Dinoflagellates in a saltwater aquarium –

a plague in detail

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Dinoflagellates

Dinoflagellates are not in principle a pest. Most species are even important components of the reef's biocoenosis. Zooxanthellate corals harbour dinoflagellates (*Symbiodium spp.*) in their tissue. Also a large part of the phytoplankton consists of dinoflagellates.

Dinoflagellates are not real algae, but neither are bacteria. They represent an independent group that does not belong to the three kingdoms of animals (Animalia), plants (Plantae) or fungi (Fungi). Today about 2,400 different types of dinoflagellates are known.

Dinoflagellates are characterized by two extensions („flagella"), which allow them to rotate in water. This typical rotational movement is caused by the right-angled arrangement of these two beating cilia. Only few dinoflagellate genera are immobile. These include, for example, the coral symbionts of the genus *Symbiodinium*.

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Dinoflagellates are found in every marine aquarium, especially if corals are present. The vast majority of dinoflagellates are useful to important in the aquarium, and only a few species cause problems through mass propagation. These include in particular species of the two genera *Ostreopsis* and *Gambierdiscus*.

In a biologically well matured reef tank, whose water values are in a reasonable relation to each other, dinoflagellate mass reproductions rarely occur. Even if you inoculate such an aquarium with the dinoflagellate, e.g. by inserting a coral carrying Dinos on the substrate rock, you would hardly trigger any reproduction.

A dino mass propagation is particularly faciliated when the biological balance in the aquarium is disturbed, because some dinoflagellate species can then reproduce uncontrolled. But even if this happens, it only becomes problematic if the dinoflagellate species in question has the ability to produce toxins. This is for example the case with the genera *Ostreopsis* and *Gambierdiscus*, but also with *Phacus* and *Protocentrum*. A massive infestation with such dinoflagellates can lead to the loss of the entire aquarium inhabitants.

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Genus determination of dinoflagellates

With a microscope you can determine the genus of your dinoflagellates. Other dinoflagellate genera can be distinguished from golden algae (*Gambierdiscus spp.*) by their flattened pole and a highly refractive cell wall. Under the microscope you can also observe that the dinoflagellates move like scooters, although some dinoflagellate genera are motionless under the microscope.

In addition to the toxic dinoflagellate genera, dinoflagellates, which are ejected zooxanthellae from the corals, have increasingly been found in reef aquaria in recent years. You can recognize those types by the fact that there is no rapid colonization of free areas, those dinoflagellates do not produce a strong, chemically effective smell and no invertebrates such as snails die.

To understand dinoflagellates, it helps to divide them into two groups. However, this representation of the dinoflagellates in two groups is a strong simplification; in fact, the world of dinoflagellates is much more complex, and there are also hybrids of groups and intermediate stages. For the sake of simplicity, however, let us stick to this method of representation.

1. Autotrophic dinoflagellates

The term „autotrophic“ stands for „self-nourishing“. Autotrophic dinoflagellates are able to produce their own food from inorganic carbon sources and do not need to ingest other living organisms or bacteria. Most plants and algae are autotrophic organisms.

These dinoflagellates are photosynthetic organisms that are able to produce their own food, even when their bodies contain hardly any nitrogen and inorganic phosphate. Their advantage is not only their ability to reproduce rapidly but also in their enormous resistance to extreme situations. If the conditions for these dinoflagellates are suitable, they can propagate enormously, forming slimy deposits on all surfaces, which often form gas bubbles due to oxygen accumulation and cover the entire decoration.

Their nutrient requirements are so low that it is almost impossible to starve them out through nutrient scarcity. Whatever gets into the water from depotsits is sufficient for them.

These dinoflagellates have chloroplasts that enable them to synthesize their food even under extreme light deficiency. Some species can form so-called plastids, cysts that survive for a long time even in complete darkness, so it would not even help us to completely darken our aquarium for months. As soon as the light is available again and the ambient conditions are suitable, they start to propagate again.

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Most of the problematic dinoflagellate genera, however, have a feature that enables them to be effectively controlled if the lever is applied precisely there. With sufficient light intensity, they settle on all solid surfaces, starting with those with the strongest nutrient deposits. Usually this is the bottom gravel. Adhesion is caused by a mucus secretion that also surrounds and protects them. However, when it becomes permanently dark, these dinoflagellates enter a planktonic life phase: they begin to dissolve the slimy secretion and move into open water. Here they can then be detected by an effective UV-C sterilizer.

