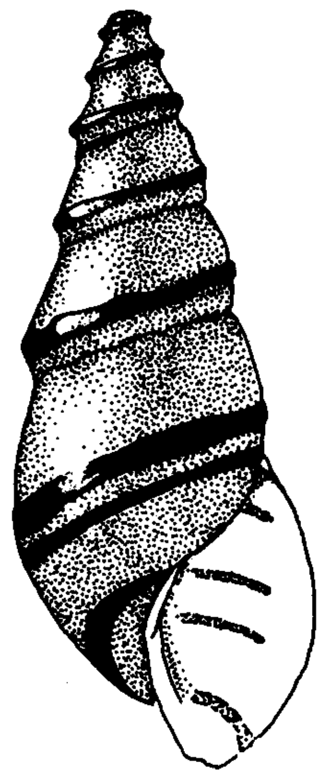
SRO-NERP-10

The Aquatic Snails (Gastropoda) of the Savannah River Plant Aiken, South Carolina



by

Douglas H. Wood

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THE AQUATIC SNAILS (GASTROPODA)
OF THE SAVANNAH RIVER PLANT
AIKEN, SOUTH CAROLINA

by

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of
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INTRODUCTION

Aquatic snails are of interest to ecologists because they are sensitive to environmental changes, important to the life histories of aquatic systems, and important as food chain components and parasite hosts. Snails therefore provide a useful index of environmental impact and should be considered in studies of effects on aquatic systems.

One problem faced in monitoring populations of snails is identification of specimens. To help solve this problem the author has prepared a system of taxonomic aids to the snails of the Savannah River Plant (SRP) area. The first part of the system is a dichotomous key. Descriptive terms not used in general ecology have been defined in a glossary.

The second part of the system is a series of illustrated descriptions which will confirm identifications made using the key. Illustrations were prepared from specimens collected on the SRP or in the Savannah River on or near the SRP, with the exception of a few uncommon species which have been illustrated by using specimens from the Academy of Natural Sciences of Philadelphia (ANSP). The Academy collected those specimens in surveys of the Savannah River from 1952 through 1975 (ANSP, 1953, 1961a, 1961b, 1967, 1970, 1974). Ecological and distributional notes, where available, are included with the species descriptions.

The third part of the system is a permanent reference collection containing documented specimens. This collection can be consulted by staff and visiting scientists and can be expanded by addition of specimens as needed for documentation of routine collections. The collection is located at the Savannah River Ecology Laboratory (SREL) of the University of Georgia at Aiken, South Carolina.

Much effort was made to assure the validity of the species names used. Taxonomic references were consulted and collected specimens were compared with those of the Academy. Representative specimens were deposited at ANSP. In this text, species names are written according to standard convention: The name of the author who first described a species is included after its Latin name (genus and species) and the person's name is placed in parentheses whenever the genus has been changed since the original description.

The author alone is responsible for the accuracy of this guide. However, a note of caution is in order: If a specimen appears to "key out" to one of the listed species but does not fit the included description or illustration, it may be either a species not listed here or a variant of one of the listed species. In such a case it may be best to consult a local malacologist.

SAVANNAH RIVER PLANT STUDY AREA

The Savannah River Plant includes a wide variety of aquatic habitats, some of them artificially altered by nuclear production activities (Figure 1). Within the plant boundaries lie several tributaries of the Savannah River and over 25 kilometers of shoreline of the river itself. The streams, and the ponds formed by their impoundments, include areas formerly heated by thermal effluents (post-thermal areas); areas presently heated (thermal areas); and areas never heated (ambient areas).

The post-thermal areas sampled included Pond B, the Steel Creek Delta and the North Cove of the Par Pond reservoir. These areas were heated from the early 1950's to the mid 1960's. Pond B is unique in that since heating ceased, the pond has had no connection with other bodies of water (Figure 2). The other post-thermal areas are adjacent to ambient areas.

