DISEASE PREVENTION AND CONTROL:

Diseases of marine fishes have been the subject of a number of books and articles. This is a specialized subject and will not be discussed here in detail. The aquarist is referred to other works, some of which are included in the "List of Readings" if suspicion of a disease problem exists. However, a few general remarks will be made about disease as it applies to marine aquariums.

Far less is known about the disease of marine fishes than about those of most freshwater fishes. There are few fish diseases that can be recognized without sophisticated laboratory equipment, but most require scientifically trained personnel and a battery of microscopes, staining equipment, glassware, and even electronic equipment. Certain diseases and disorders such as internal tumors, functional disorders, and organ degeneration are incurable and it is best to eliminate the fish rather than wasting time and money trying to save it.

Disease diagnosis is an involved and complex subject, but these few suggestions will help you identify if there is a problem that needs to be treated:

1. Determine that a problem exists
2. Identify the source of the distress or disease
3. Refer to an appropriate text for treatment

First, to determine that a problem exists, it behooves the aquarist to really look at the fish daily, observing them at various times of the day, but most especially during the feeding time. Make it a point to observe the fish carefully when the fish is healthy. Notice the smoothness of the epidermis, no ragged fins or tail, clear eyes, and the brightness of the coloration and pattern. Color changes and pattern changes may not always indicate a problem exists. Colors of some species, e.g., rock beauties, royal grammas and some angelfish, fade after they are in an aquarium for a few months. Also color changes may
appear due to reproductive activity, aggression and feeding, but usually disappears within minutes after the associate activity disappears. Color changes may occur in species, e.g., wrasses and angelfishes, as they mature. But color changes that occur suddenly and do not return to the normal brightness within a day or two, the aquarist should suspect that this is related to some problem or disease.

Pay attention to behavior patterns, as well as the physical appearance of the organisms. This is one of the best indicators of disease. Notice listlessness, not feeding, rubbing against the rocks or coral, disruption of normal swimming pattern, trouble maintaining balance, and timidness in an otherwise bold or aggressive fish. Some species have a tendency to jump out of aquariums apparently as a response to bad water quality that agitates the respiratory organs. Some species of fish, e.g., wrasses and tangs, are more susceptible to poor water quality than others.

Second, to identify the source of disease or distress, may be more difficult than merely observing the behavior and physical condition of the fish. Most diseases are caused either by bacteria or parasites, the remainder by a fungi or virus. Fish often become sick as a result of direct contact with a diseased fish or through the addition of bacteria or parasites via the water of shipping bags in which they are purchased, via the water in which they are caught, or the water which is used to make the monthly water change. Bacteria can enter the tank through air or even from a person's hands when he feeds the fish or cleans the tank. Bacteria and parasites are always present in a tank in some form and quantity. Why, then, do some fish get sick and others do not? Fish often simply get sick when stressed.

Stress is any external influence that can weaken a fish's resistance to disease. Stress can take the form of a sudden change in temperature, pH, ammonia levels, sudden changes in lighting, or other environmental conditions. These stresses reduces the fish's resistance to disease; thus changes in a tank should be made gradually. The various sources of physiological and psychological stress which animals endure after their capture is a primary agent in disease contraction.
There are several questions the aquarist may seek to answer in order to locate the source of stress and its potential for generating conditions suitable for disease in the aquarium.

(1) Does the fish have adequate shelter; adequate escape routes and areas from stressful situations occurring within the aquarium? Territorial disputes, competition for food, movement in, or around, the aquarium, irregular lighting patterns, and loud sounds or tapping the glass of the aquarium itself, all produce a high level of stress for the fish. The fish's psychological response to these situations is to "fight or flee". Since, usually fleeing is the only solution to these situations, the fish must have adequate shelter in which to hide. Many different secure, dark places can be provided in the aquarium through the use of rock or coral caves or overturned large shells. Providing adequate shelter cannot be stressed too much.

(2) When was the last water change and filter cleaning? A ten-percent (10%) water change on a weekly basis, would be ideal, but a twenty-five (25%) water change on a monthly basis is usually adequate. Keeping records of the cleaning procedures will easily facilitate the aquarist in determining if this is the problem.

