CHAPTER 21

OUR WETLAND ORGANISMS

21. 1. LIFE RESIDENCE CATEGORIES

21. 1. 1. Introduction

A freshwater biologist is interested in classifying an organism by its residence, where it stays. For a freshwater biologist, there are 5 basic 'places of residence'.

Their inhabitants are **plankton**, **nekton**, **neuston**, **benthos**, and **aufwuchs** (see below for pronunciation). Several of these match our open ocean descriptions so they should be somewhat familiar to you.

21. 1. 2. Plankton

Plankton live in open water but don't swim well, if at all. Most plankton are very small, even microscopic. Most are designed, evolutionarily speaking, with a high float ability.

First, they are small. Water buoys them up. Many are able to hold air bubbles, or oil bubbles, in their cells. These also cause them to "rise". Others have very long appendages (like arms, legs and antennae) for their tiny bodies; by spreading out these appendages they float more easily.

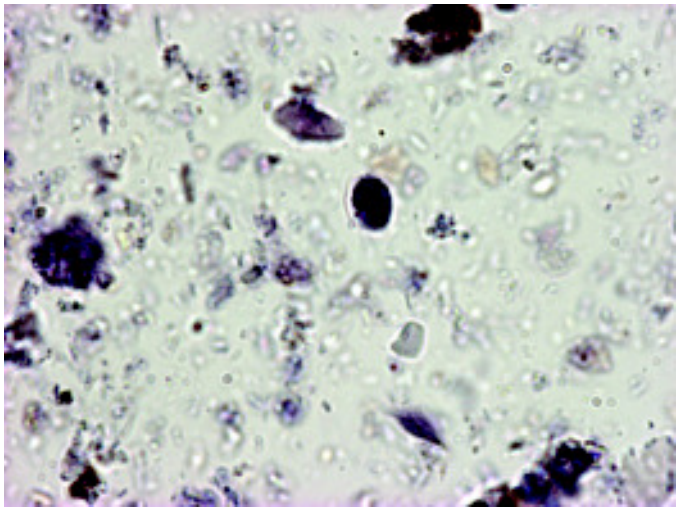
Test this by trying to float with your hands and feet held very close, so your body forms a straight line. Then spread out your arms and feet. Which way keeps you floating more easily?

Many plankton rely on water currents to move them up if they do start to sink. Others do a sort of 'vertical breast stroke' and manage to stay off the bottom that way.

What organisms are planktonic?—many bluegreen algae, green algae and diatoms (goldenbrown algae). Many, many protozoans, like *Paramecium,* and small animals such as rotifers and microcrustaceans like *Daphnia* and *Cyclops* are also planktonic.

Many adult animals that aren't planktonic have larval stages that are. These include mollusks, several arthropods, and most fishes.

Many types of algae, along with other organisms, make up the plankton.



Plankton live in open water but don't swim well, if at all.

Nekton are swimmers, live in open water and can navigate against a current so they have well-developed muscles. Fish are the major nekton of freshwaters.

21. 1. 3. Nekton

Nekton are swimmers. These live in open water and can navigate against a current so they have well-developed muscles. They usually are fairly large and have streamlined bodies—narrow from side to side with pointed heads and tails.

Fish are the major nekton of freshwaters. Turtles, frogs and salamanders are also nekton.

21. 1. 4. Neuston

Neuston are floaters. They live on the surface, right where air and water meet. Some live mostly in the air; others, mostly in the water. There aren't many true neuston, but they are noticeable in freshwater.

Flowering neuston plants like KANGKUN (*Ipomea aquatica),* often cover the surface of springs and rivers.

Neuston, including water striders, aquatic spiders and whirligig beetles, seem to skate on surface tension - the 'skin' of water that air touches. A mosquito larva hangs below the surface film, with an air tube extending to the top.

Neuston must be lightweight or able to spread their body weight over a large area; they depend on surface tension. Their leaves float on the surface, but the stem and roots are anchored in the mud. (Is a water lily neuston—or benthos?)

21. 1. 5. Benthos

Benthic organisms live on or burrow into the bottom sediments. Some benthic animals, like freshwater shrimp, are large and active, crawling along the bottom and searching for food. Others burrow into the bottom and stay there.

All sizes and shapes of organisms are benthic. The category includes bacteria and fungi, all sorts of protozoans, some algae and many rooted plants.

Most of all, it includes worm-like creatures. These include flatworms, nematodes, aquatic earthworms, and larval stages of many insects. Also included are mollusks (clams and snails), crustaceans, and non-worm-like insect larvae like those of dragonflies.

21. 1. 6. Aufwuchs

Aufwuchs (owf'vooks) is a German word referring to things that grow (wuchs) on or against (auf) other things. These 'other things' include rocks, logs, plant stems and leaves.

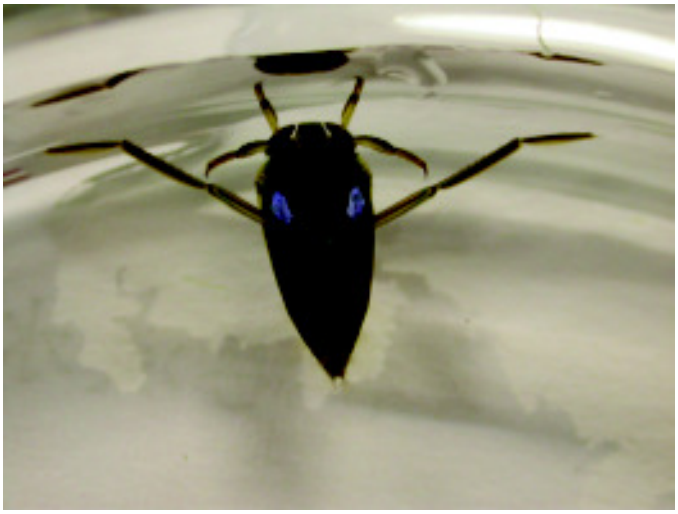
Some scientists look at this group narrowly; if the organism isn't firmly attached, it isn't aufwuchs. Most scientists take a broader view. They feel that if the organism stays in one place or moves, but is definitely associated with materials attached to the environment, it is aufwuchs. (As you might guess, lots of organisms are going to be in this group.)

Rocks you pick up will have dragonfly and damselfly larvae attached, but not permanently—they immediately crawl to the underside of the rocks. They're able to hang on to tiny crevices.

They have flat bodies which they flatten even more against the rock. This way, the current doesn't wash them away. 'Aufwuchs' is a good place for them because they don't really fit any of the other categories.

Marine biologists have a good time with this group. The reef front where waves break is like a small mountain stream with fast-flowing, splashing water. Aufwuchs living on boat hulls, bridges, pilings and piers are called 'fouling organisms'. Why?

Aufwuchs include the same kinds of organisms as benthos: bacteria, fungi, bluegreen algae, protozoans, algae, mosses, nematode worms, flatworms, and many kinds of aquatic larval stages of insects. Worms aren't so common in this group. Some vertebrates such as turtles and tiny toads which have not yet crawled out onto land are part of the aufwuchs.



Floaters, such as this backswimmer, live on the surface and are part of the neuston.

21. 2. AQUATIC MEMBERS OF THE KINGDOM MONERA

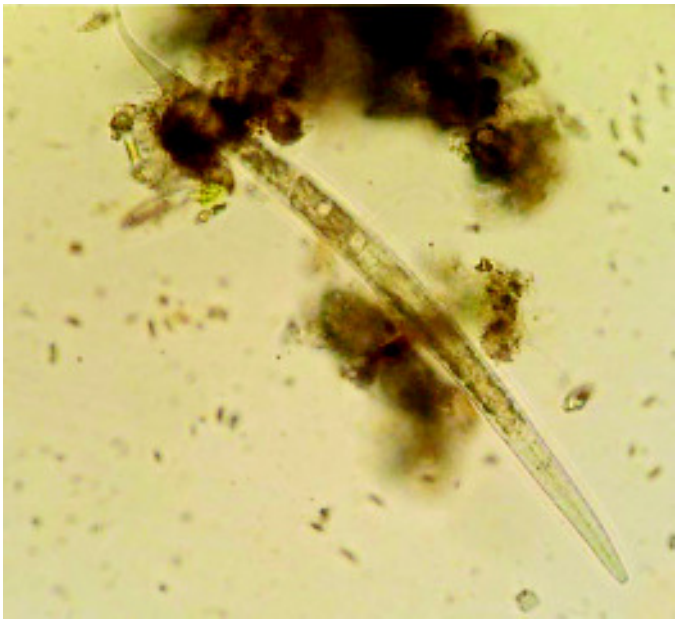
21. 2. 1. Introduction

Aquatic members of the Kingdom Monera are small organisms. Most can be seen only if magnified. They have no internal membranes; the only membrane is the cell's exterior membrane.

