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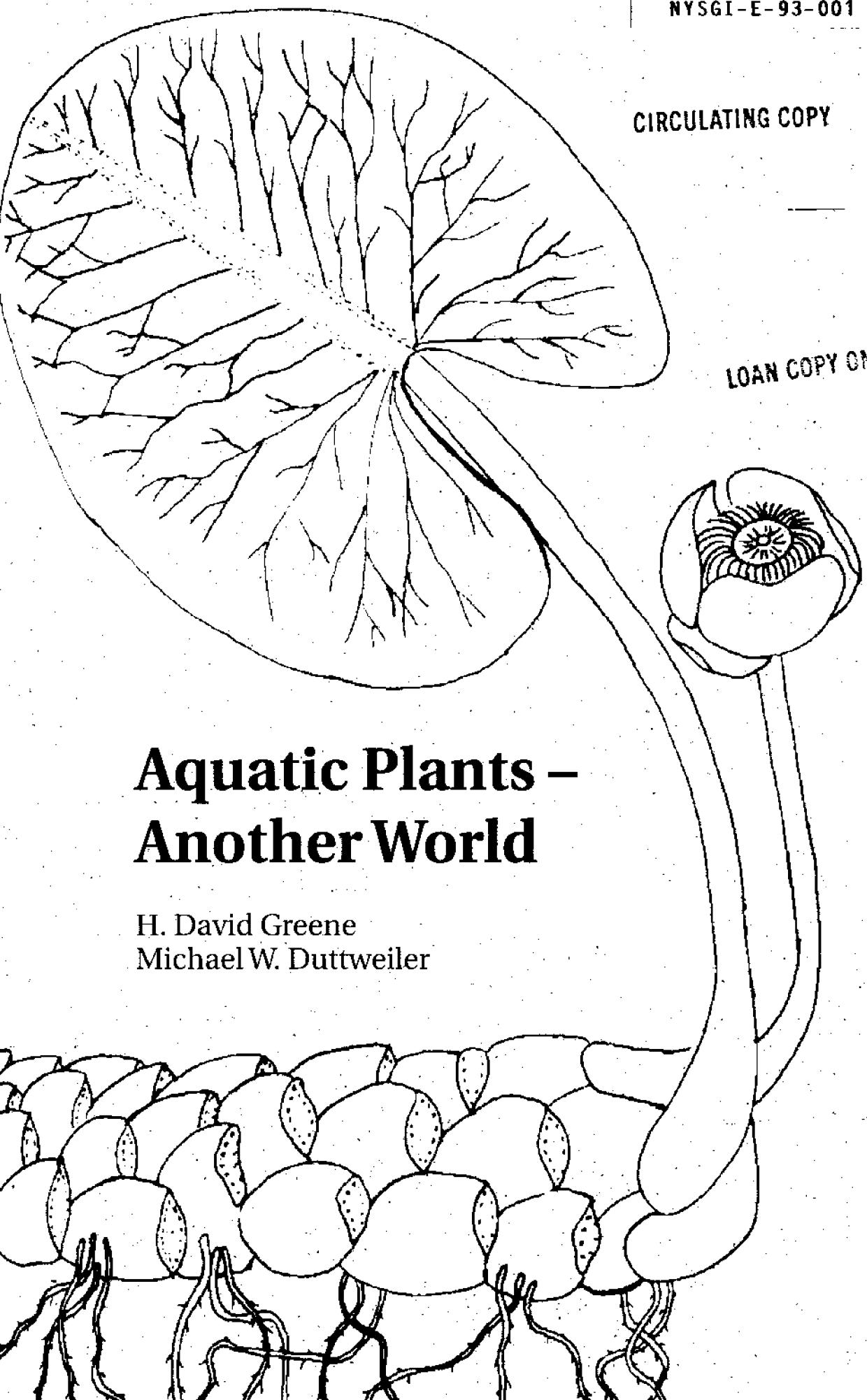

# Aquatic Plants – Another World

H. David Greene
Michael W. Duttweiler

This publication is a revised version of *Aquatic Plants – Another World*, Aquatic Activity for Youth No. 9, by Michael W. Duttweiler (1981) and was developed to support 4-H programs in New York State.

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# Aquatic Plants – Another World

## Contents



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# Preface for Group Leaders and Teachers

Land plants are obvious members of our communities. We appreciate, culture, and use them in many ways. Plants that live in and around water, although less obvious to the casual observer, are equally important. This set of activities is designed to provide a basic introduction to the world of large (not microscopic) aquatic plants. Three levels of involvement are described.

## *General Objectives*

**Level I. Plants in the Water**
*Appropriate for grade levels 4 and higher.*

- Participants will recognize major similarities and differences between land plants and water plants.
- Major groupings of aquatic plants will be recognized.
- Simple plant preservation techniques will be learned.

**Level II. Getting to Know Aquatic Plants**
*Appropriate for grade levels 6 and higher.*

- Participants will be able to identify common aquatic plants by using simple visual keys.
- Participants will be able to identify major interactions between aquatic plants and their environment.

**Level III: Plant Communities and People**
*Appropriate for grade levels 6 and higher.*

- Participants will be able to describe in detail potential interactions between aquatic plants and people.

## *Background Information*

Many youths participating in this program will find some background information to be complex. Leaders may wish to explore other references for program participants, including:

Reid, G.K., et al. 1967. *Pond Life.* Golden Press. New York. 160 pp.