The thermal areas sampled included Pond C and the middle arm of Par Pond. These areas have been heated from the early 1950's to the present. Pond C is much warmer than the middle arm of Par Pond since Pond C is the first impoundment to receive heated reactor effluent, the effluent is then drawn from below Pond C's surface and ducted into Par Pond. The thermal streams (Pen Branch and Four-Mile Creek) were not sampled since they are generally devoid of molluscan fauna with the exception of protected coves which are more similar to the ponds than to true stream habitats.

Ambient areas sampled included sites in Par Pond near the Pump Station and the main retaining dam, the Cold Dam (Figure 2). Also sampled were two small impoundments, Steed Pond and Dick's Pond, and sites along Upper Three Runs Creek, Four-Mile Branch, Meyer's Branch and Lower Three Runs Creek. In addition, Silver Bluff and Johnson's Landing on the Savannah River were also sampled.

The Par Pond sites were characterized by cattail stands, water lilies and occasional sand beaches. Wave action was more intense near the Cold Dam than in other areas. Steed Pond and Dick's Pond include diverse shoreline vegetation and heavy organic sediments. Four-Mile Branch exhibits a rapid flow rate and coarse sediments while Meyer's Branch is practically still and has finer sediments and much fallen vegetation. The larger streams, Upper Three Runs and Lower Three Runs, include a variety of mud flats, small tributaries and sand bars, but the former is swifter and several degrees cooler.

The two sites on the Savannah River itself are similar, with submerged logs, large tree roots and alternating sand and clay banks except that Johnson's Landing includes a jetty constructed of loose, 15-23 cm cobblestone.

COLLECTION SITES

This section contains a list of stations visited by the author, other SREL personnel and limnologists of the Academy of Natural Sciences of Philadelphia. Data gathered by ANSP was published in various Savannah River Survey reports and is given here because the surveys took place over a long period of time (1952-1973) and were more likely to reveal uncommon species than recent collections (1976-1977).

In addition, a chart (Table 1) is included showing which species were found at which stations and their degrees of abundance. Abundance data are subjective since sampling was qualitative and therefore abundance classes are defined as follows: A species listed as "abundant" (A) appeared to be very numerous and was collected in over half of the sampling units (dip-net sweeps or dredge hauls). These species can be reliably collected in large numbers where so indicated. A species listed as "common" (C) was seen often and appeared in at least one tenth of the sampling units. These species can probably be found in repeated samplings but not in large numbers. A species listed as "uncommon" (U) was found only once or twice in a collection and may not be reliably found again. A species listed as "absent" (0) was not found; it may be capable of surviving in the indicated area but is apparently unable to establish a stable, productive population there.

The abundance status of a species (abundant, common or uncommon) may change from year to year due to fluctuations in weather (Russell-Hunter, 1964). Therefore measured abundances are subject to variation. Abundance data are presented in Table 1.

LIST OF COLLECTING SITES

A. Stations visited by ANSP (1952-1975) and Savannah River Ecology Laboratory (1977)

Savannah River (Figure 1)

JL - Johnson's Landing (public)
SB - Silver Bluff (Audubon preserve)

Lower Three Runs Creek (Figure 1)

DS - Donora Railroad Station
TCR - Tabernacle Church Road bridge (open to public)
L3R - S.C. Highway 125 bridge (open to public)
BS - Boiling Springs Natural Area (open to public)

B. Stations visited by SREL only (1976-1977)

Upper Three Runs Creek (Figure 1)

DP - Dick's Pond on SRP Rd. F 699 m East of Rd. 4
SP - Steed Pond near SRP Rd. 2
U3RF - At SRP Rd. F bridge
U3RC - At SRP Rd. C bridge

Four Mile Creek (Figure 1)

4MB - Four Mile Branch downstream of SRP Rd. 3

Steel Creek (Figure 1)

