effective in tank treatment is known at this time, so treatments must be done either in a quarantine tank or as a dip with the coral returning to the display afterwards.

At the Omaha Zoo, this predator was eliminated using a series of dips using levamisole hydrochloride powder. At a dosage of 40 $mg.L^{-1}$, the corals were kept in a bath for 1 h. During this dip, the coral was thoroughly inspected for egg masses. If any egg mass

was found, they were either picked off, or that piece with eggs was removed from the colony. Since the eggs are not affected by the chemical dip, the colonies were dipped once per week for four weeks.

The use of levamisole does have disadvantages. Corals are more susceptible to bleaching after multiple exposures to the drug. Some *Acropora* species also show negative reactions (tissue loss, bleaching) to dosages above 40 $mg.L^{-1}$ or to prolonged dips. It is also best to use levamisole at the first sign of the infestation. Dipping corals in the drug once the coral has become severely compromised, can lead to the death of the coral. At the Omaha Zoo, the flatworms were caught fairly early, before severe infestation. Though many of the *Acropora* did show some minor bleaching during the later dips, none of the corals were lost and the flatworms were eliminated and have not returned for three years.

Other known dip treatments include freshwater dips, commercial coral dips and Lugol's iodine. Freshwater dips can be rather harsh on thin tissue corals such as *Acropora*. If a freshwater dip is performed, try limiting the dip to 30 seconds or less. Lugol's iodine at a concentration of 1.32 $ml.L^{-1}$, or commercial dips (Tropic Marin Pro Coral Cure, Two Little Fishies Revive) can also be used. As with the levamisole dip, multiple dips will be necessary, as none of these treatments will kill the eggs. Dip the coral once per week for four weeks and make sure to remove all signs of eggs.

NUDIBRANCHS

Nudibranchs are a beautiful group of animals known for their bright, gaudy colors and also for their often very specific diets. Unfortunately for aquarists a large majority of these animals cannot be kept in captivity for any length of time, due to a short life span or a specific diet that cannot be provided. Also unfortunately for coral aquarists, a few do quite well in captivity since some species of nudibranchs are specialists in feeding on corals.

One of the most common predatory nudibranchs that are encountered in aquariums is the *Montipora* eating nudibranch, a species that preys on *Montipora* sp. and *Anacropora* sp. This nudibranch has become quite common in aquaria. It is hard to detect early infestations, the animals are easily transferred amongst aquarists and are nearly impossible to defeat. If not caught in its early stages, this nudibranch can reproduce at an incredible rate. It can start reproducing after only two to three weeks of age and produce egg masses easily containing forty eggs or more. These eggs hatch out in five to seven days and have direct development. After a day or two, the juvenile nudibranchs are ready to start feeding on the coral.

Once this *Montipora* eating nudibranch gets large enough, or attains enough numbers, the damage of predation is easily seen. The nudibranchs will usually line up along the edge of live tissue and start to consume the tissue, leaving bare white skeleton. They are mostly nocturnal, small in size (1-5 mm) and sometimes cryptic, but the tissue damage from the small whitish-brown nudibranchs is grossly apparent. Eradication of these predators can be extremely difficult. At the Omaha Zoo, an infestation was found over seven years ago and to this day the animals still inhabit certain exhibits. Various tools can be used to try to eradicate them. Biological controls using various wrasses (*Coris* sp., *Halichoeres* sp. *and Pseudocheilinus* sp.) have shown that an infestation can be kept under control and possibly eliminated, when only a few small colonies are present with the coral showing good growth and color. However in a large system with multiple large colonies, complete elimination cannot be practically accomplished. Another way of combating them is by using mechanical means of removal. This involves inspecting individual colonies and manually removing all nudibranchs and eggs with toothbrushes, water piks, toothpicks, forceps or other means. This can be effective when only a few colonies are present, but is quite tedious and difficult when either multiple or large colonies are present.

The last means of treatment is by using various chemicals as a dip to chemically eliminate them. As mentioned before various commercial dips can be used. Revive by Two Little Fishies and Tropic Marin Pro Coral Cure are two that have been effectively used by the author. Levamisole at a dose of 40 $mg.L^{-1}$ was also an effective treatment. The length of the dip was four hours, as most nudibranchs were not moving and falling apart by this time. The drug at this dose, does not kill the nudibranchs, but paralyzes them and causes them to release from the surface of the coral. At the end of the dip the coral was vigorously shaken and blown off using water flow from a powerhead (Maxi-Jet 1000, Marineland Inc.) to dislodge any nudibranchs stuck in the whorls or crevices of

the coral. The drug does not affect the eggs, so repeat dips were performed once a week for four weeks. Over 100 colonies were dipped using this process and only 5 % of the colonies did not survive. After multiple dips however, some corals may slightly bleach and lose some color. The dip is also very hard on corals that are in a compromised state and higher mortality rates maybe seen. Unfortunately after the series of dips and after a month of not seeing any nudibranchs, they began to reappear. After years of trials and tribulations with little success, it was decided to fragment small pieces of each infected coral that were well away from the nudibranch infestation and then placed in a tank free of the predators, effectively producing new daughter colonies free of nudibranchs.