(3) What are the current nitrite levels and specific gravity levels? High nitrite levels (more than 5 PPM) indicates that excess waste products have accumulated in the tank. A water change is due and perhaps a partial cleaning of the substrate medium. The specific gravity, if high (above 1.028) will cause gill irritation and other physical stresses on the metabolic system. High specific gravity occurs when the evaporating water leaves behind a higher concentration of salts in the remaining tank water. Periodic additions of FRESH water to the tank will prevent this problem. Lowering the specific gravity to 1.021 for a few weeks will greatly alleviate metabolic stresses on the fish and will allow them to use their energy to rebuild their health.

(3) Any recent introductions, such as ornaments, chemicals, fish, or "live rock", to the aquarium? The ornaments or decorations contain metallic parts or paint which is lead based; thereby being released
into the water producing a toxic quality to the aquarium. Chemicals, either added to the tank, such as medication in the form of copper sulfate, or accidently introduced into the tank (including paint or smoke fumes), can also pollute the quality of the water. The beautiful pieces of "live rock", replete with sponges, hydroids, or algae growing on it, which can add so much beauty to the tank, can also "add" some unwanted bacteria or parasites to the aquarium.

(4) Is stress being caused by an overly aggressive tank mate? If this is occurring, the more timid fish, will not be able to feed adequately to survive and the constant stress of fleeing from the bully, will further the psychological stress.

(5) Has the fish been feeding well? Is it receiving an adequate and nutritional diet? Many fish will not eat if harrassed by more aggressive tank mates, food size may be too large for mouth size, food type may not be familiar to fish, boredom with same type of food, slow eater in competition with more aggressive feeders, and food provided that does not fit the needs of the fish.

Is the fish primarily a herbivore but is being fed a carnivore diet? The aquarist should understand the nutritional needs of the fish in the aquarium. Since most aquariums contain communities of a mixed nature, a single food source is usually not adequate to serve all needs to all fishes. There are however, combinations of foods, either used singly or on a rotating basis, or a combination of foods prepared in a mixture which can provide most of the nutrients required by most fish and invertebrates. See section on "Recommended Foods for Marine Organisms".

The various sources of physical and psychological stress which may affect an organism and leave it prone to disease, may be corrected by attention to the above factors. The determination that a problem exists, the identification and correction of the problem, does not always necessarily mean that the fish are infected by bacterial or parasitic disease. Since many conditions can cause fish to appear ill, the immediate use of remedies and medicines may only serve to complicate the situation. Most aquarium remedies are very effective in killing bacteria as well as the pathogenic (disease-causing) bacteria.
If visible signs of infection are present, appropriate treatment can be started. It is at this point that the aquarist should refer to the various treatments for diseases described in many of the texts in the "List of Readings".

WATER QUALITY:

The major changes occurring in the aquarium water in the presence of animals and plants result from bacterial decomposition in nitrogenous organic compounds. These substances are present in the shape of proteins and breakdown products of proteins released by the metabolic processes of plants and animals. All of these compounds must undergo rapid bacterial decomposition if the water is to remain a healthy environment. The nitrobacter bacteria living in the substrate medium (the biological filter) of the aquarium, can accomplish this to a remarkable degree, but periodic water changes still must be made to assure high water quality. To maintain a healthy aquarium, these changes, in addition to specific gravity, pH and temperature must be monitored.

Specific Gravity

Specific gravity is a comparison (ratio) of the weight (density) of a substance, to the weight of an equal volume of pure distilled water. Salt water, which contains dissolved salts, has a greater density (i.e., is heavier) than pure distilled water. To measure specific gravity, the buoyancy of a hydrometer floated in the aquarium, is used to determine how much salt is in the water; the salinity of the aquarium.

Evaporation causes constant increases in the total salinity since only pure water evaporates and the salts are left behind. The higher the salinity, the less oxygen the water can hold. Increased salinity also places fish under stress by making their body processes work harder, weakens them and results in their becoming more susceptible to diseases.