This inexpensive member of the 'Golden Guide' series is a comprehensive introduction to pond life. The text is appropriate for high school students. It is amply illustrated, however, and students of all ages should find it useful. Alternatively, most modern science texts review aquatic systems as part of a unit on ecology or environment.

### *References for Group Leaders and Teachers*


Boyd, C.E. 1979. *Water Quality in Warm Water Fish Ponds.* Auburn Univ. Agric. Exp. Sta. Craftmaster Printers, Inc., Opelika, Ala. 359 pp.

Crawford, R.M.M. (ed.) 1987. *Plant Life in Aquatic and Amphibious Habitats.* Blackwell Scientific Publ. Boston. 452 pp.

Fassett, N.C. 1972. *A Manual of Aquatic Plants.* Univ. of Wisconsin Press. Madison. 405 pp.

Grinstain, D.T. 1991. *Pools, Ponds and Waterways.* Grove Weidenfeld. New York.

Klots, E.B. 1966. *The New Field Book of Freshwater Life.* G.P. Putnam's Sons. New York. 382 pp.

Ogden, E., J.K. Dean, C. Boylen, R. Sheldon. 1976. *Field Guide to the Aquatic Plants of Lake George, New York.* Bull. 426. N.Y. State Museum.

Sculthorpe, C.D. 1967. *The Biology of Aquatic Vascular Plants.* Edward Arnold (Publ.), Ltd. London. 610 pp.


This publication includes a glossary of terms used in the text that might be unfamiliar (see back cover). As these words first appear in the text, they will be in *italics.* In addition, three appendices have been provided that will assist the reader in collection, identification, and preservation of plant specimens.

### How to Use this Book

*Terrestrial* plants are obvious members of our communities. We appreciate, cultivate, and use them in many ways. Although they may be less obvious to you, *aquatic plants,* which live in and around water, are just as important as land plants. The activities in this book provide an introduction to another world—the world of aquatic plants that you can see without a microscope.

Your leader or teacher will have you work on the activities in Level I, II, or III. In each level you will learn how to identify, collect, and preserve aquatic plants. In Levels II and III, you will also learn about the relationships between plants, between plants and fish, and between plants and people.

On the back cover, you will find a word list (glossary) that explains unfamiliar terms. Refer to this glossary as you read about aquatic plants and do the projects. These glossary words are printed in *italic* type the first time they are used.

In the back of this book, you will find additional helpful information:

- Appendix 1 is a key to the basic forms of aquatic plants. Scientists use keys like this to help them identify different plants and animals.
- Appendix 2 explains how to make and use a plant press for preserving aquatic specimens.
- Appendix 3 shows sample collection notes and includes blank forms for you to copy for making your own field notes.

If you would like to do further reading, try one of the references listed on page 1, or ask your leader or teacher for suggestions. As you explore the aquatic plants in your community, we hope that you will come to understand and appreciate them.



# I. Plants in the Water

*Aquatic plants* are important members of the communities that inhabit our lakes, ponds, rivers, and streams. They release oxygen to the water, provide shelter and food for many waterfowl and animals, and shade, cool, and clarify water.

Underwater or aquatic plants have the same growth requirements as land plants: light, *nutrients,* and appropriate soils (some aquatic plants do not need soils). Living in water is an advantage because water supports the plants and they need not develop the rigid stems needed by land plants. Lack of water, often a problem for land plants, does not apply.

Yet, living in the water presents some special challenges. Light does not penetrate water to great depths. In most waters, plants can get enough light only to depths of about 15 feet. In some cloudy waters, light will not penetrate below 2 feet or so. Moving gases such as oxygen or carbon dioxide underwater requires special actions. The chemistry of underwater soils is considerably different than that of land soils, requiring special ways for aquatic plants to get needed nutrients.

Some aquatic plants (the *algae*) have always lived in water. Others are actually members of land plant groups that adapted to living on or in water. Thousands of different kinds of aquatic plants successfully inhabit the waters.

## Plant Identification

### *Basic Forms*

One useful grouping of plants is based on the part of the *aquatic system* they inhabit. On this basis, plants can be grouped as:

- those that grow primarily attached under the surface *(submergents),*
- those that float on the water *(floating plants),*
- those that have a substantial portion of their growth above water *(emergents).*

***Submergents*** have adapted almost entirely to underwater life, with the exception of some that flower above the water surface. They gain the bulk of their nutrients from sediments. Pondweeds are common submergents.

***Floating plants*** live primarily at the water surface. They draw their nutrients from the water and have access to sunlight and the atmosphere at the surface. Duckweed is an example.

Some plants, such as pond lily, have forms between submergents and floating plants, with their roots and long stems underwater but their leaves floating on the surface.

***Emergents*** are like land plants with their "feet" in the water. They grow primarily above the water surface in shallow areas or on the shoreline. Cattails and bulrushes are common emergents.

Learning about these basic forms of aquatic plants helps to understand the ecology of an aquatic system. A simple observation key (Appendix 1) helps to distinguish the basic plant types.

When too much plant growth becomes a problem, different controls are used for different forms of plants.

### *Plant Groups*

All but two plant groups *(phyla)* have aquatic members. Thus, accurate plant identification down to *genus* and *species*—and sometimes only down to *family*—can be difficult. Fortunately, most common plants fall into several easily identified groups.