MB9 - Meyer's Branch at SRP Rd. 9
SCD - SREL Boat Landing on creek delta

Par Pond System (Figure 2)

PBS - South Shore of Pond B

PCE - East Short of Pond C (heated to 10^{o} above normal)
NCP - North Cove of Par Pond

BD - SREL boat dock on Par Pond (heated to 5^{o} above normal)
PSN - North Shore of Pump Station Arm of Par Pond
PSSC - Cattails along south shore of Pump Station Arm
PSSB - Muddy bank along south shore of Pump Station Arm
CDW - West end of Cold Dam
CDE - East end of Cold Dam

Note: Visits to stations not listed as public or preserve areas must be arranged through SREL.

Table 1. Abundance of snails at various collecting sites.

	COLLECTING SITES[a]																					
	Savannah River		Lower Three Runs Creek				Upper Three Runs Creek				Four Mile Creek	Steel Creek		Par Pond System								
SPECIES	JL	SB	DS	TCR	L3R	BS	DP	SP	U3R6	U3RF	4MB	MB9	SCD	PBS	PCE	NCP	BD	CDW	PSSC	PSSB	PSN	CDE
Succinea ovalis	O[b]	O	O	O	C	O	O	O	O	O	O	O	O	O	A	O	O	O	O	O	O	O
Fossaria humilis	U	O	O	U	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Pseudosuccinea columella	C	C	U	C	C	U	O	O	O	O	O	U	U	O	O	O	O	O	O	O	O	U
Laevapex fuscus	U	U	U	U	U	C	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Ferrisia rivularis	A	C	O	U	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Physella heterostropha	C	C	U	C	C	C	O	U[c]	O	O	O	O	C	C	C	A	A	A	A	A	A	A
Gyraulus parvus	U	C	O	U	U	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Menetus diliatatus	C	C	U	U	U	O	O	O	O	O	O	O	A	O	O	O	A	A	A	A	A	A
Helisoma anceps	U	O	O	O	O	O	O	O	O	O	O	O	C	C	O	A	O	A	A	A	A	A
Helisoma anceps- (Narrow variant)	O	O	O	O	O	O	O	O	O	O	O	O	C	O	O	O	C	O	C	C	O	O
Helisoma trivolvis	C	C	O	C	C	O	O	O	O	O	O	O	C	A	C	A	A	A	A	A	A	A
Valvata tricarinata	U	O	O	O	U	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Amnicola limosa	A	U	O	U	C	O	O	O	O	O	O	O	O	O	O	O	O	O	O	A	O	O
Amnicola sp.	U	A	O	U	A	U	O	O	U	O	O	O	O	O	O	O	O	O	O	O	O	O
Somatogyrus sp.	U	U	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Pomatiopsis lapidaria	U	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Goniobasis proxima	O	O	O	A	C	A	O	O	O	O	O	C	O	O	O	O	O	O	O	O	O	O
Campeloma decisum	U	C	A	A	A	A	O	U	A	A	C	O	A	O	O	C	O	O	O	O	O	O

[a] See text for explanation of site symbols (p.6).

[b] A = abundant, C = common, U = uncommon, O = absent

[c] Eggs belonging to same genus found, no adults

COLLECTION AND PREPARATION OF SPECIMENS

Aquatic snails are collected using standard methods for benthic invertebrates. For quantitative samples, a Peterson or Ekman grab can be used, but since snail distribution may be clumped, a large number of random samples must be taken. A benthic dredge pulled by a motor boat is nearly as accurate as a grab sampler and is more rapid (Russell-Hunter, 1961). For shallow waters, a dipnet can be used, sampling either by quadrat or by sweep count. For qualitative samples, a dipnet is quickest but a kitchen strainer tied to a long pole may be most convenient. For snails that prefer hard substrates, the collector can simply lift rocks and bits of dead vegetation and inspect for snails clinging to them.