The rate at which water evaporates varies with a number of factors, the most important being the dryness of the air in the room which houses the aquarium. In air conditioned rooms the rate of evaporation is also fast since the air is very dry. A drop in water level must be compensated as soon as possible with pure fresh water, not salt water.
The specific gravity of a marine aquarium does not have to be a constant value; it can have a range of 1.024 to 1.021, with no harmful effects upon the fish. It is only the sudden changes in salinity or the higher salinities over a long period of time (two or more weeks) that can cause problems.

The range in specific gravity can be attributed to either evaporation of the water or to the temperature of the water itself. The hydrometer floated in the aquarium will sink deeper in warm water than in cold water. This is because the molecules of warm water are further apart than colder water; the warm water is less dense than cold water.

Here is a list of numbers to remember when measuring the specific gravity of the aquarium:

<table>
<thead>
<tr>
<th>Specific Gravity</th>
<th>Temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.024</td>
<td>66-71°F</td>
</tr>
<tr>
<td>1.023</td>
<td>72-77</td>
</tr>
<tr>
<td>1.022</td>
<td>78-82</td>
</tr>
<tr>
<td>1.021</td>
<td>83-86</td>
</tr>
</tbody>
</table>

Specific Gravity in the MOP Aquariums:

**Lounge Area**

Specific gravity in this area was relatively constant at 1.022 – 1.024. Temperature varied between the lows at nighttime (Hawaii's "winter") at 60°F to highs at daytime of 86°F.

**MOP Office**

This aquarium fluctuated in specific gravity more frequently due to the air conditioning system in this small area. The dry air, and subsequently cooler temperatures, accelerated the evaporation process often leading to a specific gravity high of 1.024 to 1.027.

**pH**

pH is a measure of acidity and alkalinity expressed on a scale of 1 through 14 with 1 being the most acid, 7 neutral, and 14 the most alkaline. The symbol pH stands for the "power of hydrogen" and the H is
capitalized because it represents the chemical symbol for the element hydrogen. An acid condition is caused by an excess of the positively charged hydrogen ions and the alkaline condition is caused by an excess of the negatively charged hydroxyl ions. When there is an equal number of each, the solution is neutral.

The acceptable pH range for a marine aquarium is 7.6 to 8.3 and most fall between 7.8 and 8.1. Freshwater fish, by contrast, require a somewhat lowered pH of 6.8 to 8.4 range.

One can be a successful marine aquarist without ever taking a pH reading. Changes in the acidity of the water (pH) which lead to harmful consequences usually are not a problem in an aquarium set up and maintained properly. However, the pH of an aquarium is a good indicator of the quality of the water. Inexpensive kits are available for measuring the pH using a liquid with a pH color-sensitive indicator. It is important to test for pH primarily, if (1) you do not change a percentage of water regularly and (2) use activated carbon to maintain water clarity. If the water is filtered with activated carbon, a fall in pH may occur (to below 7.5) without the aquarist noticing it until it is too late to save the fish suffering from excess acidity in the aquarium water.

The consistent trend in marine aquariums is always toward a lower pH. Sea water has considerable natural buffering capacity, however, the biological activity of the filter and the animals eventually overcomes this built-in buffer and the pH begins to drop. The decline is hastened by overcrowding, accumulation of dissolved organic, heavy detritus accumulation, and lack of exposed calcareous material.

The high calcium content of coral sand and coral heads used in most marine aquariums results in the strong buffering needed to provide the proper environment for marine fishes. Calcium carbonate and magnesium compounds are released from the coral and coral sand by the dissolving action of carbonic acid in the water. In this way, coral regulates the pH of the water, quite effectively unless there is a very heavy accumulation of detritus on the coral sand and coral in the tank.

Although the trend is always toward a lowered pH, once in a while, however, pH can rise above the acceptable range of 8.3. This can be caused by excess algal production and growth. The excess algal growth
will increase the oxygen content of the tank, but may be harmful to the animals. Algal blooms can clog the gills of fish and cause death due to suffocation.