Because of the large number of families and species involved, it is not possible to construct a satisfactory simple key. Most references for nonbiologists use illustrated keys with plants grouped into the basic forms described above. For the purposes of this program, the following publications should be appropriate:

*A Guide to Plants Commonly Found in the Freshwater Wetlands of New York*, by T. Rawinski, R. Malecki, and L. Mudrak. Available through the Dept. of Natural Resources, Fernow Hall, Cornell University, Ithaca, NY 14853.

*Field Guide to the Aquatic Plants of Lake George, New York.* Available through the New York State Museum, Publication Sales, 3140 Cultural Education Center, Albany, NY 12230.

As a comprehensive reference text, the following is one of the most popular:

Fassett, N.C. 1972. *A Manual of Aquatic Plants.* Univ. of Wisconsin Press, Madison. 405 pp.

Guides to saltwater species:

Hillson, C.J. 1977. *Seaweeds: A Color-Coded Illustrated Guide to Common Marine Plants of the East Coast of the United States.* Pennsylvania State Univ. Press, University Park.

Lee, T.F. 1977. *The Seaweed Handbook.* The Mariners Press, Boston, Mass. 217 pp.

Silberhorn, Gene M. 1982. *Common Plants of the Mid-Atlantic Coast - A Field Guide.* The Johns Hopkins Univ. Press, Baltimore, Md. 256 pp.

Tiner, Ralph W., Jr. 1987. *A Field Guide to Coastal Wetland Plants of the Northeastern United States.* The Univ. of Mass. Press, Amherst. 286 pp.

*Note: Identifying aquatic plants to the genus and/or species level often requires detailed examination of flowering parts or other procedures frustrating even for experienced botanists. This difficulty is particularly evident in the pondweed genus (Potamogeton spp.). You should not expect to be able to exactly identify all specimens.*

### Collecting Plants

First and foremost, gain permission to collect the plants. Since taking aquatic plants is illegal in some nature preserves, you should be aware of certain protected plants, and it is common courtesy to obtain permission from the water owner under all circumstances.

Plant-collecting techniques are almost as varied as your imagination. Safety is an obvious concern, with *bog* areas, waters with sharp drop-offs, or areas heavily littered with broken glass or other debris to be avoided. Don't overlook the nearby drainage ditch, marshy back lot, or slow-moving stream in which a wealth of plant species may reside.

### Materials

**Useful tools to help in collecting include:**

- **Boots or waders or, if the water is warm enough, sneakers to protect feet.**
- **Pails to hold collected specimens in a small amount of water.**
- **Collecting pole. The simplest would be a tree branch 4 or more feet long with a fork on the end to snag plants in deeper water; or, use a garden rake.**
- **Collecting net. A small aquarium-type net can be used to collect floating plants. Or, use a small cup or any other vessel.**
- **A hand lens is useful to observe the intriguing fine details while the plants are still fresh.**

**Some plants grow all year round, making seasonal comparisons interesting. The summer months, however, will likely yield the largest variety of plant types.**

## Preserving Aquatic Plant Specimens

Preserved aquatic plants can be used for further study such as accurate identification and review of physical characteristics, or they can be appreciated for their simple beauty. The most practical means of preserving many large aquatic plants is by pressing and drying.

Commercial plant presses are available from biological supply houses. Homemade presses can be equally effective. See Appendix 2 for instructions for making your own press. Plants may also be dried in an old catalog or phone book. Choose one with nonglossy, absorbent paper.

Whether using a press or catalog, carefully blot excess water with an absorbent paper, such as a paper towel, and arrange the plants naturally on the drying surface. If using a press, alternate drying and spacing materials between specimens and tightly cinch the press (see Appendix 2 for details). If using a catalog or phone book, leave about 1/8-inch of pages between specimens, close the book and place several books or other weights on top. Allow plants to dry thoroughly. This may take a week or more, especially if a catalog or phone book is used. Thick-bodied, "juicy" plants may mold if dried in books.

Dried specimens can be mounted on any paper, but heavier grades or even light cardboard will better protect the plants. "Invisible" or regular transparent tapes work fine. Or, a good-quality paper glue can be brushed on the paper and the plants embedded in it.

The specimen number, collector's name, and the date and location of collection should be recorded directly on the mounting sheet. Additional sheets with field notes should be clearly identified by specimen number. This allows further study if needed.

Drying should be satisfactory for preserving most common aquatic plant species. Here are some tips:

- Wash off soil before drying.
- Carefully separate plants when arranging them on drying surfaces. They will stick together if you do not.
- Dry tiny amounts of surface plants such as pond scum, being careful to spread out the filaments. Otherwise, they will not be recognizable when dry.
- Split thick stems and roots to speed up drying.
- Many dried aquatic plants are fragile. Open the press and handle them carefully.
- Plants will dry more rapidly if the press is suspended over a source of low heat. A simple wooden frame can be constructed to support the press on edge over two low-wattage light bulbs.
- *Filamentous* and other small *algae* can be dried and mounted on index cards. Slide an index card under specimens floating in water. Carefully lift the card from the water and set aside to dry. The algae should stick to the card without glue. Individual cards can be stored in envelopes for protection.