Because of this fact, one cannot see a nucleus inside the cell. Nuclear stuff—chromosomes and DNA—is there, but not wrapped in a neat package by a nuclear membrane.

Also, **mitosis** (cell division) is an unorganized process in Monera, though in other kingdoms it is very orderly. Monera include viruses, rickettsiae, bacteria, and bluegreen algae.

The first two, viruses and rickettsiae, are so small we can't see them with a standard microscope. The last two groups, bacteria and bluegreen algae, are in two separate phyla: **Schizomycetes** and **Cyanophyta**.



Worms, such as this nematode, live on or burrow into the bottom sediments and are part of the benthos.

21. 2. 2. Phylum Schizomycetes

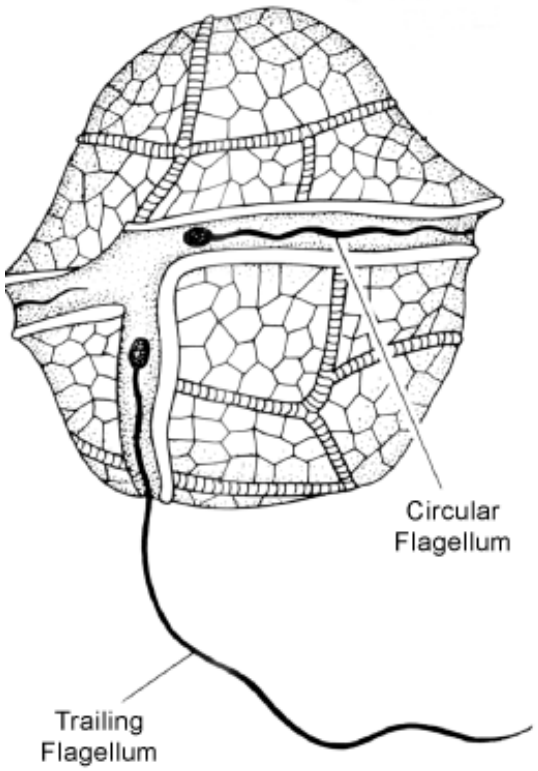
These are the bacteria. These are monerans without chlorophyll. They don't produce food by photosynthesis, although they may do it by chemosynthesis. (Recall the deep oceanic 'smoker' communities)? Chemosynthetic bacteria also inhabit hot geothermal ponds.

Round bacteria are **cocci** (singular: coccus). For example, *Staphylococcus sp.*; a common type worldwide that causes "staph" infections is a round bacteria, often forming colonies. The word "staph" comes from the Greek word "*staphyl*" meaning a bunch of grapes, which is what colonies of these round bacteria looked like to early microscopists.

Square or rectangular bacteria are **bacilli** (singular: bacillus).

Spiral-shaped ones are **spirilla** (singular: spirillum). Spirilla would be easiest for us to see in water samples. They are very active, and swim or twist. All bacteria are very small. We can see colonies of millions of bacteria together, but we need a lot of magnification to see single ones.

Phylum Chrysophyta includes the diatoms, also known as goldenbrown algae.



Phylum Pyrrophyta includes the dinoflagellates.

21. 2. 3. Phylum Cyanophyta

These are bluegreen algae. Cyanophytes are monerans with chlorophyll. Each produces its own food by photosynthesis. They grow everywhere, not just in freshwater. Some bluegreen algae here in the CNMI make the black or gray steaks on buildings where water drips down.

Our large bluegreen algae, *Nostoc sp.*, lives along road edges and in grass. It has a jelly coat, and absorbs rainwater. Many of us have slipped on *Nostoc*.

Bluegreen algae usually live in colonies, with cells forming chains. Sometimes these are hard to tell apart from other algae. If we remember that Cyanophyta cells don't have nuclei, it'll be easy. To see cells, though, you need a microscope's magnification.

21. 3. AQUATIC MEMBERS OF THE KINGDOM PROTISTA

21. 3. 1. Introduction

A lot of aquatic organisms are categorized into this kingdom. They are grouped together because of small size more than anything else. Many are plant-like and are called **protophytes**. Others are more like animals and are called **protozoans**.

Protozoans are usually one-celled, but many protophytes form colonies which may be round or thread-like. All members of the Kingdom Protista have internal membranes, and we can see structures inside their cells—including a nucleus.

Most are small and need to be magnified to be seen. However, they are not as small as the bacteria, viruses and bluegreen algae.

21. 3. 2. Phylum Chrysophyta

These are the diatoms, also known as goldenbrown algae. They live everywhere in water. In the open ocean they are the major producer organisms. Each cell has a clear cell wall around it made out of silica (glass). This wall usually has fine lines in it. Each of these cell walls is in two parts ("di" of diatom means two).

Each cell is photosynthetic, and has chlorophyll. It also has other pigments which make the diatom look goldenbrown. Also, many diatoms move, looking like tiny boats gliding through the water.

21. 3. 3. Phylum Pyrrophyta

These are the dinoflagellates (dino = armored; flagellate = whip-bearer). Each is a single-celled algae which builds itself a "shell" of clear plates made out of cellulose. They usually have two flagella, one around the middle, and one hanging down.

Dinoflagellates are very common in the open ocean. They also live inside animals like corals and giant clams. In fact, the colors of live corals are made by dinoflagellates (see chapter 14 on coral reef ecology).

Saltwater dinoflagellates living inside other animals are called zooxanthellae. Many live in freshwater, too—but these live free in the water.

Dinoflagellates are algae, and they photosynthesize, but they don't usually look green. This is because they also have other pigments in addition to chlorophyll.

The "armored" dinoflagellates *Cystodinium spp.* and *Peridinium spp.* are common in Lake Susupe.

21. 3. 4. Phylum Euglenophyta

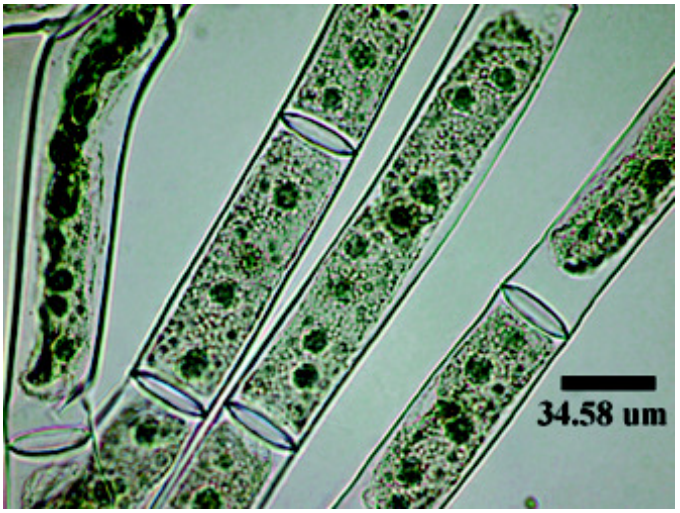
This is a small Phylum, with just a few species. All *Euglena sp.* are single cells. Each has a flagellum or two. Some have chlorophyll, and some don't. All require an extra source of food, even those that photosynthesize.

The "*Euglena*" cell doesn't have a rigid wall, and can change shape as the organism moves. Green ones look like green algae.

Euglenas caused a great disturbance amongst orthodox systematists. "Were they animals or plants?" The debate led to the creation of our multi-kingdom biological classification system.

21. 3. 5. Phylum Chlorophyta

The green algae are a large and highly varied group. Some are single-celled; some are colonies composed of many cells. The colonies can be round, or in long strings.