If snails are collected as part of a general benthic survey, they can be preserved in Rose Bengal and formalin with the rest of the sample. The dye may, however, change the shell color. Because of the possible use of dyes, no identification made with this guide will depend entirely on natural shell color. If snails have been preserved in formalin the operculum may have become separated from the shell. This makes the identification of a few species difficult. If it causes a big problem, first try "matching up" the operculae with the shells. The operculae, or "snail shell doors", look like dark to transparent chips with "fingerprints".

For display of research specimens, snails can be preserved either "wet" or "dry". For the "wet" method the snails are relaxed in 5% percent alcohol for about an hour, then transferred to 10% formalin. Wet-preserved snails should be stored in glass screw-top vials nearly full of formalin. For the "dry" method, snails are dropped into boiling water for several minutes, then cleaned out with a bent dissecting pin. The operculum, if present, can be re-attached by gluing in with a wad of cotton for support. Very small snails can be dried. Dry-preserved snails are placed in shell vials or cork-stoppered vials. Cotton can be used instead of a cork or stopper and should also be placed in the bottom of the vials to protect the shells.

Whichever method is used to preserve the snails, the label should be placed inside the vial. If the vials are arranged in subdivided drawers, duplicate labels can be placed in the compartments so that specimens, once removed, can be returned to their proper compartment.

Snails collected alive and preserved using one of the described techniques can be identified more accurately than dead shells picked up in samples. Erosion or mineral deposit can change the shell's color or thickness or obscure fine details. Once several well-preserved specimens of each type are identified, broken shells and poorly preserved material can be identified by comparison.

Ideally, specimens should be checked with a mollusc taxonomist. The taxonomic status of snails changes often and only a specialist can keep up with published changes in scientific names. Researchers should at least note the sources used for species identification in their published reports. If the status of an investigated species then changes, the reader can determine which species was involved by checking more recent guides or contacting the author of the older taxonomic guide.

GENERAL ECOLOGY OF AQUATIC SNAILS

The distribution of aquatic snails has long been known to depend upon chemical and physical characteristics of the water (Boycott, 1936; Macan, 1950). Different locations, therefore, will harbor different assemblages of snails. The snails' sizes as adults and their fecundity and abundance will vary from place to place and from year to year according to climatic factors (Russell-Hunter, 1964). Because of their responsiveness to the environment, snails constitute a useful indicator of water quality (Patrick, 1950). In other words, the numbers and kinds of snails will change when the water quality changes. The prosobranch snails (gill breathers) and the pulmonate snails (lung breathers) respond differently to environmental change. In general, the prosobranchs depend upon clean, flowing waters and are endangered by pollution or impoundment (Heard, 1970). The pulmonates, however, are usually pollution-tolerant and some are benefited by alteration of lakes and streams. However, different types of pollution have different effects upon the various groups of pulmonates. For example, certain lymnaeids (pond snails) tolerate large amounts of organic material in the water or low oxygen concentrations, but these types may be eliminated by changes in the water level or increases in temperature. The physids (pouch snails) are heat-tolerant, having evolved as shoreline dwellers, and will tend to replace other groups of snails around power plants. The planorbids (orb snails) are tolerant of moderate levels of organic and thermal pollution, but require fairly still waters. Increasing the flow rates of rivers may harm the orb snails.

Snails lack mobility and are generally restricted by habitat but still manage to spread to new areas. They reach suitable new habitats by various passive means. For example, snails are transported in the feathers of water birds (Roscoe, 1955; Malone, 1965; Dundee et al., 1967). Limpets are transported within a stream by attaching to water insects (Rosewater, 1970). Human modes of transportation can carry snails long distances. European and Asian snails are occasionally found in North America and sometimes appear to be well established in their new environment (Dundee, 1969). Imported snails can become pests by fouling water supplies and introducing diseases such as snail fever and liver flukes. Native snails, however, are rarely harmful (Laycock, 1966). Disease-carrying tropical snails may become a problem in the warmer areas of North America but whether they will move into thermally altered areas of cooler regions is uncertain. Tropical animals are generally intolerant of temperature changes, which are common in power-plant environments. A more certain risk of thermal alteration is that local parasite populations may increase if the snail hosts increase in number or become more susceptible to infection. Temperate-zone snail parasites normally infest fish and water birds and occasionally produce an annoying skin irritation in humans (swimmer's itch). The role of temperature in natural host-parasite interactions has been investigated by SREL scientists.