To adjust the pH in the tank, buffers can be added. Caution is prudent here, as buffers should be added very slowly; over a period of seven to ten days is recommended. Abrupt changes cause stress and disease.

To increase pH:

Dissolve 1 teaspoon sodium bicarbonate (baking soda) for each 20 gallons in a cup of water from the tank and slowly add solution to tank. Wait one day for thorough mixing, test again and repeat process until pH is up to 8.0.

To decrease pH:

Remove the excess algal growth from the tank; scraping it from the glass walls on one day and later removing some of the coral and brushing it free of excess algae. This should be done slowly, over a number of days to reduce stress on the fish. A partial water change should also be made at this time.

pH in the MOP aquariums:

pH was not measured in the MOP aquariums because partial water changes were done on a monthly basis and periodic cleaning of the coral sand was done to remove detritus accumulation. In addition, the MOP aquariums were well stocked with many large pieces of coral heads and coral-rock conglomerates. This assisted in the release of sufficient calcium as a buffering agent.

RECOMMENDED FOODS FOR MARINE ORGANISMS:

Metabolism is the sum of the processes whereby body tissues are built up and broken down. Fishes, like all other living creatures, require the proper foods in order to carry out metabolic functions. Carbohydrates, proteins and fats, as well as minerals and vitamins, must be present and in the correct proportion in the diet if metabolism is to proceed properly. Proper nutrition is essential if the fishes are to
survive in a healthy manner. If fish are lacking in these elements, deficiency symptoms, and in many cases death, will result.

Chances are that a varied diet will prevent any deficiencies and, in addition, will prevent the fish from becoming conditioned to only kind of food. Many kinds of food suitable for fishes are available commercially. The aquarist can try such food as dried flake food, which provide quite a varied diet which may include items as crab, fish, mussel, seaweed, and many other organism. Dried food with a wide number of dietary items actually is nearly sufficient to meet all the requirements of most marine fishes. The supplement of live fresh food could complete the various specialized requirements for ideal nutrition of select fishes.

Fish with broad, unspecialized dietary requirements usually adapt most easily to the foods and conditions of captivity. In the wild the diets of many species of fishes are so specialized that even closely related species can live side by side on the reef without fighting over food. Even specialists, however, will snap up other tidbits that come their way. Most can be trained to accept a more varied and diverse diet in the aquarium. The few fish that refuse to accept more than one type of food will be the most trouble to care for in the aquarium. The omnivores, those which eat a variety of plant and animal matter are the least trouble to meet the nutritional requirements. The following is a list of animals and their generalized feeding requirements:

<table>
<thead>
<tr>
<th>STRICT CARNIVORES</th>
<th>STRICT HERBIVORES</th>
</tr>
</thead>
<tbody>
<tr>
<td>scorpionfish</td>
<td>some parrot fish</td>
</tr>
<tr>
<td>anglerfish</td>
<td>some surgeonfish</td>
</tr>
<tr>
<td>lionfish</td>
<td></td>
</tr>
<tr>
<td>grouper</td>
<td></td>
</tr>
<tr>
<td>frogfish</td>
<td></td>
</tr>
<tr>
<td>moray eel</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>OMNIVORES</th>
<th>INTERMEDIATES</th>
<th>PRIMARILY ANIMAL EATERS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primarily plant eaters</td>
<td>Intermediate tings</td>
<td>Primarily animal eaters</td>
</tr>
<tr>
<td>tangs</td>
<td>clownfish</td>
<td>hawkfish</td>
</tr>
<tr>
<td>filefish</td>
<td>damselfish</td>
<td>- likes live food</td>
</tr>
<tr>
<td></td>
<td>gobies</td>
<td>Moorish idols</td>
</tr>
<tr>
<td></td>
<td>wrasses</td>
<td>- needs live crustaceans</td>
</tr>
<tr>
<td>Intermediates</td>
<td>Primarily animal eaters</td>
<td></td>
</tr>
<tr>
<td>---------------</td>
<td>------------------------</td>
<td></td>
</tr>
<tr>
<td>sweetlips</td>
<td>soldierfish</td>
<td></td>
</tr>
<tr>
<td>blennies</td>
<td>squirreletfish</td>
<td></td>
</tr>
<tr>
<td>basslets (grammas)</td>
<td>snappers</td>
<td></td>
</tr>
<tr>
<td>Heniochus sp.</td>
<td>triggerfish</td>
<td></td>
</tr>
<tr>
<td>Emperiorfish (Pygop-lites diacanthus)</td>
<td>cardinalfish</td>
<td></td>
</tr>
</tbody>
</table>