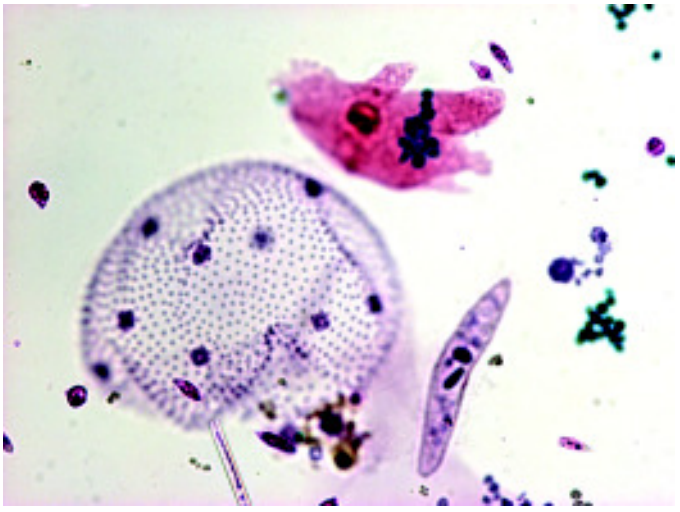


Chlorophyta are a large and highly varied group. Some are single-celled; some are colonies composed of many cells.

Many colonies are large enough to be seen easily. We need magnification to see individual cells. All have chlorophyll and look greenish, although other colors may be present. Some green algae have one or more flagella. In freshwater, some are planktonic and others are aufwuchs.

21. 3. 6. Phylum Protozoa

These are usually single-celled and animal-like (proto = primitive; zoa = animals). None have chlorophyll. Most move (but remember so do some algal protists with flagella). Protozoans are classified into four classes, not all of them living in freshwater.



Protozoa are usually single-celled and animal-like (proto = primitive; zoa = animals).

Class Flagellata

These have flagella, (whip-like threads) usually one per cell. Some freshwater ones are in the Phylum Pyrrophyta, some in Euglenophyta, and some in Chlorophyta. As you can see, there is a lot of confusion about this group!

There are some animal-type flagellates—like trypanosomes, which cause sleeping sickness. These are not typically freshwater organisms.

Class Sarcodina

Sarcodines move by 'flowing'. They have flexible cell membranes and usually no flagella or cilia. Their flowing projections are **pseudopodia** (pseudo = false; pod = foot). Some make shells with holes in them. To move, they stick their pseudopodia out through the holes. "Smarter ones" like amoebas don't make shells. They just stick out their pseudopodia without having to find a hole to go through.

Slime molds comprise the class Myxomycophyta.

The mushroom we see is the part that reproduces sexually.

Class Sporozoa
All Sporozoans are parasites. They don't move much. They don't live in freshwater, but they are inside freshwater organisms.

Class Ciliata
Ciliates move with cilia, which look like many very short hairs. Ciliates are usually single-celled, and are very common in freshwater. In addition to cilia, they have two nuclei in each cell. Most are carnivores and have large mouths. They are so complicated inside that it's hard to believe they're single-celled.

21. 4. AQUATIC MEMBERS OF THE KINGDOM FUNGI

21. 4. 1. Introduction

There are lots of fungi, including mushrooms, molds, rusts, mildews, and yeasts. Yeasts are single-celled, but most of the others are many-celled.

Fungi are usually **saprophytes** or decomposers. They eat decaying and dead organic matter. None are photosynthetic, but many have pigments and are brightly colored.

There are some parasites in this kingdom, but they're not common in freshwater. There are two classes of fungi; the Myxomycophyta and the Eumycophyta.

21. 4. 2. Class Myxomycophyta

These are the 'slime molds' (myxo = slime, myco = fungus-mold; phyta = plant). They look like large, colored amoebas. They are not common in fresh water, but are often seen on damp logs and leaves in shady woods.

21. 4. 3. Class Eumycophyta

Bracket fungi and mushrooms are the true fungi (eu = true). The obvious part of mushrooms is in the open, but the main body of true fungi are **mycelia** (white threads) growing inside wood and under dead leaves.

The mushroom we see is the part that reproduces sexually. Sexual reproduction happens only at certain times of the year. Mycelia live year-round.

Fungi reproduce by budding and also by producing spores. The spores fall to the ground and sprout to form mycelia. Many spores are found in freshwater. A spore is single-celled with a heavy black or brown wall.

There are many water molds, fungi which don't produce a mushroom. They have thousands of mycelia which can also form spores.

Some water fungi are parasitic. They infect fish with characteristic white patches. These are clumps of fungal mycelia. Water fungi are very common, but you need to magnify them to see them.

21. 5. OUR LOWER WETLAND PLANTS

21. 5. 1. Introduction - Division Bryophyta

Mosses, liverworts and hornworts are all called **bryophytes**. Their life cycle has three stages.

The **gametophyte** stage produces gametes (egg cells and sperm cells). In this division, the **sporophyte** stage is a sort of parasite on the gametophyte stage. The sporophyte produces the **spores** (third stage).

Bryophytes include mosses, such as those growing on these trees.

21. 5. 2. Class Musci

These are the mosses. Some are aquatic, but most grow in shaded, wet terrestrial habitats. Most have root-like structures for attaching the plant to the ground, logs, tree trunks, etc.

Tiny leaf-like parts are carried on a short stem. The sporophyte is usually a brown stalk topped with a pointed brown capsule which holds spores.

21. 5. 3. Class Hepaticae

These are the liverworts. Most are aquatic or grow in wet places along ponds and streams.

The gametophyte grows flat on the ground, and looks like a small green piece of liver. The sporophyte stage looks like a little umbrella. It grows on top of the gametophyte. Spores are carried under the umbrella part.

21. 6. OUR WETLAND HIGHER PLANTS; FERNS AND FLOWERING PLANTS

21. 6. 1. *Acrostichum aureum*

In Chamorro the swamp fern, *Acrostichum aureum,* is called LANGAYAO. There is no English common name for this species. *Acrostichum* is in the *Family Pteridaceae*.

LANGAYAO is very large fern, only found in tropical wetland ecosystems. It grows to a height of 2 meters. It is indigenous and grows throughout the tropics.

It grows locally in lowland marshes and at the borders of mangrove and *Scirpus* swamps. It is a common resident in all suitable locations.

The reproductive fronds of *Acrostichum* are covered with spore-bearing “sporangia”. These entirely cover its upper surfaces. The spores are minute and are distributed by the wind.

Acrostichum aureum provides important hiding cover to our endemic and migratory waterfowl. As discussed below, LANGAYAO fronds are trampled down by our Mariana moorhens. Nests are made on top of these.

The **rhizomes** extend into the water providing a substrate for aquatic insects and crustaceans.

Acrostichum aureum is a very large fern, only found in tropical wetland ecosystems. It grows to a height of 2 meters.

Phragmites karka grows from tropical Africa to Malaysia and across the Pacific, wherever wetland environments exist.

Panicum muticum grows to about three feet in height and has dense hairy nodes, or spots between sections of the grasses' stems.

21. 6. 2. *Phragmites karka*

Phragmites karka is usually the first plant our teachers tell us about when introducing our local wetland plants. This is because it is our most widespread and "indicative" plant. Where you find *Phragmites karka*, you've found a wetland. *Phragmites* is in the plant ***Family Graminae***.

In Chamorro, *Phragmites karka* is called KARRISO. The English common name for it is "reed". This plant grows from tropical Africa to Malaysia and across the Pacific, wherever wetland environments exist.

The flowers, or, more properly, the **inflorescences** ("*infloresc*" is Latin for begin to bloom) are greenish at first, gradually becoming brownish, never whitish or silvery, never reddish purple. If you see these colors, it is not *Phragmites karka*.

KARISSO is a tall species, growing as high as 5 meters. It tends to stay in freshwater wetlands and only rarely does it survive in brackish areas. It forms dense broad, almost impassable stands.

Young shoots are supposedly edible, though this is not a common food source. The split stems are made into coarse mats for wall partitions, etc.

They are favorites of Marianas High School and NMC students for the temporary roof thatchings of "Cultural Day" and "Founders Day" huts.