Snails are important to the nutrition of wildlife species and are involved in several routes of energy flow in nature. Some feed upon algae attached to rocks or aquatic plants, while others feed upon organic material and microorganisms in the mud. Both types are important to higher animals, since the food energy in algae and sediments is not concentrated enough for the needs of active animals. By feeding upon snails, fish and birds can obtain that food energy in a more concentrated form. Stomach content analyses have confirmed the importance of snails as food for fish (Eyerdam, 1968; Bennett and Gibbons, 1972). Young turtles also eat snails (Knight and Gibbons, 1968). It is readily understood, therefore, how factors affecting aquatic snails may have indirect effects upon wildlife species.

The preceding has been a general discussion only; specific information is needed for reliable decision-making. Therefore, ecological notes have been added to the descriptions of the SRP snail species included in the following section.

SPECIES LIST OF THE AQUATIC SNAILS OF THE SRP

Subclass Pulmonata

Order Stylommatophora

Family Succineidae

Succinea ovalis (Say)

Order Basommatophora

Family Lymnaeidae

Pseudosuccinea columella (Say)

Fossaria humilis (Say)

Family Ancylidae

Laevapex fuscus (C. B. Adams)

Ferrisia rivularis (Say)

Family Physidae

Physella heterostropha (Say)

Family Planorbidae

Gyraulus parvus (Say)

Menetus dilitatus (Gould)

Helisoma anceps (Menke)

Helisoma trivolvis (Say)

Subclass Prosobranchia

Order Mesogastropoda

Family Valvatidae

Valvata tricarinata (Say)

Family Hydrobiidae

Amnicola limosa (Say)

Amnicola sp.

Somatogyrus sp.

Pomatiopsis lapidaria (Say)

Family Pleuroceridae

Goniobasis proxima (Say)

Family Viviparidae

Campeloma decisum (Say)

KEY TO THE AQUATC SNAILS OF THE SRP

1.	Shell limpet form (cap-shaped)	2
	Shell planispiral or with elevated spire	3
2.	Shell height ÷ length = about 0.43 (=elevated). Apex with fine radial striae (often eroded).	*Ferrissia rivularis*
	Shell height ÷ length = @ 0.26 (depressed). Apex smooth but shell may have fine raised riblets on the anterior slope.	*Laevapex fuscus*
3.	Shell planispiral	4
	Shell depressed spire or with elevated spire	7
4.	Shells carinated above and below	5
	Shells not carinated	6
5.	Shells with deep umbilical pit above and below	*Helisoma anceps*
	Shells with one side flattened and without umbilical pit	*Helisoma trivolvis*
6.	Shells with shallow wide umbilical area	*Gyraulus parvus*
	Shells with deep, narrow umbilical hole	*Menetus dilitatus*
7.	Shells with depressed spire, three spiral cords	*Valvata tricarinata*
	Shell with elevated spire	8
8.	Shell sinistral	*Physella heterostropha*
	Shell dextral	9
9.	Shells with aperture length about 1/3 of total shell length; with operculum	10
	Shell with aperture length about ½ of total shell length, with or without operculum	11
10.	Shell length 4 to 8 mm, in height, whorls rounded.	*Pomatiopsis lapidaria*
	Shell length > 10 mm, whorls flattened	*Goniobasis proxima*
11.	Operculate shells	12
	Without operculum	15