After many years of dealing with these predators, there still seems to be no consistent opinion on how they affect the corals. Both coral exhibits at the Omaha Zoo have colonies of various *Montipora* species and all have nudibranchs. However, it seems that colonies that are kept in a healthy, fast growing state are not affected to the degree that significant mortality occurs. Colonies that become compromised are quickly consumed, as the numbers of nudibranchs seem to explode very quickly on those corals. In contrast, corals that have been little affected for years and appear healthy can suddenly become colonized by a large outbreak. The best way we have found to deal with them is a vigilant quarantine procedure, and maintaining a number of potential predators in the display.

CILIATES

Ciliates can be problematic in an established reef tank. The most commonly seen ciliate is associated with a “Brown Jelly infection”. Almost all corals can be attacked, though corals with large amounts of flesh (i.e. *Euphyllia* sp*., Trachyphyllia* sp.) seem too be especially vulnerable. A coral being consumed by this ciliate is easily seen, as a brown jelly like material will be surrounding coral tissue. These infestations can be brought on by various stress events, especially injury or a seemingly healthy coral can be attacked. It is best to siphon off all the jelly like material using a small bit of tubing. Once all the material has been removed, a dip can be used to cleanse the coral. Fleshy corals can be given a freshwater dip (same temperature and pH of tank water) for up to one minute. Corals with thin tissue are best treated with a dip of Lugol’s iodine (1.32 $ml.L^{-1}$) or with iodine based commercial coral dips. After the dip, inspect the coral and note tissue loss. If any area of the coral is missing significant tissue, it is best to break off those pieces, only leaving healthy tissue. After dipping the coral and removing lost tissue, place the coral back into the tank, and put in an area of higher flow to help facilitate healing.

Another ciliate that has the potential to be devastating to a reef tank is the “barrel bug”, named after is barrel like shape and corkscrew like swimming pattern (Carl, unpubl. data). This ciliate has not been identified, and has been seen infrequently. This animal is fairly large and can be seen as white specks with the naked eye. As it consumes the corals, a web like material encompasses the coral. Once the consortium is present, it can consume all coral tissue very rapidly. It was observed to consume a 9 cm long *Acropora* in a little over one hour. It is easy to spot in tanks with low flow, as the web becomes quite evident, however, in tanks with high flow it might be more difficult to spot. In tanks with high flow, a rapid, random loss of tissue might point to this predator. Quick action must be taken to stop an infestation. Remove all effected corals, clip off all areas consumed and follow dipping procedures as outlined for brown jelly. It may also help to move the coral to a different system, but there is also always the chance of spreading it to another tank.

II. CORAL PESTS

The next group of animals is placed in the “pest” category. These nuisance species can hamper your coral growth, coloration and overall general health, but rarely leads directly to mortality.

RED BUGS

Red Bugs (*Tegastes acroporanus*) have become a global pest species in captivity over the last five years. These copepods have quickly spread across the *Acropora* sp. keeping world as reefers fragment and swap species freely amongst each other. These “bugs” act as an irritant to *Acropora* (only known genus they live on) coral, much like fleas or ticks on mammals. Since they have direct development, they can

spread fairly quickly. They rarely lead to the death of the coral, but impede growth and polyp extension and can lead to mortality in severe infestations. A coral that starts to lose growth tips, coloration and polyp extension should be searched thoroughly for these pests. A magnifying glass is useful to look over the coral with, as the little yellow copepods with a red dot on their abdomen are then easily seen.

Once an infestation of red bugs has been confirmed, a plan of action is now in order. Some have done nothing and their corals continue to survive. Another course of action is trying biological controls. The usual course of small wrasses, pipefish and symbiotic coral crabs (*Trapezia* sp.) can be tried. If this course of action is tried, be aware that these copepod predators may keep the numbers in check, but will most likely not eliminate all of them. Because of this, the corals should not be traded or swapped with others. The best way of treating *Tegastes* is using the heartworm drug Interceptor for large dogs (Milbemycin oxide). The most effective treatment is to use 1 tablet of Interceptor for large dogs per 1,436 liters of water (23 mg Milbemycin oxide per 1,436 L or 0.016 $mg.L^{-1}$), and add to the tank for five to seven hours. The corals can either be treated in the exhibit system or separately. If treating an exhibit, keep in mind that other crustaceans may be lost during the treatment. Try to remove ornamental crabs and shrimps to avoid losses during the treatment. After the treatment is finished, a small water change and carbon can be added to the system.