### *Project 1. The Three Major Forms of Aquatic Plants (Level I)*

*This project familiarizes participants with emergent, floating, and submergent forms of aquatic plants and provides experience in drying plants.*

**Materials needed:**

- Plant collecting and preserving equipment as described in this guide.
- Notebook and marking pencil.

***Procedures:***

- Locate a nearby body of water on which plant collection would be permitted and safe.
- Collect and dry at least two specimens from each of the three basic forms of aquatic plants. (See Appendix 1 for classification help.)
- Observe the plants in their environment. Take notes on how they look, feel, smell; or whether any animals appear to use them. (See Appendix 3 for suggested note formats.)
- Mount samples with notes in notebook.

**Thought provokers:**

- What are the similarities between the groups of collected specimens representing the three basic forms of aquatic plants? In shape? In feel? In parts of the plants? Others?
- What are the differences between the groups of collected specimens representing the three basic forms of aquatic plants? What do you think are the reasons for the differences?
- Which group of specimens is most similar to land plants? In what ways?
- Which group of specimens is least similar to land plants? In what ways?

# II. Getting to Know Aquatic Plants

Aquatic plants have many complex influences on their environment. Over a *geological time* period, aquatic plants play their most important role in changing a water environment to land. Sometimes they keep waves and currents from their natural flow and cause more soil to settle out of water. They can also change the areas where chemicals settle in the water. These long-term changes happen slowly and are hard to see.

Shorter-term influences include those on the chemical and physical aquatic environment and those influencing other organisms, each of which is described below.

## The Chemical and Physical Environment

As plants grow actively during warm seasons, they release oxygen into the water as a result of *photosynthesis*. How much oxygen is released into the water depends upon the species of plant, the amount of light and nutrients available, the size of the plant beds, and similar factors. The importance of the oxygen given off by plants depends on how much oxygen is released from other sources, such as *aerated* source water, and oxygen movement across the air-water surface. Oxygen generated by plants can be significant, especially for smaller bodies of water.

Plants also consume oxygen. Through their *respiration* and *decomposition* too many plants can completely use up available oxygen in confined areas, especially in the fall. The warm water of the summer does not hold as much oxygen. Decomposition of plants and leaves can remove the remaining oxygen. Widespread growths of dense, floating aquatic plants, in particular, use up oxygen. Their growth is space-inefficient in that they shade plants below from needed light, limit currents of oxygenated water, and encourage *sedimentation* on other plants. Most oxygen released by growing plants is eventually consumed by decaying plant matter. When this happens rapidly, it can cause problems for aquatic animal life if there isn't enough oxygen for their use.

Photosynthesis also influences water chemistry through secondary effects, such as increases in *pH*, and use of carbon dioxide and nutrients. Plants use large amounts of dissolved nutrients, often accumulating larger quantities than they need for growth *(luxury consumption)*. Much of the total available nutrients within an aquatic system can be tied up in the *vegetation*. These nutrients become available again to other life forms as plants die and decompose. But until nutrients are released by decomposition, there will be fewer *phytoplankton* (the small free-floating plants—"pea soup"—that are crucial to the food chain in all bodies of water) and other organisms, due to competition for nutrients by large aquatic plants. This can be a problem in the short term. (See discussion under Interaction between Plants.)

In addition to shading of sunlight and slowing water currents, physical influences of plants include reduced *erosion* through root development and more of suitable habitats for many organisms. Floating and emergent plants break the water surface, encouraging movement of oxygen, carbon dioxide, and other gases. Plants can even cause major changes; for example, clogging of *outflows* may cause significant changes in water level.

## Interactions between Plants

There are many different forms of aquatic plants, including single-celled phytoplankton, filamentous algae, submergents, floating plants, and emergents (see Appendix 1). Each has its own requirements, and all compete for available light, nutrients, and *substrate*.

Establishment of a plant species on any given site depends on the site's depth, water current, wave action, water temperature and transparency, substrate, nutrients, and water chemistry. Competition occurs not only between species of *macrophytes* (large rooted, floating, and emergent plants) but also between macrophytes and phytoplankton.

## Interactions between Plants and Fish

Fish rely in varying degrees on aquatic plants for food, shelter, and *spawning* substrate.

Few fish use macrophytes directly for food. (Carp and goldfish are notable exceptions.) However, plants do provide food for many organisms that are consumed by fish, including mollusks (e.g., snails) and crustaceans (including some crayfish). Plants give off complex chemicals, which are used as food by bacteria and the larval stages of many *organisms*. The underwater surfaces of plants support abundant growth of animals and insects that are prime fish food, especially for young fish. Many mollusks spawn and insects lay eggs directly on aquatic plants, in addition to feeding there.

On the harmful side, macrophytes compete with phytoplank-

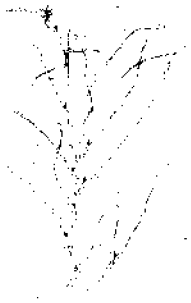
ton for sunlight, nutrients, and oxygen. These phytoplankton are a direct food source for many fish species and the *prey* of fish.

Many fish use aquatic plants for shelter from light, extreme temperatures, and predation. Shelter from predators can be a disadvantage as well. Dense plant growths can provide so much cover from predators that the prey (sunfish for example) can overpopulate and become stunted. In addition to shelter, some fish use plants for support when resting.

Some fish, including carp, many minnows, pickerel, pike, and muskellunge, use plants for spawning substrate. Many others, bass and sunfish, for example, avoid plants or may actually remove them from spawning sites.