The predatory fish such as, scorpionfish, groupers, surgeonfish, parrotfish, hawkfish, basses, wrasses, and anglerfishes, which live near the bottom, do not be to fed as often as the other fish. Once every three days is usually sufficient for these sedentary fish. This is the rule, unless these are juveniles are are new intros to the tank. It is important that these categories of fish begin to eat frequently in order to assure their survivability.

The following list will give a generalized overview of the nutritional requirements for the types of fishes found in most aquariums:

**Foods for Carnivores**

- live feed/fodder fish
  - such as: freshwater minnows, guppies or mollies

- fish fillet pieces
  - white fish is best as red fish contains too much fat and oil which may foul the water and the circulation system

- pieces of beef heart, mussels, shrimp and crabmeat or scallops
  - mussel meat may slightly cooked in order to prevent fouling of the water
  - shrimp, crab and scallops may be frozen fresh and then grated before feeding

**Foods for Herbivores (and Omnivores)**

Seaweeds: Place in aquarium after rinsing thoroughly in fresh water
Species recommended:

- Caulerpa
- Ulva
- Rypnea
- Dictyota
- Sargassum

Dried Pacific Kelp
- found in health food stores

Spinich and lettuce
- thoroughly rinsed in fresh water to remove all pesticides

Oatmeal
- first soaked in water

Food for Intermediates

- Small crustaceans
  - tiny crabs, shrimps, clams
  - Note: especially important for butterflyfish and angelfish

Live coral
- Pocillopora sp.
  - Note: especially important for parrotfish, some angelfish

Chopped mealworms

Tubifex worms
- must be kept in running water for at least 24 hours for flushing of their internal systems (otherwise may contain pathogenic bacteria)

Mysis

Artemia (brine shrimp)
- comes in live or frozen form. Both should be thoroughly rinsed in freshwater before feeding to fish.

Gel Mix
- basic diet which will keep most fish (except those which are strictly carnivores) well fed and nutritionally satisfied. The recipe that follows is recommended by the Waikiki Aquarium.
Gel Mix diet for the Home Aquarist:

1) Chop and weigh:
   a) 2 T or 1 oz. or 30 gm, koi pellets or trout meal
   b) 4 T or 2 oz. or 40 gm, smel or herring (avoid oily fishes)
   c) 2 T or 1 oz. or 30 gm, squid
   d) 2 T or 1 oz. or 30 gm, spinach
   e) 4 T or 2 oz. or 40 gm, grated carrot
   f) 1 small portion seaweed (fresh or dried)

2) Place chopped ingredients in 48 oz, blender or food processor.
   a) Add 1 tsp. liquid vitamins (baby unflavored vitamins)
   b) Add 2/3 cup very hot water
   c) Add 1 2/3 oz. or 50 gm, or 10 heaping tsp. Knox gelatin
   d) Add sprinkle of dried Brewer's yeast

   Blend all ingredients until smooth

3) Pour mixture into 13 X 9" baking pan (preferable glass) and refrigerate for 2 hours. After the mixture has set, cut it into smaller blocks, wrap tightly in foil and freeze.

4) Remove gelatin from freezer for daily feeding, let thaw to room temperature prior to use.