The number of treatments can vary from a one time treatment to twice per week for three weeks (six treatments). At the Omaha Zoo both display and propagation systems were first treated with a one time treatment. After a few months, the copepods made a return. The systems were then treated once per week for three weeks (three treatments) and again, they were not eliminated. It was then decided to try the twice per week for three weeks treatment. The copepods were eliminated and have not returned.

As stated earlier, the treatment is fairly benign to corals, but it will affect any animal that has a chitin-based shell such as crab, shrimp and various sand fauna. An attempt should be made to remove symbiotic crabs and ornamental shrimp from the tank before treating. After the end of the treatment, it might be necessary to reintroduce some live sand to get the sand fauna population reestablished.

NUISANCE FLATWORMS

Though nowhere near the destructive level of the Acropora eating flatworm, there are various flatworms that can be anything from an eyesore, to a bother for your corals. The most common flatworms encountered are a brownish to a rusty coloration and fairly small (1-3 mm) and another that is slightly larger (3-5 mm) and yellowish with a red dot and ones that are clear. Most of these belong to the genus *Convolutriloba*, however, many different species can be found in reef aquaria. These flatworms are relatively benign in small numbers, though in large numbers they can overrun corals and shield the corals from getting any light. These pests most often will congregate in areas of low flow and accumulated detritus.

There are various ways to deal with these types of flatworms. The first thing to do is to increase flow, eliminate areas of detritus and siphon out as many as you can. When the numbers are brought down to a more manageable level, various predators can be added to the tank. Successful treatment includes the use of *Halichoeres* sp., *Pseudocheilinus* sp. and the dragonets *Synchiropus* sp.. If these methods fail, chemical treatment is possible. Using a lower dose of levamisole hydrochloride has proven effective. A dosage of 4 $mg.L^{-1}$ is applied and left in the tank for 10-30 minutes. Once the drug is placed in the water, the flatworms should immediately begin to lose adhesion and float around the tank. After the dosage period, carbon and a large water change can be performed. Keep in mind that once these flatworms begin to die, they can release toxins that are quite harmful to fish. Make sure that as many flatworms are manually eliminated from the tank before any kind of treatment. Also check the backsides of rocks, in the rocks and under rocks for large pockets of flatworms and siphon out accordingly. A commercial product by Salifert called Flatworm Exit has been shown to be effective. Again, manually eliminate as many as possible first, then follow the directions of the manufacturer.

OTHER PESTS

Another potential pests that will invariably show up in any tank are the various types of Polychaetes worms. Bristleworms are ubiquitous worms that are in nearly all reef systems. A vast majority of bristleworms are

harmless detritivores that are great additions to a reef tank. They take care of uneaten food and keep the sand stirred and aerated and also provide a great source of food for corals with their spawning and production of subsequent larvae.

Though a vast majority of bristleworms are harmless, there is one species to be wary of. This large Fireworms (*Hermodice carunculata*) can and will eat corals and other reef animals. These Fireworms are usually much larger than their helpful cousins. To be on the safe side, if a worm is seen longer than 9cm and thicker than a pencil and especially if they have a squareish head, it is best to remove them. They can usually be caught at night, or enticed out of their lair with food. Make sure they are almost all the way out of their home, as they can retreat quickly and are very had to remove from inside a rock.

Urchins are most often a helpful addition to a reef system. They will eat many of the algae that other reef herbivores will not. Though urchins are usually a benefit, if they run out of their preferred food, they can turn to other more desirable organisms of the tank. They can consume coralline algae, sea stars, various corals and anything else they can get their mouths on. Diadema and Pencil urchins have been the most notorious for occasionally eating what they are not supposed to. If an urchin is found eating something desirable, first try to supplement their diet with Nori or other dried algae. If they continue to eat desirable organisms, remove and place in another system with organisms they cannot catch and eat.