Chemically, the primary influence of plants on fish is through oxygen supply, with plants often providing a significant proportion of oxygen used by fish and their food organisms. Again, there is a two-edged sword: Respiration and decomposition of massive plant growths in confined waters can wipe out fish populations through oxygen removal. More subtle effects can be caused by shifts in insect or microbial populations accompanying oxygen changes.

***Project 2. Common Aquatic Plants (Level II)***



*This project is designed to familiarize participants with the common aquatic plants in their locale.*

**Materials needed:**

- Plant collecting and preserving equipment as described in this guide.
- Notebook and marking pencil.
- Suitable aquatic plant guide or field book, as listed earlier.

**Procedures:**

- Find two or more small bodies of water in which plant collection would be permitted and safe.
- Review the plant descriptions starting on page 2.
- Collect and dry 8-10 different plants identified in the bulletin.
- Tell which form (e.g., submergent) each plant represents (See Appendix 1). Group specimens by form, keeping samples from each body of water separate.
- Mount samples with notes in notebook.

**Thought provokers:**

- How are the specimens collected similar? Different?
- Are there particular characteristics that helped you to identify each of the specimens? If so, record them on the mounting sheets.
- How were plants collected from the different waters similar? Different? What might explain those similarities or differences?



# III. Plant Communities and People

*If you have not already read sections I and II, a review of that material will be helpful before proceeding.*

## Aquatic Plants and Uses of Water

People use water for drinking, fishing, swimming, and boating, while others simply look at it. Aquatic plants can influence each of those uses. Water supply managers become concerned when plants clog *intake pipes* or create color and odor problems. Some plant growth is necessary for healthy fish populations, but too much plant growth can encourage too many undesirable fish and make it difficult for anglers to catch anything other than the plants themselves. Dense plant beds can be a hazard to swimmers and make boating difficult at best. For many people, a lake crowded with plants is less appealing than open water.

Several approaches have been developed for dealing with problem plant growth. Sound *plant management* encourages protection of desirable plant species in appropriate amounts. The exception might be residential, industrial, or agricultural water supplies, in which most plant growth may be undesirable.

The approach for controlling aquatic plants depends in large part on the interests of the persons involved. Swimmers may

### *Project 3. Plant and Animal Interactions (Level II)*

*This project is designed to familiarize participants with common aquatic plants' ability to provide shelter to aquatic insects and fish, and to explore relationships between plants and animals.*

**Materials needed:**

- Clothing suitable for water, including boots, waders, and other waterproof gear.
- White-bottomed pan for sifting materials. Old refrigerator trays are excellent; plastic bleach bottles cut in half also work well.
- Pocket lens, tweezers, collecting bottles (clean baby food jars).
- Kitchen strainers.
- 12 x 24-inch piece of vinyl window screen.
- Two 1-inch diameter dowels, 24 inches long.
- Utility-grade staple gun

An excellent reference for this activity is *The New Field Book of Freshwater Life*, by Elsie Klots; see references, page 1.

**Procedures:**

- Make a 1 x 2-foot hand screen by fastening the 12 x 24-inch window screening to dowel rods; staple through two thicknesses of screen.
- Find a small body of water that has a variety of aquatic plant life (submergents, emergents, floating plants).
- Using the handscreen and strainers, collect insects from around, on, and under plants in pond. Keep track of plant identification and/or form. Keep each collection in separate jars and label location of collection.
- If possible, observe if fish are found near various plant forms.

**Thought provokers:**

- How did the insects differ from location to location? How were they similar?
- From your observations, what roles do plants and insects have with each other?
- How do plants benefit from insects? Harm them? How do the insects benefit from plants? Harm them?
- What types of plants seem to attract fish?

wish to see all plants removed from an area. Boaters and anglers may be most concerned with controlling dense floating plants. Thus, finding out the desired uses for a body of water is a first step. This information will suggest both the nature and extent of control required.

The second step is to identify the plants present. Different control measures are effective on different species.

With information on water uses and plant species in hand, specific control measures can be considered. These range from dredging to chemical *herbicides* to large-scale harvesting machines. (A thorough discussion of these options appears in Cornell Cooperative Extension Information Bulletin 107 *Aquatic Plant Management and Control.*) For the purposes of this activity, only simple mechanical techniques are described. These include:

1) Shading - Black polyethylene plastic sheeting can be suspended on wood framing and floated over plant beds. This blocks light and kills plants. Shading works best when applied between May 1 and June 15.

2) Raking - Floating plants may be skimmed or raked from the surface.

3) Cutting - Any blade may be used to cut rooted or emergent plants.

4) Cutting and harvesting - Many submergent plants can reproduce from cut fragments. Simply cutting them may worsen the problem. Harvesting includes removal of cut plants from the water.

5) Uprooting and removal - Uprooting is even more effective than harvesting, since regrowth doesn't have the running start of an existing root system.

Large scale plant problems cannot be handled effectively with these hand techniques. But these approaches can be just the thing for small-scale controls.

## Collecting, Identifying, and Preserving Aquatic Plants

Using the materials described, follow the suggested procedures for collecting and preserving aquatic plant specimens, as outlined under Section I. Plants in the Water, page 4.

