# THE ROLE OF AQUATIC PLANTS AND SUBMERGED STRUCTURES IN THE ECOLOGY OF A FRESHWATER PULMONATE SNAIL, *PHYSA INTEGRA* HALD.

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## ABSTRACT

*Physa integra* Hald. was abundant on aquatic plants in the Ohio River and apparently preferred species with dense foliage. The termination of annual plant growth in fall was followed by a die-off of snails. Strong currents in spring carried off segments of the mollusk population that were living on submerged driftwood and the bottom. The *Physa* population was largely maintained from fall to summer by individuals inhabiting stable and somewhat protected dock pilings.

## INTRODUCTION

The importance of aquatic higher plants as habitats for freshwater organisms is well known, but few reports have dealt in detail with the mollusk inhabitants. This paper is primarily concerned with the role of plants and other submerged surfaces in the ecology of *Physa integra*. These observations were made during a study of the mollusks in a small area of the Ohio River (River Mile 600.5—600.6) at Louisville, Kentucky. Other findings will be considered in future papers.

At this location the river bottom varied from loose silt and sand mixtures on a broad shoal with depths up to 1 m, to coarse sand and pebbles in the main channel. Scattered beds of the aquatic plants, *Potamogeton pectinatus*, *P. crispus*, and *Najas minor*, formed a zone of submerged vegetation throughout the littoral area, but were more concentrated among a line of boat slips that extended over much of the area studied. Three types of submerged surfaces (permanent, seasonal, and temporary) were present in this area. The permanent substrata were dock pilings and the wooden or stone retaining walls that bordered the shoreline. Aquatic plants and larger pieces of submerged driftwood were considered seasonal because they were present only during certain times of the year. Their removal and subsequent return was an annual phenomenon. Larger driftwood, consisting mostly of tree branches, was washed awwy and replaced with similar material by heavy currents that accompanied spring floods. Thus, there was a yearly overturn of materials that were light enough to be transported by the increased current during late winter and spring. Temporary substrates were miscellaneous smaller objects, such as trash or small pieces of wood, that were readily displaced by minor water movements.

Four other gastropods, *Somatogyrus subglobosus*, *Amnicola integra*, *Promenetus exacuous*, and *Ferrissia fragilis*, were associated with *Physa* on these surfaces.

## MATERIALS AND METHODS

Plants were collected with a fine wire mesh hand net or with a plant hook, and all snails were removed, sorted, and counted in the laboratory. The wet plants were weighed after being blotted free of excess wwter. Gastropod densities were expressed as the number of snails per 100 g of wet plant material. Five such quantitative collections were made between August and November, 1963 and samples were taken again in June and July, 1964. An Ekman dredge was used to take quantitative bottom samples twice monthly from 11 to 16 sites in the 90 m square study area. Samples from such irregular surfaces as submerged driftwood and dock pilings were evaluated somewhat subjectively using the terms abundant, common, and infrequent. A species was regarded as abundant when it constituted a major part of all samples, common if present in over 50 percent of the samples, and infrequent if found in considerably less than 50 percent of the samples. Dock pilings and retaining walls were sampled with a plant hook or by hand. In most cases it was unnecessary to remove the animals from driftwood to evaluate their densities, and they were returned to the water on the object.

## RESULTS

Aquatic plant growth commenced in June but snail communities were not established on the plants until mid July. At this time plant beds covered about 44 percent of the bottom at depths of 3 m or less. *Physa integra* was most abundant on *Potamogeton pectinatus* and *Somatogyrus subglobosus* preferred *Najas minor*. These species were also present, although less abundant, on *Potamogeton crispus*. Small numbers of *Amnicola integra* and *Promenetus exacuous* were found only on *Potamogeton pectinatus* (Table 1). The plants died off in late October and early November but snail populations stayed on the degenerating plant bodies as long as the material survived. Shoots of *Potamogeton pectinatus* were the first to appear in June, 1964, and eggs and juveniles of *Physa integra* were present on these plants by early July. Later in the month the other plant species had developed scattered growths and *Amnicola, Promenetus,* and *Somatogyrus* began to appear on plants. Throughout the study *Potamogeton pectinatus* supported the highest densities and largest variety of mollusks.

TABLE 1

Average snail populations of higher plants August through October, 1963. Values are the number of snails per 100 g of plant material. P. p. - *P. pectinatus*, P. c. - *P. crispus*, N. m. - *Najas minor*.

| Snail | P.p. | P.c. | N.m. |
|---|---|---|---|
| *Physa* | 101 | 1 | 13 |
| *Somatogyrus* | 7 | 2 | 24 |
| *Amnicola* | 1 | - | - |
| *Promenetus* | 2 | - | - |

Most submerged driftwood was situated near the docks and amid plant beds, since the pilings tended to immobilize and accumulate material carried by floodwaters. *Physa integra* was present on the driftwood and boatslips throughout most of the year (Table 2). *Somatogyrus subglobosus* was abundant on these substrata, while *Promenetus exacuous* and *Amnicola integra* occurred only rarely. A freshwater limpet, *Ferrissia fragilis*, was collected infrequently and seemed to be restricted to driftwood. The wood and stone retaining walls along shore were void of snails.