5) This recipe makes about 2 pounds of gelatin mix.
AQUARIUM CAPACITY AND NUMBERS OF FISH:

The question of how many fish an aquarium can hold has no single correct answer. The factors are diverse and numerous: (1) the kind, size and numbers of fish; (2) the size of the aquarium; (3) the efficiency of the filtration system; (4) the capacity of the biological filter and; (5) the efficiency of the feeding procedures. With so many variables, it is difficult to lay down any hard and fast rules. To remain on the safe and certainly very conservative side, the aquarist should figure on one inch of fish for every two inches of biological filter and/or every two gallons of water. By far, the size of the biological filter is more important than gallon capacity of the aquarium. In two aquariums of the same gallon capacity, the one with the larger filter bed will have a greater capacity of metabolizing the waste materials of the fish. It will, of course, contain more area for the nitrifying bacteria to live and to perform their function in the aquarium.

For the beginning aquarist, being conservative in the number of fish kept in the aquarium is the best choice. For the more advanced aquarist, more fish may be added to the aquarium, but very close monitoring of the water quality and the fish behavior should be done. Water changes definitively have to be made more frequently; perhaps 10% per week would be a wise decision. The filter medium (floss) in the outside power filter may have to be changed twice a month instead of the normal monthly change.

Signs of overcrowding are usually recognizable by increased levels of aggression between the inhabitants, rapid accumulation of detritus in the substrate, and certainly, by the death of many previously healthy fish.
COMPATIBILITY:

There are general rules of behavior the aquarist must learn in order to help select the fish and how many to keep in an aquarium. These include considerations of species, size, aggressiveness, and feeding habits. Knowledge of these factors is used to "balance" an aquarium. By starting with the proper species and sizes of fish, the aquarist can develop behavioral balance enabling the determination of the number of fish a given aquarium ultimately can hold.

There is little problem achieving this when only few fish are present because space limitations are not great and fish can stay away from one another enough to reduce aggression. However, as numbers and species increase, they are forced to associate more closely with one another. This factor can increasing the incidents of aggression.

Adequate space in the aquarium is not the only factor that can aid in creating compatibility among fish. Providing adequate cover for shelter is of utmost importance. Increasing the number of objects; coral heads, rocks, and other decorations, or piling them over a greater area of the bottom seems to keep some aggressive fish busy swimming among these items, thereby reducing aggression. Besides providing adequate space and shelter for the fish there are other factors that can aid in reducing aggression. These are:

1. Well fed fish
   -If fish are adequately and frequently fed, the level of aggression will be lessened.
   A fish that is well fed is more content with his tankmates.

2. Proper introduction of newcomers
   -Incidents of aggression are usually high toward the newcomer unless some steps are taken to protect it during the introduction process. Rearrangement of the rock cover or adding a new piece of coral with the new fish provide the new arrival some cover unfamiliar to the established fish.
   -The temporary addition of a glass partition through which the fish can see the newcomer and become accustomed to each other helps to cushion the shock of the new introduction.
(3) Smaller fish versus bigger fish
As a general rule, larger fish will bully the smaller fish unless they are of very diverse species. In the predator/prey situation the smaller fish will surely lose out and become the meal for the larger fish. Size differences and whether predator or prey fish knowledge is important in compatibility.

(4) Normal territorial behavior
Many fish will claim an area that is specifically theirs. It will defend this territory fiercely against other fishes, particularly those of the same species. Size of their territory varies but, generally, small species maintain smaller territories than large species.

(5) Normal aggressiveness of fish
There are some fish that are very aggressive by nature, most especially with those of their own species or similar in shape and smaller in size. There are some fish, however, that are so aggressive that few if any fish can be kept with them, and triggerfish are the prime example. They nip and bite the fins and body of all other fish kept in the same tank.

RECOMMENDED LIST OF FISHES

I. Species for the Beginner
-Hardy fish with generalized feeding habits.

a) damselfishes: practically all Dascyllus species;
   D. trimaculatus (domino damsel), D. carneus (cloudy damsel),
   D. aruanus (white-tailed damsel), D. albisella (white-spotted damsel),
   D. reticulatus (marginate damsel), Chromis xanthurus (blue demoiselle,
   Chromis hanui (dark-finned damsel)

b) clownfishes: Amphiprion species;
   A. percula (Percula clownfish), A. sebae (Black clownfish),
   A. ephippium (red saddle clownfish), A. melanopus (cinnamon clownfish)
   A. xanthurus (yellow-tailed anemonefish)