### *Project 4. Characterizing a Plant Community (Level III)*

*This project is designed to familiarize participants with the common aquatic plants in their locale, discover criteria for distinguishing among them, and explore relationships between plants and their environment.*

**Materials needed:**

The materials required are the same as listed in Project 1 (page 3).

**Procedures:**

- Find two small bodies of water in which plant collection would be permitted and safe.
- Collect samples of as many different kinds of plants as can be done safely. Observe plants carefully before collecting. (See Appendix 3 for suggestions.)
- Tell which form (e.g., submergent) each plant represents (Appendix 1) and identify each plant as specifically as possible using any suitable field guide or Cornell Cooperative Extension Information Bulletin 107, *Aquatic Plant Management and Control.*
- Group specimens by form and (when possible) genus separately for each body of water.
- Mount samples with notes in notebook.

**Thought provokers:**

- How were the two bodies of water similar? Different?
- How were the plants collected from the two bodies of water similar? Different? What might explain those similarities or differences?
- From your own observations and review of background materials, what roles can you identify that the plants in each body of water might play?
- How might the plants present help or hinder people wishing to use the bodies of water



### *Project 6. Plants as Problem Indicators (Level III)*

*This project is designed to sharpen participants' investigative and observational skills by using aquatic plants as possible indicators of pollution problems. One cause of excessive plant growth is fertilization resulting from nutrients entering the pond from nearby land.*

**Materials needed:**

- Newsprint or other drawing pad, writing instruments.

**Procedures:**

- Locate a small body of water that you can observe with permission and safety. Organize an investigative team with a designated "note taker."
- Make a simple drawing of this water body. Allow space around the perimeter of the pond for notes concerning land activity.
- Note location of plants on drawing of pond. Note form and identity to genus if possible.
- Note on drawing the locations of various activities or land forms (houses, roads, fields, woods) that could be affecting water.

**Thought provokers:**

- Does any particular land activity seem to affect plant growth in water? Are there more plants near homes, fields, or woods?
- Is plant type affected by land activity? Do you see a difference in variety of plants? Types of plants?
- If plants are being affected by nearby land activity, can this activity be changed to reduce this effect?
- Visit another pond with a different land activity nearby. If you first visited a pond near homes, go to the country. If you visited a pond near a farm field, visit one near a wooded area.

### *Project 5. Aquatic Plants and People (Level III)*

*This project is designed to show participants how aquatic plants may influence the use of a body of water.*

**Materials needed:**

The materials required are the same as listed in Project 1 (page 3).

**Procedures:**

- Find two small bodies of water apparently used for different purposes (for example, one used for swimming, one not), preferably with two different owners, in which plant collection would be permitted and safe.
- Collect samples of as many different kinds of plants as can be done safely. Observe plants carefully before collecting. See Appendix 3 for suggestions.
- Tell which form (submergent, etc.) each plant represents (Appendix 1) and identify as specifically as possible using any suitable field guide.
- Group specimens by form and (when possible) genus separately for each body of water.
- Mount samples with notes in notebook.
- Interview the owners to find out what uses the bodies of water have, how they feel about the plants in them, and whether they control the plant growth in any way.
- Try to identify two persons representing each of the major users of the two bodies of water (for example, two anglers from pond A and two swimmers from pond B) and ask them their feelings about aquatic plants.
- Describe how the plants present might influence each use identified for each body of water.

**Thought provokers:**

- Do all of the plants you identified have the same potential to interfere with use of the water? Why?
- Are the opinions of different user groups about aquatic plants similar or different? In what ways?
- What approaches might be used to solve a nuisance plant problem in a pond for which there were many different uses?

## *Project 7. Mechanical Control Techniques (Level III)*

*This project demonstrates the effectiveness of mechanical control alternatives and subsequent effects on plant growth.*

**Materials needed:**

Plant collecting and preserving equipment as described in this guide on page 3 and these items:

- Meter stick
- About 15 meters (50 feet) of clothesline
- Twine
- 8–12 8-penny nails
- Hedge shears (manual type only!), sickle, or other cutting device
- 14 stakes cut from lath or scrap wood, at least 1 meter (3.28 feet) long
- 4 pieces of 2x4-inch lumber, each 1 meter (3.28 feet) long
- One black polyethylene plastic square, 1 meter on a side (can be cut from a garbage bag)
- Thumbtacks

**Procedures:**

Locate a bed of submerged aquatic plants in shallow water that is relatively uniform for at least 6 meters (19.7 feet) along the shore. It should be a site not likely to be disturbed by people or large animals for two months. Get permission to set up your project.

- Make a 1-meter-square frame using the four lengths of 2x4 lumber and nails. Simple overlapping joints are fine.
- Tack the polyethylene to the square to complete the shading float.
- Cut clothesline into one length slightly over 10 meters (32.8 feet) and three lengths slightly over 1 meter (approximately 40 inches).