12.	Shell ovate conic, height about double the width, height > 12 mm, operculum with concentric growth	*Caompeloma decisum*
	Shell globose, height about equal to width, height < 10 mm, operculum paucispiral	13
13.	Shell thin, body whorl rounded, columella not thickened, umblicate	14
	Shell thick, columella thickened, body whorl shouldered, imperforate or with only umbilical chink	*Somatogyrus* sp.
14.	Deep pronounced umblicus	*Amnicola limosa*
	Shallow umbilicus	*Amnicola* sp.
15.	Aperture about 80% width of shell; height of aperture about 81% length of shell	*Succinea ovalis*
	Aperture width < 90% width of shell; height of aperture < 65% length of shell	16
16.	Width of aperture ÷ width of shell = @ 0.78	*Pseudosuccinea columella*
	Width of aperture ÷ width of shell = @ 0.66	*Fossaria humilis*

DESCRIPTIONS OF SPECIES

Succinea ovalis Say

Description

The shell is elliptical in outline, dextral and imperforate. It is thin, amber or pale yellow and has no distinct markings. The spire is small and rounded, the body whorl nearly covering the inner whorls. The aperture is broadly elliptical, with its length being about twice the aperture width. Adult snails are about 6 - 8 mm in total shell height.

The head and eyestalks are dark and the foot, whitish. The mantle and body are olive drab, giving the living snail a dark appearance despite the light-colored shell. Hubricht (1963) disputes the existence of *S. ovalis* in the Southeast. However, the specimens collected on the SRP fit the description for the *Succinea ovalis* group according to Pilsbry (1948).

Ecology and Distribution

Succinea ovalis is found on wet shorelines throughout the U. S. and, where present, is found in large numbers. It was found among scattered cobbles and on cattails along Pond C by John C. Aho (SREL) and on aquatic plants along Lower Three Runs and Steel Creek by the author. *Succinea* is a true land snail (Stylommatophora) but, because of its preference for wet areas, it is also likely to be encountered in aquatic sampling.

Pseudosuccinea columella Say

Description

The shell is ellipitical in outline, dextral and imperforate. It is thin, translucent amber and smooth. The aperture height is about half the total shell height. The spire is not prominent but is sharply pointed. Adults are about 8 - 10 mm total shell length.

The head and mantle are whitish grey. The eyes are found at the bases of short, thick tentacles.

Ecology and Distribution

Pseudosuccinea is common in lakes and along stream banks throughout the eastern U. S. and occasionally is found in the U. S. West and South America. It was collected in the unheated area of Par Pond, Lower Three Runs and Steel Creek by the author. It was also found in Lower Three Runs and the Savannah River by the Academy of Natural Sciences. Like other lymnaeids, *Pseudosuccinea* may require cool waters and grows rapidly despite the lower temperature. Certain lymnaeids produce an annual generation in habitats of lower productivity and two generations in habitats of high productivity (Hunter, 1975).

Fossaria humilis (Say)

Description

The shell is dextral with an elevated spire. The whorls are elliptical and annulated and have fairly deep sutures. The aperture is elliptical, its inner lip reflected and whitish. The lower lip is rounded. The shell is thin, translucent and amber in color. The species was formerly referred to as *Lymnaea humilis* Say and *Galba humilis* (Say) (described from ANSP specimen 330504).

Ecology and Distribution

The genus Fossaria is widely distributed (Clench, 1959). F. humilis is probably an eastern species. It is found on mudflats and other silty areas, usually burrowing in the mud of shorelines. Core samples of a New York lake indicated that Fossaria was present in the lake's early history, but disappeared in the 1800's when dredging of the outlet lowered the lake level (Harman, 1970). The species may serve as food for swamp-dwelling birds, but evidence of this is lacking. This species was found twice in the Savannah River (1952, 1972) by the Academy of Natural Sciences.