c) gobies
   Asterropteryx semipunctatus (bluespotted goby), Ptereleotris heteropterus
     (Indigo hover goby)

d) wrasses
   Thalassoma lunare (Lyretail wrasse), T. duperrey (saddle wrasse)
   Coris flavittata (black-banded wrasse)
RECOMMENDED LIST OF FISHES (cont)

e) Hawkfish

-Note: most suffer when competition for food is severe

Paracirrhitus forsteri (Freckled hawkfish), Paracirrhitus arcatus
(arc-eyed hawkfish)

f) others

Scatophagus argus (spotted scat), Monodactylus argenteus (Singapore
Angel) - a schooling species, advisable to keep in groups.

II. Compatibility Rating

a) Good tankmates except with fishes noted:

<table>
<thead>
<tr>
<th>Fishes</th>
<th>Incompatible with:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blennies</td>
<td>triggerfishes, groupers, puffers,</td>
</tr>
<tr>
<td>(Blennidae)</td>
<td>lionfish, moray eels, smaller</td>
</tr>
<tr>
<td></td>
<td>wrasses</td>
</tr>
<tr>
<td>Filefishes</td>
<td>triggerfishes, coral, sponges,</td>
</tr>
<tr>
<td>(Monacanthidae)</td>
<td>small crustaceans</td>
</tr>
<tr>
<td>Goatfishes</td>
<td>triggerfishes, aggressive feeders</td>
</tr>
<tr>
<td>(Mullidae)</td>
<td></td>
</tr>
<tr>
<td>Parrotfishes</td>
<td>triggerfishes, crabs, shrimp,</td>
</tr>
<tr>
<td>(Scaridae)</td>
<td>sponges, live coral</td>
</tr>
<tr>
<td>Wrasses</td>
<td>triggerfishes, groupers, moray</td>
</tr>
<tr>
<td>(Labridae)</td>
<td>eels, crabs, small invertebrates,</td>
</tr>
<tr>
<td></td>
<td>some gobies, live sponges, anemones</td>
</tr>
<tr>
<td></td>
<td>sea urchins</td>
</tr>
</tbody>
</table>

b) Good tankmates except territorial or aggressive and with fishes noted:

<table>
<thead>
<tr>
<th>Fishes</th>
<th>Incompatible with:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Damselfishes</td>
<td>triggerfishes, groupers</td>
</tr>
<tr>
<td>(Pomacentridae)</td>
<td></td>
</tr>
<tr>
<td>gobies</td>
<td>riggerfishes, groupers, puffers</td>
</tr>
<tr>
<td>(Gobiidae)</td>
<td></td>
</tr>
</tbody>
</table>

c) Good tankmates except with own kind and with fishes noted:

<table>
<thead>
<tr>
<th>Fishes</th>
<th>Incompatible with:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surgeonfishes</td>
<td>sponges, coral, crustaceans</td>
</tr>
<tr>
<td>(Acanthuridae)</td>
<td></td>
</tr>
<tr>
<td>Porcupinefishes</td>
<td>mulluscs, sea urchins, crabs</td>
</tr>
<tr>
<td>(Diodontidae)</td>
<td></td>
</tr>
<tr>
<td>Puffers</td>
<td>triggerfishes, wrasses, blennies,</td>
</tr>
<tr>
<td>(Canthigasteridae)</td>
<td>damsels, gobies, hawkfish, small</td>
</tr>
<tr>
<td></td>
<td>crustaceans, live coral</td>
</tr>
</tbody>
</table>
"LIST OF READINGS"

BOOKS


JOURNAL

Freshwater and Marine Aquarium Magazine
DIAGRAMS

*1 (page 8)

*2 (page 9)

*3 (page 9)

*4 (page 9)

*5 (page 10)
Ammonia-nitrite-nitrate sequence:

Nitrogen Cycle

\[ \text{NH}_3 = \text{ammonia} \]
\[ \text{NO}_2^- = \text{nitrite} \]
\[ \text{NO}_3^- = \text{nitrate} \]

*13 (page 25)

*14 (page 31)