21. 6. 3. *Scirpus littoralis*

Scirpus littoralis is called Bulrush. *Scirpus* is in the plant ***Family Cyperaceae***. These grass-like wetland herbs are indigenous to our islands, being here when the first Chamorros arrived.

Below the mucky bottoms of our wetlands, *Scirpus littoralis* sports thick rhizomes. Its stems grow upwards about one meter tall or more.

Bulrush grows in muddy, often brackish water. It tends to be **gregarious**, that is, where it grows it tends to dominate, not allowing other species to mingle in with it. *Scirpus* grows both on Saipan and on Tinian. Globally, *Scirpus littoralis* grows in a wide distribution ranging from Europe, through Asia Minor, to India and to Southeast Asia and Australia.

21. 6. 4. *Panicum muticum*

Panicum muticum is in the ***Family Graminae***. There are no known local names for this species. In English it is called Para grass.

These common wetland grass plants grow to about three feet in height. A telltale characteristic is its densely hairy nodes, or the spots between sections of these grasses' stems.

Botanists think it is probably a native of Africa, but it was first described from Brazilian specimens. It is introduced commonly by ranchers since it is a high value pasture and forage grass. Locally it thrives best in damp locations such as wet fields, ditches and gullies.

21. 6. 5. *Cyrtosperma chamissonis*

Cyrtosperma chamissonis is a large to massive herb (Remember our definition of an herb, long ago? Check our glossary if you can't recall).

The English name Elephant taro fits it well. In Chamorro it is called BABA. In Carolinian it is called BWULA. Elephant taro is in the plant ***Family Araceae***.

It has large, rather dark green leaves which point upwards. One leaf can grow up to two meters long. Its leaf stems, or *petioles*, can be as much as three meters.

BABA is used as a food crop much like the suni taro (see below). Like the suni taro it has a tuberous rootstock. There are several cultivars in other Micronesian Islands, particularly Pohnpei and other Caroline Islands.

Cyrtosperma chamissonis is a large to massive herb with large, rather dark green leaves which point upwards. Its tuberous rootstock is used as a food

21. 6. 6. *Colocasia esculenta*

Colocasia esculenta is called SUNI in Chamorro. In English it is called Taro. In Carolinian it is WOOT. Suni is also in the plant ***Family Araceae***. The plant has tuberous roots called rhizomes.

These tubers are edible, providing a potato-like food. In Hawaii *Colocasia esculenta* is used to make a thickish, slightly fermented liquid called "poi". Sections of rhizomes are used to propagate new plantings.

The leaves are somewhat pale green, darkening to violet at the veins and petioles. The tips of the leaves point downwards. When flowering (a rare occurrence) it displays a yellow **spathe** and **spadix**. The roots are sometimes purplish in color.

Many varietal forms of Taro exist, differing in color and ability to tolerate wet or swampy soil.

21. 6. 7. *Ipomoea aquatica*

Ipomea aquatica is called "KANGKUN" locally. This name is applied by Chamorros and Carolinians alike. There is no English name, but when it is grown in Hawaii it is sometimes called "watercress". Watercress is also a common name of a very different plant grown in the US mainland.

Ipomoea aquatica is in the ***Family Convolulaceae***. The green leaves are variable in shape. They most often grow out in an oblong fashion. They sometimes sport rather spongy stems.

Ipomoea aquatica is a creeping or floating, commonly subaquatic vine. It grows only in fresh water. Its trumpet shaped flowers are very pretty. They are pinkish-violet, darker (purplish) in the center throat, (rarely, though, the center throat is nearly white).

Ipomoea aquatica is a creeping or floating, commonly subaquatic vine with trumpet shaped flowers. It is cultivated for its delicious edible leaves and young stems.

Kangkun is grown by farmers throughout the tropical world. It is cultivated for its delicious edible leaves and young stems. It also has escaped into most natural tropical wetlands having standing water. The leaves are an excellent "spinach" and are best eaten when cooked.

All members of the genus prefer sunny environments and avoid shade. KANGKUN is closely related to our beach morning glory vines, *Ipomoea pes-caprae*, and our sweet potato, *Ipomoea batatas*. Interestingly these "cousin" vining plants always twine to the right.

21. 6. 8. *Hibiscus tiliaceus*

The tree *Hibiscus tiliaceus* is called PAGO in Chamorro. In Carolinian it is GHU'LU'FÉ. As its genus name suggests, it is closely related to our common red-flowering ornamental hibiscus, *Hibiscus rosa-sinensis*. Recall that we also described this plant in ch.17.

Hibiscus tiliaceus are medium-sized trees which can grow up to 50 feet high. They have spreading low branches without a central trunk and flowers that are yellow with a maroon-purple central eye.

These medium-sized trees are in the plant ***Family Malvaceae***. Under ideal conditions they can grow up to 50 feet high. Usually, though, they are no higher than 30 feet. PAGO is indigenous to our islands.

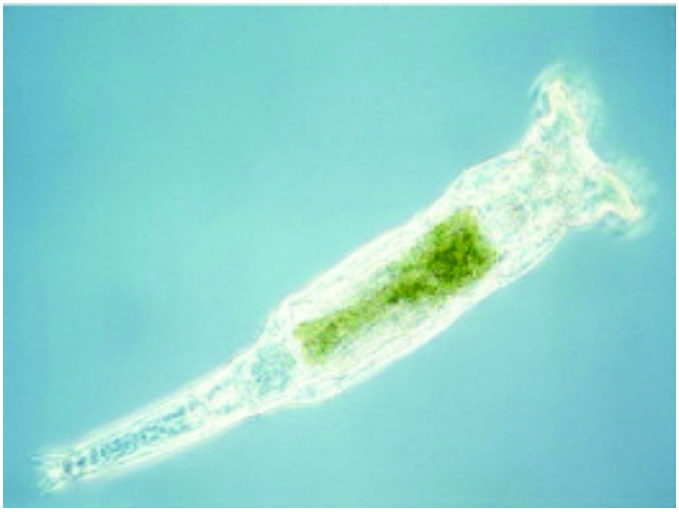
As an older plant, it is intricately branched and has spreading low branches without a central trunk. The youngest branches are grayish and hairy. The older ones are also grayish, with rather smooth and very fibrous bark.

The bark is also **mucilaginous**, meaning it is moist and sticky like mucous. This somewhat unusual bark is very important culturally. It is often stripped from trees and used for many purposes.

PAGO flowers are yellow with a maroon-purple central eye. These age after falling to an orange-red color. These flowers, like most *Hibiscus* genus flowers, last only one day on the tree before falling. The tree itself produces such flowers all year long.

Hibiscus tiliaceus grows in many of our local habitats. It is a pantropical strand plant, favoring somewhat muddy coasts. It also grows on limestone rocks, often at the edges of mangrove swamps.

The wood is light, fairly tough, and pale. When freshly cut the heartwood is reddish but it soon darkens. This wood is easily finished but is not very durable.



Rotifers, such as this Philodina roseola are sometimes called 'wheel animals' (roti = wheel; fera = to bear).

The fibrous bark is a source of cordage all over the Pacific Region. The trees often form a nearly impenetrable thicket with interlacing low horizontal branches. If these branches have thin roots hanging down from them, called **adventitious roots**, it is an indication of wetland conditions.

GHU'LU'FÉ is sometimes cultivated. If trimmed, it makes a useful shade tree. It can form a natural "arbor," or roof, of leafy twigs.

In Pohnpei, mucilage from the bark is added to the ceremonial "sakau," a drink prepared from the roots of *Piper methysticum* (kava).

The leaves of *Hibiscus tiliaceus* form dense crowns. They have velvety hairs covering them. This fact serves botanists to tell them apart from the commonly co-inhabiting BINALO or (*Thespesia populnea)* trees, which are coastal strand plants and are not as tolerant of wetland conditions.

21. 7. OUR WETLAND-ADAPTED INVERTEBRATES

21. 7. 1. Phylum Annelida - Class Rotifera

Rotifers are sometimes called 'wheel animals' (roti = wheel; fera = to bear). The 'wheel' is a row of cilia around the mouth. When these cilia move, they make a current of water that either brings food into the mouth or helps the animal move.