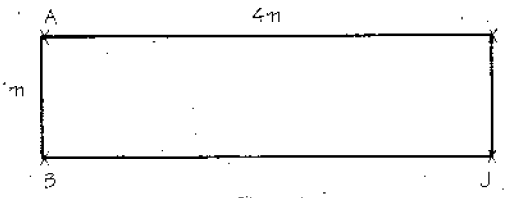



Figure 1

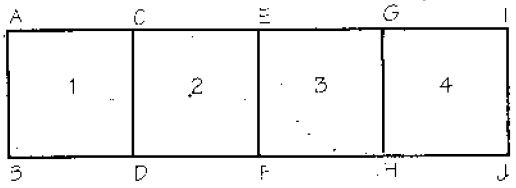



Figure 2

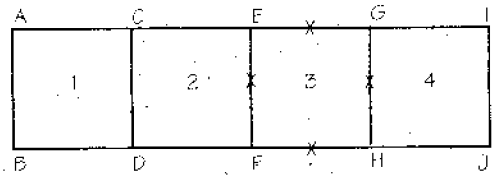



Figure 3

- Drive 4 stakes into plant bed at points A, B, I, and J following pattern in Figure 1.
- Tie long piece of clothesline to stakes, forming a 4-square-meter grid at the water surface.
- Drive stakes at points C, D, E, F, G, H and attach the clothesline to each stake with a short length of twine, as in Figure 2.
- Attach the 3 shorter (approx. 1-meter) lengths of clothesline between stakes C-D, E-F, and G-H to form 4 separate "holes" (see Figure 2).
- Draw a diagram of the grid in your notebook numbering the "holes" as above. Take four small slips of paper and write "control," "shading," "harvesting," and "uprooting" on separate slips. Place in a hat or container and shake. Assign the treatments to the grids by pulling them out one at a time so that, for example, "harvesting" might become number 1, "control" number 2, and so on. Record which treatment will be used in each grid.

***continued on next page***

***project 7 continued***

- Being careful not to disturb plants in the grids, identify as many plants present as possible using the references listed on page 3. Describe the abundance and condition of each plant.
- Place the polyethylene shade in the grid that was assigned "shading" and secure it by driving in four more stakes as shown in Figure 3. Record date of shading.
- Leave grid undisturbed for at least two weeks, then remove the shade. On the same day that you remove the shade, conduct the other two treatments. Uproot and remove all plants from the "uprooting" grid and cut all plants in the "harvesting" grid with hedge shears or other blade. Be careful not to tear out the roots. Remove the clippings. The "control" grid receives no treatment. Record the date.
- At 2 weeks, 4 weeks, and 6 weeks after these treatments, visit the grids and record their conditions as to extent of plant growth, kinds of plants present, comparison to the "control" plot, or other conditions.

**Thought provokers:**

- Was any one of the three treatments more effective than the others? If so, what do you think might explain the differences?
- Did the same plants return to each of the treated grids? Why do you think that happened?
- What are the advantages and disadvantages of each control technique?
- Which control technique would you use if you were a pond owner with a large-scale problem with plants of the kind in the grids?

# Appendix 1. Key to the Basic Forms of Aquatic Plants

*Note: This should be used as an observation tool rather than a formal key. Plants do not always fit nicely into the categories identified. For example, some filamentous algae that grow attached to the bottom detach and become floating plants.*

**A.** Are plants *entirely* underwater?

If *no*, go to B. If *yes*, they are probably submergents.

*Note: Early growth stages of emergents and some plants that later detach and float can be found entirely underwater.*

**B.** Are plants *mostly* under water?

If *no*, go to C. If *yes*,

1. Are plants mostly underwater, with only small stems bearing "blooms" (may look like flowers or nutlike) above or at the water surface?

   If *no*, go to 2. If *yes*, they are probably *submergents.*

2. Are plants mostly underwater but with floating leaves and blooms at or above the water?

   If *yes*, they are probably *floating-leafed submergents.*

   If *no*, they could be early growth stages of one of the basic forms. Or, you might want to go back through the key to see whether you got sidetracked. In either case, you might want a sample for further identification.

**C.** Are plants floating freely on water?

If *no*, go to D. If *yes*, they are probably *floating plants.*

**D.** Are plants rooted underwater in shallow depths, but with most of their growth above water?

If *yes*, they are probably *emergents.* If *no*, you might want to go back through the key to see whether you got sidetracked. In any case, you might want a sample for further identification.

# Appendix 2. Making and Using a Plant Press*

**Materials needed:**

2 - 12x18-inch pieces of 1/4-inch plywood, or better yet, 1/4-inch pegboard.

8 - 18-inch strips of 1x1-inch wood, preferably hardwood. Exact thickness and width are not important, but length is.

40 - 3- or 4-penny box nails.

2 - web or leather belts at least 36 inches long.

Desk blotter material cut into 12x18-inch pieces. *Make twice as many as the maximum number of specimens you want to dry at a time.*

12x18-inch "dryers" cut from corrugated cardboard cartons. The corrugations provide air spaces in your plant-press layers. Corrugations should run parallel to the 12-inch width. *Make 1 more than the maximum number of specimens you want to dry at a time.*

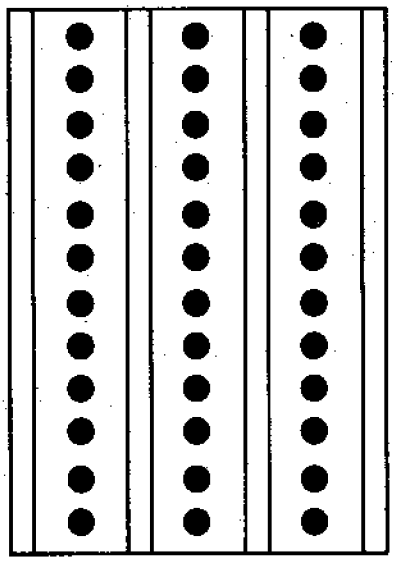
Pieces of standard size newspaper to press the plants between.

