AQUATIC PLANTS – *Seasonal cycles* Roberta Hill

Life, whether we are aware of it or not, is dominated by cycles. The water cycle, the nutrient cycle, the cycle of life itself, are all natural processes, fundamental to life on earth, which essentially follow circular trajectories. One of the great joys of exploring the littoral zone is the discovery of the many ways in which nature's cycles, grand and minute, elaborate and simple, are played out in these sun-filled watery places.

Cattails in winter

The annual cycle of the seasons is one of the most obvious--and most extraordinary--cyclical processes in the littoral zone. In Maine, where the environmental conditions vary so sharply from one season to the next, changes in these areas are especially dramatic and at no time are these conditions so extreme as in the winter. How do aquatic plant communities respond to the shortened days, the decrease in the intensity of the sun's energy, the plummeting air and water temperatures, the transformation of the habitat from one that is warm and liquid, to one that encrusted under a thick layer of ice and snow?

Though each species has its own unique approach to preparing for and surviving through the hardships of winter, there are some common strategies employed. Since most aquatic plants evolved from terrestrial plants, it is not surprising that many of their over-wintering strategies are similar to those of their wild and cultivated upland kin; strategies you may already know well from observing the plants in your garden. Aquatic plants, just like garden plants, can be sorted into groups based up what they do in response to winter and how they provide for regeneration the following spring.

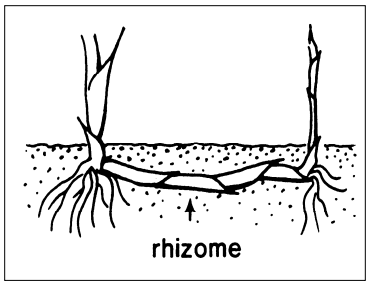
Annuals: Annual plants, in a manner of speaking, are those that have chosen not to bother with surviving the winter at all. As their name implies, annuals live for one growing season only and must produce viable seed by season's end if they are to ensure a new generation the following year. This strategy has advantages and disadvantages. Seeds are more durable and mobile than rhizomes and rootstalks. They can disperse widely and settle into small openings in the plant cover. Many seeds are able to lie dormant in the sediments for many years awaiting favorable conditions. The product of sexual reproduction, seeds also provide genetic diversity, helping to ensure the "adaptability" of the species to environmental changes. Energy-wise, however, seed production is costly, and compared to roots and rhizomes, seeds pack away relatively little in the way of energy reserves.

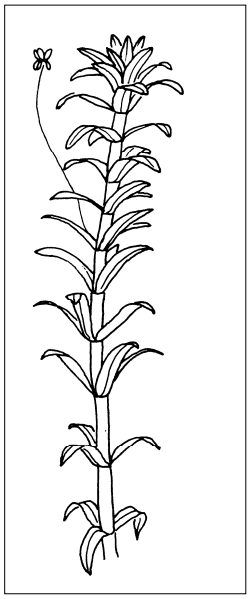
The tiny "seedling-like" waterwort (*Elatine minima*) is a good example of a native annual. The miniature flowers and seed capsules of this plant are produced in the leaf axils (where the leaf meets the stem) during the warm summer months. The ripened seeds drop and settle onto the bottom sediments through the late summer and fall, and there they remain, in a state of dormancy, through the winter. Whereas some seeds of native annuals, like wild rice (*Zizania* spp.), germinate prolifically in disturbed sediments, the key to successful germination for waterwort is a stable, undisturbed bottom and good water clarity.

The tiny waterwort is a native Maine annual (Photo courtesy of the Maine Natural Areas Program)

Of the eleven invasive aquatic plants listed on Maine's watch list, only European naiad (*Najas minor*) is a true annual. The abundant seed production of this invader--tens of millions of *N. minor* seeds per acre have been counted--is a particular torment to those trying to control this plant. During the late summer or early fall, the stems of the naiads become brittle, and the profusely branched stem tips break into small fragments. Seeds remain attached in the leaf axils, and wind and water currents disperse the fragments.

Perennials: Most aquatic plant species found in Maine are perennials; plants capable of over-wintering, in whole or in part, and surviving three or more years. Some, indeed, are very long-lived; a water-lily bed may be hundreds of years old. Aquatic perennials often form extensive and overlapping rhizome systems, expanding every growing season. These persistent mat-like networks stabilize shoreline and bottom sediments throughout the year, making these plants critical components of the aquatic habitat and important allies in the effort to protect water quality.





Elodea
Evergreen Perennial

Some perennials, like cattails (*Typha* spp.), send new shoots up from their rhizomes late in the growing season that remain dormant in the sediments until spring. Others, blue-flag (*Iris verisicolor*) for example, die back to the root or rhizome completely, waiting for spring to send up new growth. Several perennials persist as "evergreens" through the winter, and continue to photosynthesize at a reduced rate under the ice and snow. Our native common waterweed (*Elodea canadensis)* is a good example of an evergreen perennial. And though it may look rather ragged and drained come spring, the stems (and even stem fragments) of invasive variable-leaf milfoil (*Myriophyllum heterophyllum*) may also over winter in this manner, new growth ready, come spring, to unfurl from the growth tip of each blackened stem.

Most perennials that propagate primarily by root division have back up strategies for ensuring long-term success. For example, most produce seeds. Some develop compact vegetative structures called *turions* (also referred to as winter buds) or *tubers*, turion-like structures emerging from subterranean stems. These starchy, densely packed structures have the durability and mobility advantages of seeds, without the high-energy demand or the hit-or-miss nature of sexual reproduction. The highly invasive hydrilla (*Hydrilla verticillata*) sets abundant turions and tubers during the growing season, both structures helping to earn this plant its dubious title of the "perfect weed." Hydrilla tubers, for example, are unaffected by aquatic herbicides and may remain dormant in the sediments for up to ten years.

Some aquatic perennials have no roots or rhizomes to "die back" to at all. The duckweeds (*Lemna* spp.) are examples of *free-floating* native perennials. The tiny but prolific duckweeds are more cold tolerant than many other aquatic vascular plants, and can continue to grow at a normal rate in water temperatures as low as 7º C. In fact, solar radiation allows a dense mat of duckweed to generate its own microclimate (with temperatures up to 10º higher than ambient air temperatures). As temperatures approach freezing, the winter buds of the duckweeds sink to the pond bottom where they lay dormant until warmer conditions return. In the spring, the buds become buoyant and bob back to the surface, completing their seasonal cycle.

Duckweed forming turions
(Photo by Prof. Cheryl C. Smart)

Some sources:

1. Through the Looking Glass A Field Guide to Aquatic Plants, Susan Borman et. al., Wisconsin Lakes Partnership, 1997
2. Aquatic and Wetland Plants of Northeastern North America, Garret E. Crow and C. Barre Helquist, University of Wisconsin Press, 2000.
3. U.S. Army Engineer Research and Development Center (ERDC).website