Rotifers have muscles and can also creep along the bottom. They are common in freshwater, but are small and need to be magnified to be seen. They are plentiful in stagnant water—water that has stood in one place for a long while.

21. 7. 2. Phylum Annelida - Class Oligochaeta

These are worms with a few bristles (oligo = few, chaeta = bristles). Earthworms are the best known. There are many aquatic "earthworms".

Many aquatic insect larvae look like oligochaetes but don't have bristles but do have leg stumps near the head. Aquatic oligochaetes do not have these leg stumps.

21. 7. 3. Phylum Mollusca

Mollusca means 'soft-bodied' but usually mollusks are identified as animals with shells. Many mollusks, however, don't have shells. Each has a specialized body layer, the mantle. The mantle makes the shell if it is called for.

This phylum has six classes, varied and large, including a few terrestrial, more freshwater, and many marine species. We will only discuss the class Gastropoda, our most common wetland mollusks.

Class Gastropoda

Gastropods are a class of mollusks of which snails are the most familiar. *Gastro* means stomach and *pod* means foot, so these are the stomach-footed animals. Some gastropods live in our freshwater ponds streams and lakes.

Gastropods include snails and slugs. If there is a shell, it is usually in one part or coiled. All gastropods have a head with one or two pairs of tentacles.

Snails are common herbivores in freshwater and often graze on aquatic plants or algae-covered rocks. All the freshwater snails in the CNMI have shells.

Galba viridis

These are our common freshwater lymnaeid snails. *Galba* snails grow to about a centimeter in length and inhabit our freshwater streams, ponds, and lakes. They appear mostly black, but may range from gray through brown. Their shells are relatively thin at the edge. *Galba* makes a great freshwater aquarium specimen whenever there is algae growing on the side of the aquarium's glass.

21. 7. 4. Phylum Arthropoda - Class Crustacea

Crustaceans include crayfish, lobsters, shrimp, prawns, crabs, etc. Almost all crustaceans live in water. They have five or more pairs of legs, and two pairs of antennae.

Mollusks, such as this freshwater snail, are often identified as animals with shells. Many mollusks, however, don't have shells.

Dozens of species of crustaceans are microscopic. Most animal-type plankton (zooplankton) are also crustaceans. Daphnia sp. are often use in biology classes as study organisms.

Some have an external skeleton that looks like a clamshell, but the jointed legs that stick out tell us they are crustaceans.

Dozens of species of crustaceans are microscopic. Many crustaceans are benthic. Most animal-type plankton (zooplankton) are also crustaceans.

Cardisoma carnifex, is often associated with our wetland habitats. Throughout the Pacific, these crabs most often live in mudflats near mangroves.

The juvenile stage crustaceans may not look like the adults they will grow up to be, but they also have jointed appendages.

Machrobrachium rosenbergi
Many of us have seen our common freshwater shrimp or prawns. In English they are called Malaysian prawns. The genus name translates to macro = big, brachium = arms. This species of big-armed shrimp is now commonly being cultivated in aquaculture farms for food.

Cardisoma carnifex
The purple land crab, *Cardisoma carnifex,* is often associated with our wetland habitats. *Cardisoma carnifex* is in the ***Family Gecarcinidae***. Throughout the Pacific, these crabs most often live in mudflats near mangroves. Juvenile crabs are commonly known to move more inland than adults.

Cardisoma carnifex is dark brown on top, changing to yellowish brown on the sides. Their legs are greenish brown. The main claws (**chelipeds**) are yellow to white on the "fingers". The adult males are larger and heavier than the adult females.

Like the coconut crab of the limestone forest, female land crabs regularly migrate to the sea to release their larvae. Such travels often occur during the period of the full moon. Some females drown doing this. Purple land crabs are largely nocturnal and are generally more active during high tide.

Dragonflies have two sets of wings, which they hold out sideways from the body.

Gravid females carry their eggs until they hatch. These eggs are dark blue. On one occasion a researcher counted 425,000 larvae when he kept a gravid female until it hatched it eggs.

Niche-wise these crabs are mainly herbivorous, feeding mostly on rotten leaves, although they are sometimes cannibalistic. Crabs hide in their burrows during the day. Burrows are large and deep. Food is taken down into the burrow, maybe to allow decaying to improve its digestibility.

21. 7. 5. Phylum Arthropoda - Class Insecta

This is the largest class in the animal kingdom. Entomologists already know of over one million species! (see our Insects chapter)

Insects have three pairs of legs or leg stumps, one pair of antennae, and wings or wing buds. They're usually terrestrial, but some are aquatic. Many terrestrial insects have aquatic larval stages.

There are about 26 orders of insects. We'll look only at four that live in our aquatic habitats.

Order Odonata
These are our dragonflies and damselflies. Each has aquatic larvae, and the adults fly over freshwater.

Dragonflies have two sets of wings, which they hold out sideways from the body. Their larvae are fat and rounded with no tails. The larvae have huge, shovel-shaped mouths. These larvae are carnivorous, and should never be put into collecting bottles with other specimens!

Damselflies have two sets of wings, which they fold vertically together when feeding. Their larvae are slender with three tail projections. These larvae are also carnivores, but take smaller prey than do dragonfly larvae.

Order Hemiptera
These are the true bugs. The order name means half-wing (hemi = half; ptera = wing). The wings are thick and heavy at the top, and thin and fragile at the end. We can easily identify a hemipteran by the x-pattern of the wings.

It is always a wise idea to identify insects of this order because many of them have mouth parts like hypodermic needles, which can cause considerable pain to the ignorant collector! Aquatic hemipterans are usually the adult stage, not the larvae.

Most common in the CNMI are the water striders, or 'Jesus bugs'. These are neuston, and can be seen in large groups walking on the **surface tension**.

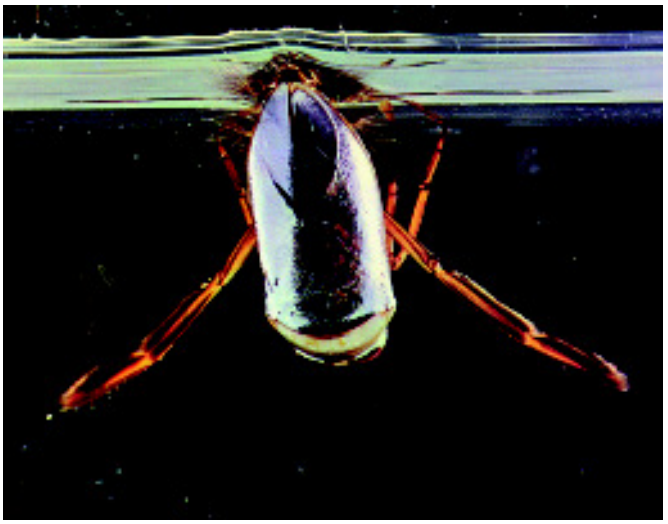
Order Diptera
These are the flies, gnats, mosquitoes, and those 'giant mosquitoes'—our craneflies. The adults are never aquatic, but many dipterans lay their eggs in water and have aquatic larvae and pupae. Adult members of the Order Diptera all have only a single pair of wings.

Dipteran larvae are worm-like, and are usually benthic organisms. If we look at one carefully, we see a head with mouth parts, and usually 6 stumpy projections which eventually become legs.

Most of us are familiar with mosquito larvae. They wriggle through the water and often hang down from the surface.

Order Coleoptera
These are the beetles and weevils. Their larvae and pupae are almost never aquatic, but there are aquatic adults. The whirligig beetle is a good example.

Some skate on the surface tension; others dive underwater for brief periods. All beetles have two sets of wings. The outer set is stiff and hard and is lifted up when the underwings are used for flying.



Coleoptera larvae and pupae are almost never aquatic, but there are aquatic adults. The whirligig beetle is a good example.

Anguillid eels must reach the sea to spawn. After a number of months, elvers (juvenile eels) invade estuaries and rivers where they will live for many years.

21. 8. OUR WETLAND FISHES, AMPHIBIAN(S), AND REPTILES

21. 8. 1. Class Pisces

Mosquito Fish (*Gambusa affinis*)
Gambusa affinis is able to tolerate a wide range of salinity conditions. They are commonly called 'guppies' and were introduced to our lakes to control mosquitoes. They do this very effectively, eating both the eggs and larval stages of mosquitoes.