**Instructions:**

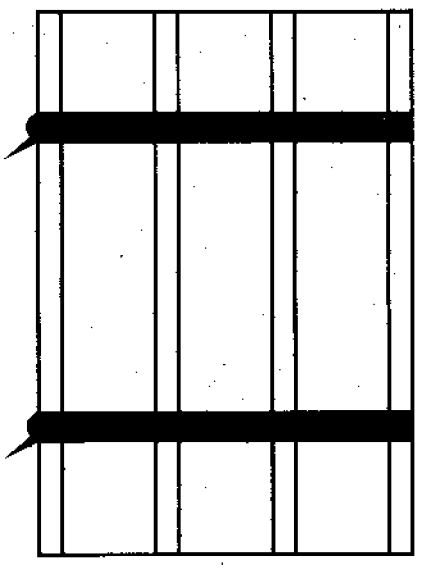
1. Nail the 8 wooden strips to the 2 sheets of plywood or pegboard as shown in D-1. *Note:* If using pegboard, nail strips on rough surface.
2. Place one frame on a table smooth side up. Place dryers, blotters, and specimens on the frame in this sequence:
   1) dryer, 2) blotter, 3) specimen in newspaper, 4) blotter, 5) dryer, 6) blotter, 7) specimen in newspaper, 8) blotter, 9) dryer, 10) blotter, and so on in same sequence.
3. Place second frame on top, smooth side in.
4. Tightly cinch the entire press with the two belts. (See illustration D-2.)
5. Allow to dry. Most specimens will dry in two days or less.

* Adapted from notes provided to the authors by Dr. Lowell D. Uhler of Cornell University.



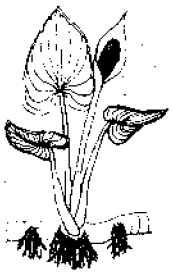



D-1




D-2

# Appendix 3. Sample Collection Notes



(May be reproduced; see also long form below.)

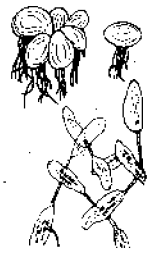
## Short Form

Collector:_____ Specimen no.:_____ Date:_____

Location:_____

Plant form:_____

General notes:_____



(May be reproduced; see also short form above.)

## Long Form

Initials/Year/Specimen

Collector:_____ Specimen no.:_____ Date:_____

Location:_____

Plant form:_____

Depth of collection:_____ Bottom material:_____

Light:_____ Maximum depth observed:_____

Water flow:_____ Water clarity:_____

Condition of plants:_____

Use by organisms:_____

Distribution:_____

Tentative identification:_____

General notes:_____

# Glossary

*Aerated* - supplied with oxygen.

*Algae* - a group of aquatic plants lacking a vascular system, that is, a system of veins for conducting gases, water, and nutrients through the plant.

*Aquatic* - growing or living in or on the water.

*Aquatic plant* - plant growing in or on the water.

*Aquatic system* - a body of water and all the living and nonliving things in it.

*Bog* - wet, spongy mats of plants surrounding open water.

*Decomposition* - process of breaking down into chemical parts, rotting.

*Emergent* - plant rooted in shallow water and having most of its growth above water.

*Erosion* - the action of wearing away of soil or rocks.

*Family* - a biological subgroup of related plants or animals.

*Filamentous algae* - algae in the form of hair-like or net-like mats.

*Floating plant* - an aquatic plant that lives free-floating at or near the water surface.

*Genus* (plural: *genera*) - biological category of more than one related plant species, or of a single, uniquely different species.

*Geologic time* - the long period of time since the formation of the earth.

*Herbicide* - a chemical designed to kill plants.

*Intake pipe* - a pipe that takes water out of a stream, pond, or lake for use in homes or factories.

*Luxury consumption* - when a plant takes in more nutrients than it needs for growth.

*Macrophyte* - large (non-microscopic) aquatic plant.

*Nutrient* - food substance.

*Organism* - a living plant or animal.

*Outflow* - the return of water to a stream, pond, or lake after it has been used in homes or factories.

*pH* - a measure of acidity.

*Photosynthesis* - the process by which plants use light and nutrients to form carbohydrates and other life-sustaining materials.

*Phyla* - a large biological group of plants or animals that have the same general features.

*Phytoplankton* - small, free-floating plants in a body of water, including microscopic forms.

*Plant management* - a series of actions designed to increase the benefits and decrease the problems caused by the plants present.

*Precipitation* - settling out of materials dissolved or suspended in water.

*Predator* - an animal that eats another animal.

*Prey* - an animal taken by a predator as food.

*Respiration* - a physical-chemical process by which an organism supplies its cells and tissues with oxygen and removes carbon dioxide.

*Sedimentation* - process by which solids such as soil particles settle out of water to the bottom.

*Spawning* - laying of eggs by fish.

*Species* - biological category that represents a particular kind of plant or animal.

*Specimen* - an individual plant or animal that has been collected.

*Submergent* - a plant rooted and living underwater.

*Substrate* - the base material upon which an organism lives or which an organism uses. Example: the spawning substrate for muskellunge often is aquatic plants.

*Terrestrial* - living in or on land.

*Vegetation* - plant life.