One thing that is not often thought of as a pest in reef tanks is the different coral that are added. Most corals have a both an offense and a defense for staking out it's territory and moving in on others. Some corals are much more aggressive than others in this quest for space. Depending on what the goal is for the system, be careful of the organisms that you add. Corals such as zoanthids, star polyps, mushrooms and *Xenia* sp. can end up spreading rapidly throughout the systems and taking space from more valuable corals. There are also many corals with extremely long sweeper tentacles that can quickly wipe out anything they contact. *Euphyllia* sp.*, Galaxea* sp.*, Plerogyra* sp. and various "Brain" corals should be added and placed with caution with plenty of allowance for their long, aggressive sweepers.

The last pest that every reef keeper has dealt with, are the different varieties of anemones. The most infamous of these are the glass anemone in the genus *Aiptasia*. These animals can thrive in almost any condition and can reproduce at an amazing rate, especially in tanks that are fed well. They have a powerful sting and can outcompete corals. Removal should begin as soon as possible once they are spotted. If the rock they are on is easily removed, take out the rock and using a knife, scrape under the anemone, removing both it and a couple millimeters of the rock it is attached to. A number of chemicals have been developed to deal with these pests. Though many of them have been tried (Muriatic acid, Joe's Juice, kalkwasser etc.) not much success has been had. The adult anemone is usually killed, but many of the small pedal lacerates are left to grow into new anemones. The best success is generally found in biological controls such as Copperband butterflies (*Chelmon rostratus*), Raccoon butterflies (*Chaetodon lunula*) or Peppermint Shrimp (*Lysmata wurdemanni*). These animals have been used for years with good success. Of course with any animal, they often do not all act the same. While most of these predators will act accordingly, some either will not eat the anemones, or proceed to eat everything else. The Copperband is more reef safe than the Raccoon, but can eat various worms. The Raccoon tends to pick on fleshy corals, but it is a great addition to a tank dominated by *Acropora* sp.*, Montipora* sp. and the like. Peppermint shrimp tend to be less harmful, but quite a few needed to be added to make a difference. One downside to adding a predator is that the anemones tend to just pull in the rock to avoid being eaten. They can stay this way for years and when the threat is removed, pop back out and resume being a nuisance. Another recent addition, is the Berghia nudibranch. These nudibranchs eat only Aiptasia anemones and are quite good at it. They are often hard to come buy and hard to get established. If done right, they can permanently eliminate all the anemones in short order.

The other pest anemone that is often encountered is the Majano anemone (*Anemonia majano*). This anemone is not quite as bad as the Aiptasia, but still can become a nuisance after a bit. Manual removal of this anemone is much easier as it does not tend to leave bits of tissue behind like the Glass Anemone. It is also much easier to kill with chemicals as it tends to quickly let go of the surface and become easy to remove. The one thing that is more difficult,

is a biological removal. Not many animals tend to go after them. Peppermint shrimp in high numbers, Raccoon butterflies and the False Saddle Butterfly (*Chaetodon ulietensis*) all have been reported to feed on these anemones.

III. STRESS RELATED SYNDROMES

Two types of coral loss often associated with stress are Rapid Tissue Necrosis (RTN) and Slow Tissue Necrosis (STN). Both types of tissue loss usually occur from the base of the coral and progress upwards. The main difference between the two is the speed of which it occurs. RTN is a quick acting malady that can kill a coral in a few hours to a few days. It is usually associated with some type of stress event, however, corals that have been doing well in a stable environment can also be affected. STN is a slow progression that can take weeks to months to kill off a colony of coral. Both of these conditions have been linked to bacterial infections, but nothing has been conclusively proven. In the case of RTN, the coral should be quickly fragged and moved to a different location. Try to frag the coral at least 5 mm into good healthy tissue. STN can be caused by a variety of reasons, one of which is environmental conditions. The coral is not doing well and is slowly dying from lack of light, current, food etc. Try placing the coral in different locations and increasing food to the coral.

This paper is by no means an exhaustive review of all the predators and pests of captive corals, but merely a review of ones that the author has direct experience with. There are many more predators and pests popping up all the time as corals are being brought in, in record numbers and from many more locations. With the popularity of swapping fragments of coral, these animals can spread quite quickly throughout the coral keeping community.

The best way to keep your corals safe is through effective quarantining measures. All corals should be placed in a quarantine tank for a minimum of two weeks. During this time, careful observation of the coral and preventative dips can be performed. Base your quarantine procedures on what you know about the coral in question. If *Acropora* corals are brought in, an Interceptor treatment and a dip for flatworms should be in order. If *Montipora* sp. is brought in an exhaustive check for nudibranchs, followed by a dip in Levamisole or a commercial dip, is in order. Each facility can come up with their own quarantining policy and procedures, but the days of getting new corals and placing them directly into our display systems should be over.