Tilapia *(Sarotheradon mossambicus)*
Sarotheradon mossambicus is also able to tolerate a wide range of salinity conditions. *Sarotheradon sp.*, commonly called "tilapia," were introduced to the CNMI for aquaculture in the 1950's. Tilapia are omnivorous.

Our Diadromous Freshwater Eels (*Anguilla marmorata*)
Diadromous means that the newly hatched fish larvae pass from freshwater environments to the sea via stream discharge or floods. In the sea they develop as plankton. Later they *metamorphose* and then migrate back into freshwater as juveniles. In the freshwater they grow to maturity.

Anguillid eels are diadromous in another way: each must reach the sea to spawn. After a number of months, *elvers* (juvenile eels) invade estuaries and rivers where they will live for many years, greater than 20 years in most cases. Anguillid eels can invade isolated bodies of water, miles from rivers and streams.

Anguillid eels also are able to tolerate a wide range of salinity conditions.

Bufo marinus, like most toads, has dry, bumpy skin, as opposed to frogs, which have smooth, moist skin. This toad was brought to our islands during the Japanese times by agronomists.

21. 8. 2. Class Amphibia

Translated, this class name means amphi = both; bios = life. These organisms live first in water, then on land. Amphibian eggs must hatch in a water habitat. There are several "orders" within the Class Amphibia. Only one lives in the CNMI — Order Anura, including the frogs and toads.

Bufo marinus
At the time of this book's writing, the CNMI has only one kind of amphibian, a toad called *Bufo marinus*. Like most toads, *Bufo* has dry, bumpy skin, as opposed to frogs, which have smooth, moist skin.

Toad eggs hatch into animals that look more like fish than toads. These little tadpoles quickly grow legs, lose their tails, and adapt to life on land.

This toad was brought to our islands during the Japanese times by agronomists. They hoped it would eat insects and our then common black garden slugs. It cleaned up most of the pesky slugs and few are seen today. They still eat lots of insects.

When disturbed, the toad makes a white juice on its skin, which is poisonous to small animals. This juice keeps animals like dogs and cats from eating them.

If one needs to, it is normally okay for humans to pick up these toads. They will not give people warts, a common superstitious be-

lief. It wouldn't be a good idea to put one in your mouth, however, as the toad's protective juice could make you sick too.

Also as a protection they often defecate through their "**cloaca**", (anal/urogenital opening) when being picked up.

Toads lay their eggs in freshwater. Any puddle or pond will do. An amazing thing happens with toad eggs. They hatch into animals that look more like fish than toads. These little tadpoles quickly grow legs, lose their tails, and adapt to life on land.

Toads have become very common in the CNMI. They can be seen in large groups on our streets and lawns, especially during our rainy season.

21. 8. 3. Class Reptilia

Red-eared Slider Turtle
Red-eared sliders, *Trachemys scripta, Family Emydidae*, are the common turtles of pet stores on the U.S. mainland. They had never been recorded during wetland surveys in earlier years. Large specimens (about eight inches) started to appear at various locations around Lake Susupe in the late 1980's.

Red-eared sliders are the common turtle of pet stores in the U.S. They had never been recorded during wetland surveys in earlier years.

Most likely many of these were released by former pet owners. One story has it that, each year, they were regularly released by the teachers, students, and staff of Sister Remedios' Early Childhood Development Center as each school year broke for its summer term.

Like most turtles, red-eared sliders, have a bony **carapace** on their backs and a bony **plastron** on their bellies. They can bring their heads and arms almost completely within their "shells". Seven species of turtles, including the hazardous U.S. snapping turtle, were introduced to Guam in the last thirty years.

Ancient animals, turtles have inhabited our planet for 180 million years. At the time of this book's writing however, they have probably lived on our islands only for a decade or two.

21. 9. OUR RESIDENT WETLAND BIRDS

21. 9. 1. The Mariana Common Moorhen *(Gallinula chloropus guami)*

Scientists suggest that the ancestors of our Mariana Common Moorhen colonized this area by way of Japan and the Bonin and Volcano Islands. The species has been recorded from Pagan, Saipan, Tinian, Guam, and, most recently, Rota.

These are shy birds. When seen they are usually walking along the edge of a distant shoreline.

The moorhen *(Gallinula chloropus guami),* known in Chamorro as the PULATTAT and in Carolinian as the GHEREL BWEEL is an endemic subspecies of moorhen.

Archaeological excavations indicate that it was also once naturally found on Rota. Recently it re-established itself there at a man-made pond.

Gallinula chloropus guami is an endemic subspecies of moorhen that requires undisturbed wetlands for nesting.

Moorhens spend part of their time in the water, and part in the reedy areas along the shore.

Gallinula chloropus guami is actually a member of the rail family. Adults are purplish-black with a red forehead and beak.

The PULATTAT was listed as endangered by the US Fish and Wildlife Service in 1984.

If population densities have not changed, then based on habitat loss and the estimate of 75 formerly on Pagan, the population of our moorhens has probably been reduced in this century by 36 to 52 percent.

This ducklike bird is actually a member of the rail family. Adults are purplish-black with a red forehead and beak. Moorhens prefer open-water habitats. They spend part of their time in the water, and part of their time in the reedy areas along the shore.

Although the moorhen's feet are not webbed, their long toes make it possible for them to walk across plants floating on the water.

They eat plants, insects, and snails. Their nest is well concealed. Although the moorhen is sometimes found in relatively dry areas, it requires undisturbed wetlands for nesting. Moorhens usually build their nests a few inches above the water. These nests are supported by bulrushes, KARISSO reeds or LANGAYAO ferns.

As mentioned, LANGAYGO fronds are often trampled down into platforms for their nests. They also make hidden nests in reeds, complete with an escape ramp to the water. Baby moorhens use this ramp when danger threatens.

Mature females lay 6-13 eggs. Both parents sit on the eggs. When the babies hatch, they are covered with fluffy black down. They have white feathery eyebrows and a white beak.

Like most ground nesters, the babies are able to run and protect themselves from predators when only a few hours old. As they grow, their feathers slowly turn purple-black and their beaks and forehead turn red.

Total Moorhen Populations

In the early 1900's they were an esteemed food item and were probably heavily hunted. In February, 1990, the total population of the Mariana common moorhens (also called 'Gallinules'), was between 300 and 400. Of this about 100 were estimated to live on Saipan, about 75 on Tinian, and the remainder on Guam.

As mentioned, a population of some 75 moorhens once lived on Pagan. Recent trips to Pagan by wildlife biologists found no trace of moorhens. The population there is now considered extinct.

Saipan Moorhen Populations

For Saipan, there was no indication of the nature of moorhen abundance until after the American invasion of 1944. During the 30 years of the Japanese mandate, sugarcane occupied much of the land area of both Saipan and Tinian. Wetlands were used for rice cultivation.

Increased erosion and siltation, resulting from agriculture and military activities, probably accelerated hydric successional processes. Most remaining wetlands are now entirely covered with dense stands of *Phragmites* (KARISSO).

During the late 1970s, moorhen population estimates for Lake Susupe and all its surrounding marsh area were 60-100 and 90-120, respectively.

On Saipan, the PULATTATS may be seen or heard in the wetlands around Lake Susupe, in the American Memorial Park (inside the par course), near seasonal ponds in the Kagman, Dandan, and Lower Base areas, and at the Price-Costco site.

No large numbers of moorhens have been found in the Susupe Lake marsh area. At the time of this book's writing, the current conservative population estimate for Saipan is 100 birds.

Tinian Moorhen Populations

On Tinian, in 1742, it was written that there were "two considerable pieces of fresh water". One of them, Magpo Swamp, is now completely choked with reeds and *Hibiscus tiliaceus*, a small tree.

This change may have been accelerated because nearby wells have been pumping water since 1935. Moorhens still use Magpo, but apparently only sporadically. There had also been a few forest ponds until forest clearing increased evaporation in the 1930's to make room for sugar cane agriculture.