Gastropods were usually found on the free undersides of submerged branches, while upper surfaces of the same branches were covered with gelatinous clumps of filamentous algae and silt. The gelatinous nature of this material was not due to diatom growths. These accumulations of algal filaments and silt particles were swwyed about by weak water currents. In three separate experiments, neither *Physa* nor *Somatogyrus* showed any tendency to retreat from natural or artificial light in laboratory aquaria that were provided with plants or wood pieces for cover. Apparently the instability of the algal growths atop submerged surfaces limited snail habitation of these areas.

Dredge samples showed that *Physa integra* occurred infrequently on the bottom and at densities below those encountered on submerged objects. Specimens were present on the bottom from early fall through spring, but were ab-

sent from bottom samples between spring and early summer (Table 2). The annual decline of aquatic plants was apparently responsible for the increase in snail numbers on the bottom in fall. During October and November a substantial number of empty shells, both juvenile and adult, taken in dredge hauls indicated that a greater part of the *Physa* population perished instead of becoming part of the bottom community after plants disintegrated. The spring decrease in density was seemingly brought about by increased current that removed driftwood and carried off a few centimeters of silt from some spots. Through December, discharges were normally less than 50 000 cfs. However discharges during March and April averaged over 150 000 cfs and over 600,000 cfs between March 8 and 21. During this time the densities of most members of the mollusk assemblage were reduced.

TABLE 2

The distribution of *Physa integra* from August, 1963 through July, 1964. A : abundant, C : common, I : infrequent (see text).

| SURFACE | Aug. | Sept. | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May | Jun | Jul. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Potamogeton pectinatus* | A | A | A | - | - | - | - | - | - | - | C | C |
| *Potamogeton crispus* | I | I | I | - | - | - | - | - | - | - | - | - |
| *Najas minor* | C | C | C | - | - | - | - | - | - | - | - | - |
| Submerged driftwood | I | C | C | C | C | C | C | C | - | - | I | - |
| Dock pilings | - | - | C | C | C | C | C | C | C | C | C | C |
| Bottom (number per $m^2$) | 0 | 2 | 9 | 8 | 5 | 11 | 4 | 6 | 0 | 0 | 0 | 4 |

## DISCUSSION

*Physa integra* inhabited submerged portions of the dock structure throughout the year. The snails spread to maturing hydrophytes in mid summer most likely by means of a few pioneer individuals ovipositing on the plants. The species reached its highest density for the year on these surfaces due to intense oviposition in mid summer. Several workers have demonstrated that egg laying is induced in aquatic pulmonates by rises in temperature (De Witt, 1954). Although it was not observed as closely, newly accumulated driftwood was probably tenanted in the same manner. When the plants disintegrated at the end of their growing season, many of the inhabiting gastropods died; however, some continued to live on the bottom over winter. Both the driftwood and bottom populations were decreased by the impellent action of springtime floods. Thus, individuals established on the more permanent substrata were apparently the nucleus for annual replenishment of the local population. The absence of snails from retaining walls alongshore was probably due to the exposure of these areas to wave action generated by wind and boats.

The three plant species have characteristically different growth forms. That is, *Potamogeton pectinatus* has filiform leaves that develop dense tangles, while *Najas minor* has closely spaced rigid leaves. The broad leaves of *Potamogeton crispus* are more widely spaced. These morphological differences seemingly influenced snail preferences. Boycott (1936) stated that associations between any species of snail and aquatic plant were due to coincident occurrence of the two species. However, vegetation in the area I studied was mixed in such a way that preferences between different plants could be exercised by aquatic organisms. The dense foliage probably offered the advantages of protection from fish predators and a greater food supply in the form of epiphytic algal growths.

*Physa integra* possibly required high dissolved oxygen concentrations that were provided in this instance by close association with plants and algae during the summer months. Those individuals that ended up on the bottom

later in the year survived due to higher dissolved oxygen concentrations that normally develop in the Ohio River from fall to late spring (Table 3). Dawson (1911) proposed that aquatic plants offer an advantage to snails by oxygenating surrounding waters. Also, high rates of oxygen consumption have been reported for some freshwater pulmonates (Von Brand and Mehlman 1953).

TABLE 3

Typical fall through spring variations in dissolved oxygen in the Ohio River. From weekly values reported by Nall (1963).

| MONTH | Dissolved Oxygen (ppm) |
|---|---|
| October | 7.2 |
| November | 8.6 |
| December | 12.9 |
| January | 14.5 |
| February | 16.0 |
| March | 13.1 |
| April | 11.2 |
| May | 9.2 |

*Physa* was never seen migrating to the surface to breathe atmospheric oxygen, and it is doubtful that the snails inhabited any object merely because it gave them access to the water surface. Hunter (1955) found that populations of *Lymnaea peregra* and *Physa fontinalis* in shallow areas of Loch Lomond surfaced for air, while those in deep water utilized dissolved oxygen.

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MANUSCRIPT RECEIVED APRIL 5, 1965.