However, this requires a dark phase of two to three days. For corals this is usually no problem. This effect can be further enhanced by changing the spectral light composition to higher Kelvin values, i.e. increasing the amount of blue radiation and reducing that of other, longer-wave radiation.

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Characteristics of a dinoflagellate infection

You can recognize a dinoflagellate infection by the following signs:

- Brown to gold-coloured coverings on illuminated surfaces with strong water currents
- Snails and other invertebrates avoid those surfaces and hesitate to feed on it
- Increased mortality of snails, hermits and sea urchins
- nervous behaviour of some fish
- significant pH decrease during the dark phase at night

The room smell also changes; it smells dull and chemical, and even the water appears dull and dark. Corals contract their polyps and are sensitive to light.

2. heterotrophic dinoflagellates

The term „heterotrophic“ stands for „heterogenous feeding“. Heterotrophic dinoflagellates must absorb organic nutrients, bacteria or other algae in order to feed.

Usually these species do not pose a problem in the aquarium. There are also some species that in turn eat dinoflagellates, thus providing a population control for other genera. However, such dinoflagellates are limited to a few species and they do not usually reach high population densities.

Causes and initial measures

As a first measure in the case of a suspected dinoflagellate infestation, this diagnosis should first be confirmed. You need to clarify whether it is really a dinoflagellate infestation.

As a next step you should try to determine the genus and exclude other algae such as diatoms (diatoms) or cyanobacteria.

After making the diagnosis, you should definitely perform an ICP analysis.
Usually the corresponding shift in the nutrient or halogen levels that favoured the outbreak is already apparent here.

Supporting measures

- Siphon out the deposits and replace the water with fresh seawater.
- Raise the temperature to 28-29 °C.
- Switch off the light completely for three days, even above a possible refugium.
- Install a powerful UV-C sterilizer directly at the aquarium, with a capacity of 10 watts per 100 l (26 US gal) aquarium volume.
- Reduce the skimming
- Install a CO_2 air filter for the skimmer intake air to increase the pH value.
- Make sure that activated carbon and ozone are installed in the system.
- Stop any dosage of carbons and amino acid supplements.
- Add some fresh pieces of live rock to the tank (approx. 1 kg/100 l (26 US gal) of tank volume).

Often this is already sufficient to stop a mass reproduction.

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Combating the underlying causes

To eliminate the causes, please check the following:

Pay attention to the ratio between iodine/flour and bromide.

These substances are inhibitors, and a deficiency or disturbed relation between the concentrations of these elements facilitates the mass reproduction of dinoflagellates.

Pay attention to a nutrient ratio of 1:100 nitrate/phosphate

and avoid nutrient limitations if the amount of Dynamic Elements is too low.
Zinc and molybdenum are particularly important here.

Pay attention to the illumination level.

Often, blue spectral wavelenghts is mentioned as the reason for dinoflagellate infestation. This is not correct from this point of view. It is rather the case that blue light has a high energy output, which represents radiation stress. The resulting lack of regulating fatty acids and minerals (potassium/zinc/molybdenum) leads to the ejection of the zooxanthellae (brightening of corals). Under certain circumstances these emitted zooxanthellae can form coatings on illuminated surfaces and continue to reproduce here.

Treatment with RED X / DINO X

Put simply, the two products RED X and DINO X are suitable for eliminating dinoflagellates. Success, however, requires that the respective causes are identified and eliminated.

RED X is suitable for the use of beginning dinoflagellate mass reproduction with genera such as released zooxanthellae of corals (Symbiodinium) and supports combating autotrophic and toxin-producing species.

DINO X is suitable for the treatment of strong and continuous mass propagation where previous measures have not been successful. Depending on the genus of dinoflagellates, the duration of application may vary, and a second dosing cycle may be necessary.

Pay attention to the dosing instructions in the HTU DINO 1

DINO X contains an active ingredient that has been used in
marine aquaria for more than 25 years, and with the greatest success.
DINO X/RED X is officially registered and notified as a biocide.
You will find the approval number on the package.

The unique composition, specially designed for seawater application, is highly effective. Therefore, you should only use these preparations if you have made sure that the cause of your aquarium problem is actually a dinoflagellate mass reproduction.

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