The other wetland, Lake Hagoi, is the only relatively large open water habitat on Tinian. It was estimated to have 70 moorhens in 1945. The Hagoi Marsh is an important moorhen refuge and nesting area for the remaining flock of local moorhens.

Though recorded population estimates have ranged from 0 to 200, most estimates were between 25 and 100. The highest numbers have been recorded during the dry season. Hagoi is thought to provide a critical dry season refuge. During the 1989 rainy season, a population of 75 birds was estimated.

The wide range of recent estimates suggests that moorhens make the 5 kilometer flight between Saipan and Tinian regularly.

Pagan Moorhen Populations

As mentioned, the two lakes on Pagan supported a population of moorhens until relatively recently.

Moorhen habitat damage by domestic animals had become a problem by the 1960's. Investigators saw only one moorhen in 1979, and estimated the population at less than 10.

In 1981, the volcanic eruption of Mt. Pagan caused the human inhabitants to flee and abandon their domestic animals. Ash and cinder fall killed the emergent vegetation and any habitat that remained was destroyed by the now feral cattle, goats, and pigs.

Biologists could find no moorhens in 1983 nor in five subsequent trips between 1985 and 1989. Though the quality of water has since improved, there is still no emergent vegetation and the moorhens there are believed to be extinct.

Gallinula chloropus guami feeds on any and all emergent vegetation and benthic insects.

Ixobrychus sinensis is widely distributed on Saipan and Tinian, but is not entirely restricted to the marshes or lakes of these islands.

Acrocephalus luscinia is a great singer. Because it sometimes sings into the night, it gets its given name of "nightingale".

Rota Moorhen Populations
As mentioned earlier, in Rota the remains of three moorhens were found in archaeological excavations. The evidence suggested that moorhens were hunted there to extinction some 1500-2000 years ago.

Prior to the development of a fringe of plant growth around the earlier-mentioned sewage treatment pond system - and its recent re-adoption by a pair of moorhens - these birds had not inhabited the islands for all that time.

Today they are back, thanks to good planning and good civil engineering design.

Moorhen Populations Throughout Our Archipelago
The current estimate (as noted in the referenced literature) of the total population of Mariana moorhens is 300-400. Moorhens are difficult to count because they are somewhat secretive. They also use ponds within impenetrable swamps and reed thickets, and move about to take advantage of seasonal and temporary wetlands.

Competition with Tilapia and Other Impacts
Though evidence is circumstantial, it is suspected that moorhen densities have been reduced through competition with tilapia (*Sarotheradon sp.*). They both feed on any and all emergent vegetation and benthic insects.

If bulldozers, tilapia, and volcanoes are not enough, moorhen nests and chicks may be preyed upon by monitor lizards and introduced rats, cats, and dogs.

There are reasons for optimism, however. Moorhens are opportunists and are relatively prolific. They can probably continue to survive if their habitat can be secured and enhanced.

The US Fish and Wildlife Service has recently instituted a no-net-loss policy for our Mariana wetlands. If this policy can withstand the challenges of development, then the Mariana common moorhen will probably survive, at least for the near-term future.

21. 9. 2. The Yellow Bittern (*Ixobrychus sinensis*)

The yellow bittern is widely distributed on Saipan and Tinian. In both Chamorro and Carolinian it is known as "KAKKAK". It is not entirely restricted to the marshes or lakes of these islands.

Bitterns are particularly common at Lake Susupe where they forage among the bulrush (*Scirpus*) and ferns (*Acrostichum*). They roost at night in ironwood trees which surround the lake.

Scientists observed that throughout the day the *Scirpus* feeding areas are subdivided into apparent "feeding territories". It is reported that bitterns nest regularly in the emergent vegetation around the lake. Recall that emergent means "rising up from".

21. 9. 3. The Nightingale Reed Warbler (*Acrocephalus luscinia*)

In Chamorro, the nightingale reed warbler is known as GAGA KARISU, or "bird of the wetlands".

The nightingale reed warbler is a great singer. Because it sometimes sings into the night, it gets its given name of "nightingale". Its song is much like that of our Golden Honeyeater's only a little 'scratchier'. Only a trained ear can tell the difference. Reed warblers often sing from exposed tree and reed perches.

Males sing out loud and long, starting just around sunset. They carry on for longer periods than most of our wetland and forest birds. Come morning, like other birds, they are singing away again, being most prevalent an hour after dawn.

Their songs announce their presence to females and claim their territories against other males.

Reed warblers are distributed around Saipan and Aguiguan, but interestingly are not found on nearby Tinian. They are also known in Alamagan, Pagan, and Guam. A closely related subspecies is known to be abundant in the Caroline Islands.

A recent investigation on Aguiguan was conducted by a team of Northern Marianas College instructors and students. They led a field expedition to this island in May, 1992. At the time of this book's writing, the species is presently being comprehensively studied on Saipan by the USGS Biological Research Division.

During earlier studies, the species was found to be most abundant around Lake Susupe. The reason for the USGS/BRD study is that the species has also adopted our TANGANTANGAN forests and seems to be much more abundant here than earlier thought.

Careful observations showed that most reed warblers preferred the edge of the marsh, rather than the extensive **monotypic** reed or tangantangan stands. Monotypic means all the same.

Lizards and insects are suspected to be their favored food. [It has been reported that our particularly large grasshoppers were their most favorite.]

A USFWS Biological Recovery Plan for the species was recently developed. This bird might be so abundant, in fact, that it may deserve to be taken off the US Endangered Species list. Only the biological density data will tell for sure.

Anas oustaleti was one of the rarest ducks in the world, found only on Saipan, Tinian and Guam. It was deemed extinct in the early 1980's.

21. 9. 4. The Extinct Marianas Mallard (*Anas oustaleti*)

For a while, the Marianas mallard was one of the rarest ducks in the world. It had been found only on Saipan, Tinian and Guam. Unfortunately it is now extinct.

First recorded in the scientific literature as early as 1865, the Marianas mallard was not officially described as *Anas oustaleti* until 1894. In Chamorro it was called NGANGA and in Carolinian it was GHEREEL' BWEL.

The Marianas mallard was placed on the US Endangered Species List in 1977. In 1979, the last known pair of Marianas mallards was captured on Saipan and the two were taken to Sea World in San Diego, California. There biologists had hoped that they would

reproduce and be saved from extinction. Unfortunately, these birds did not survive and the species was declared extinct in the early 1980's.

Taxonomy of the Marianas mallard has been disputed. There is some evidence that it wasn't really a species at all, but actually a hybrid between *Anas platyrhynchos* and A*nas poecilorhyncha*.

Whatever it was exactly, it was unusual and special in that it stayed here year round. It hatched and raised its chicks locally rather than flying off to the north as our migratory ducks do.

The species nested in our marshes, swamps and streams on Saipan, Tinian and Guam. Nesting was understood to occur throughout the year.

The mallard had been described as one of the most interesting and beautiful species of Micronesian birds. Its head was dark green with buff feathers intermingled on the sides. It had a brown streak through its eyes and a faint white ring on its lower neck.

Its body feathers were dark brown, edged with lighter shades. The upper breast was a dark reddish chestnut with dusky spots. It had an olive and black bill and reddish orange feet.

The Marianas mallard lived in freshwater marshes, in reed grasses in and around ponds, in tall grass along rivers, and in mangrove-lagoon areas.

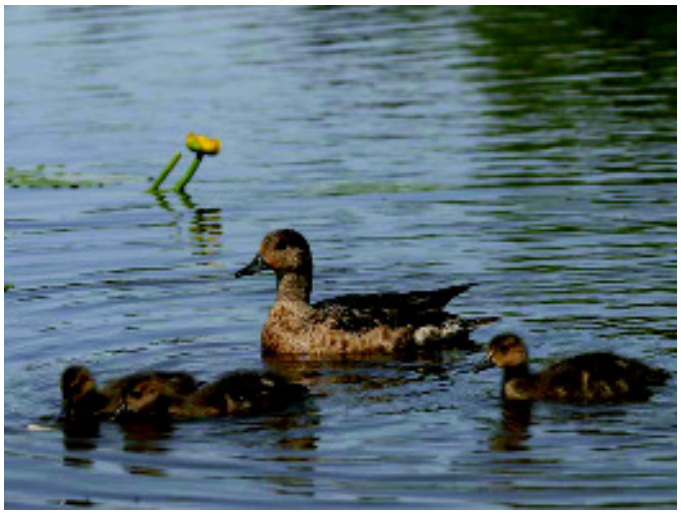
This duck was quite secretive and thus avoided any large open-water area. On Saipan, the Marianas mallard lived only at Lake Susupe and in the mangrove-lagoon area north of Garapan. It fed on snails, worms, aquatic insects, algae, and leaves and seeds of a wide variety of wetland plants.

The last sighting and study of the Marianas mallard occurred in 1979. Then the mallard was believed to exist only on Saipan, perhaps making occasional visits to Lake Hagoi on Tinian.

Now the duck has vanished altogether. Although it is uncertain, the decline of this beautiful bird is believed to have been caused by overhunting. It probably also suffered from the loss and destruction of the wetlands where the mallard lived, and from the earlier-mentioned competition with our introduced fish species.

Scientists have concluded it was never "abundant" due to the limited number of fresh water swamps and marshes in the Marianas.

The Northern Shoveler is described as a casual winter visitor to Micronesia.



Widgeons are medium-sized dabbling ducks, growing to about 20 inches (51 cm.). The female (shown, with brood) is mostly dark brown.

21. 10. OUR MIGRATORY WETLAND DUCKS

21. 10. 1. The Northern Shoveler (*Anas clypeata*)

The Northern Shoveler is described as a casual winter visitor to Micronesia. In the past it was hunted along with our other migratory ducks.

The shoveler is a medium-sized duck, growing to about 19 inches (48 cm.) in length. It has a bright blue forewing, which is visible in flight. It also has a bright green side patch.

The male's head is dark green. Its breast is white and its rear and primary wings are black. The female is mottled brown throughout. Immature males, and males that are not in their breeding plumage, resemble females. Shovelers nest in the Arctic.

Shovelers are named for their long, spatula-shaped beaks. They use this to dabble for food in shallow water. Shovelers, and all of our local ducks in fact, are vegetarians.

When swimming, a shoveler rides low in the water with its tail pointed upwards. Its head seemingly looks downward with its beak pointed towards the water. They are shy birds and are difficult to approach. The male's voice is a croaking sound while the female's voice is a weak "quack."

21. 10. 2. The Eurasian Widgeon (*Anas penelope*)

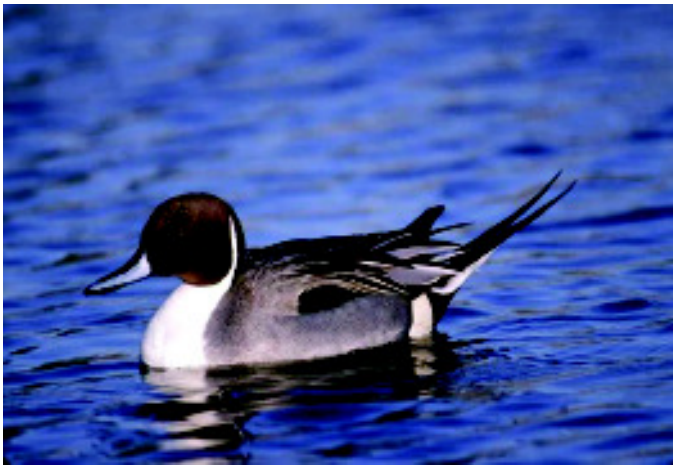
This species is an occasional winter visitor to Micronesia. It has been reported from both Lake Hagoi and Lake Susupe. Ten to fifteen Eurasian widgeons were recorded at Lake Susupe in 1978.

Widgeons are medium-sized dabbling ducks, growing to about 20 inches (51 cm.). The male's body color is mottled grey. Its head is light brown with a buff-colored forehead. Its breast is pinkish, and it has a bright white spot on its forewing. The female is mostly dark brown.

Widgeon beaks are short, blue-colored, and have a black tip. The male's voice is a whistling sound and the female quacks. Their nesting grounds are in the Eurasian Arctic.

21. 10. 3. The Northern Pintail (*Anas acuta*)

Pintails are casual winter visitors to Lake Susupe and Lake Hagoi. Flocks of about 15 birds have been sighted regularly.



Pintails are casual winter visitors to Lake Susupe and Lake Hagoi. Flocks of about 15 birds have been sighted regularly.

These are long-necked dabbling ducks of slender build. They grow to 26 inches (66 cm.), tail not included. As their common name implies, pintails have very long pointed tails. Males are grey-bodied, with a brown head and white beast. They have a distinctive white line up the side of their neck. Females are mottled brown and have a somewhat shorter tail than the male.

Pintails prefer freshwater ponds and lakes but are sometimes found in brackish water. They are usually silent but when aroused, the male's call is a double whistle, and the female's is a quack.

21. 10. 4. The Green-winged Teal (*Anas crecca*)

Teals are small dabbling ducks. Growing only to 14.5 inches (37 cm.), they are the smallest of our native ducks. Their bodies are mostly grey-brown.

The tufted duck is described as an irregular visitor to western Micronesia. The "tuft" of the tufted duck is a backwards-pointing loose crest, found on the head of both sexes.

The male's head is chestnut brown and there is a broad green streak behind its eyes. Females are mostly mottled brown. Both males and females, however, have a bright green side patch. In flight, both also show off their characteristic bright green wing bars.

Teals are rapid fliers. They live mostly in freshwater lakes and ponds. Our teals breed in the Eurasian Arctic.

The voice of the male is a penetrating 2-syllable whistle. The female's call is a rapid high-pitched quack.

21. 10. 5. The Tufted Duck (*Aythya fuligula*)

The tufted duck is described as an irregular visitor to western Micronesia. It is known from both Saipan and Tinian records. When large flocks arrive, numbering 70 or more, these are likely to be tufted ducks.

These birds feed near shore, close to the bulrush. Classified as "diving ducks", tufted ducks feed by diving underwater, often for prolonged periods. Tufted ducks are medium-sized, growing to 17 inches (43 cm.).

Males are mostly black with white underbodies. They also have a characteristic white bar on their wings. Its bill is blue with a black tip. Females are very dark brown.

The "tuft" of the tufted duck is a backwards-pointing loose crest, found on the head of both sexes. The tuft is not always visible, however, and the females' crest is a bit shorter than the male's. They breed throughout Eurasia.

21. 11. CONCLUSION

Wetlands have historically been misunderstood and under-appreciated. They have been destroyed by draining, filling, channeling, and pollution.

Today we are beginning to realize and appreciate the role of our wetlands and why it is so important to preserve, restore, or re-create them.

Wetland restoration and creation attempts are difficult and complex tasks. Throughout the world they have met with varying degrees of success.

Together these efforts are usually referred to as **mitigation**. These are procedures or techniques used by developers, government agencies, and environmental groups in an attempt to reduce impacts from wetland loss and destruction.

The most viable mitigation method for wetlands is simply preservation; that is, setting a wetland area aside to remain in its natural state. Preservation is certain to be effective and does not involve complicated engineering and monitoring procedures.

Preservation would at first hand appear simple. Pressure, however, to develop wetland areas is extremely intense. This is because, very often, wetlands occupy flat, coastal land areas. These are highly desirable locations with high agricultural, scenic, and recreational value.

Restoration of wetlands is the attempt to reconstruct or re-establish damaged wetlands. This attempt usually occurs after the wetlands have been partially destroyed by some human-induced or natural occurrence.

Typical examples of partial damage to wetlands include their being drained off for agricultural use (pasture) or the diversion of historical water flows for new irrigation purposes.

Maintaining the health and productivity of our wetlands here in the CNMI is of the utmost importance. This is because of the habitat they provide for so many species, their filtering effect on ground water, and the erosion control they provide.

We should learn from the experiences of other countries, as several regions have suffered tremendously from the loss of their wetlands. These losses have caused a host of major problems, including water pollution, loss of fisheries, shoreline erosion, drought, flooding, and wildlife extinction.

A good basic rule of thumb to assess projects which might affect our wetland areas should be *"it is better to leave it alone than to try and fix it afterwards or have to re-create it from scratch."*