Laevapex fuscus (C. B. Adams)

Description

The shell is a flattened cone, elliptical as viewed from above. The shell height, from base to apex, is about half the width. The apex is smooth and displaced to the left of the longest axis which is about 4 - 5 mm long in adults. The shell is thin, amber colored but the body is dark brown. In profile, Laevapex is lower and more rounded than Ferrisia and its apex, which is somewhat posterior, is displaced to the snail's right, while that of Ferrisia is closer to the midline. Earlier works refer to Ferrisia fusca (C. B. Adams). The correct genus is now Laevapex. Refer to Basch (1963) for a systematic review of recent North American freshwater limpets.

Ecology and Distribution

Laevapex is found in lakes and quiet areas of streams throughout most of North America. It can be collected on leaves and other solid objects in shallow water. Like other freshwater limpets, Laevapex exhibits reverse metabolic acclimation to temperature: when placed in cold water, the limpet's metabolism does not slowly return to the warm-water value after a quick decrease, but decreases further until the animals enter a state of torpor. Unlike stream limpets, Laevapex is tolerant of low oxygen concentrations and maintains a fairly constant rate of metabolism despite variations in oxygen level (McMahon, 1973).

Laevapex will probably withstand the effects of impoundment but not those of severe thermal alteration. It was found in Lower Three Runs by the author and also in the Savannah River by the Academy of Natural Sciences.

Ferrisia rivularis (Say)

Description

The shell is a flattened cone, elliptical in cross section when viewed from above. Its height from base to apex is about equal to the width. The apex is completely covered with growth rings, and is near the midline but seems to be leaning to the right. The shell is thin, dark amber colored but the body is dark brown. Adults are about 5 mm in the longest dimension, but young are much smaller and may be more numerous than adults in early summer. Description based on SREL specimen deposited at ANSP (344903). Refer to Basch (1963) for more information.

Ecology and Distribution

Ferrisia is common in North America; F. rivularis predominates in the East. It is found on hard substrates in the rapid zones of streams, both in natural riffles and on artificial substrates.

Ferrisia requires rapid currents and high oxygen concentrations (McMahon, 1973). Freshwater limpets are pulmonates and despite the simple shell form, are an advanced group. They possess a secondary gill formed by an extension of the mantle. Limpets apparently graze on algae growing on hard substrates.

Limpets are usually uncommon in coastal streams because of the scarcity of natural riffles, but are abundant on riprap associated with bridges and boat landings. Limpets seem to benefit from non-biodegradable refuse such as beer cans (Dexter, 1959). The author found several Ferrisia on bottles dumped at Johnson's Landing on the Savannah River, and on leaves at Silver Bluff. This species was also found in the Lower Three Runs by the Academy of Natural Sciences. Impoundment would definitely harm the species by eliminating the rapids zones of natural streams.

Physella heterostropha (Say)

Desription

The shell is elliptical in outline, sinistral and imperforate. The spire is small and pointed. The shell is thin and amber in color. The inner edge of the aperture is folded back slightly over the body whorl. The body is greyish; the mantle is black with white spots and is extended slightly when the snail is in motion. The tentacles are dark, long and slender. The head and foot are also dark brown. Eggs are laid in a colorless jelly mass, there being about 15-30 eggs per mass but the number varying according to environmental factors. Most adults collected on the SRP were about 6 - 8 mm in shell length; a few were larger - about 12 mm.

The taxonomy of the physids is difficult since few species have distinct shell forms or unique internal parts (Te, 1973). Since the small physids seem to be ecologically similar, confusion of species may not affect the accuracy of community-level studies. The species may, however, vary biochemically and physiologically.

Species other than P. heterostropha may exist on the SRP but remain unrecognized. Physa crocata Lea has been mentioned (ANSP, 1967; 1970), but most early references are simply of "Physa Sp." SREL specimens were deposited at ANSP (344902, 344908, 344910, 344912).

Ecology and Distribution

Physids are widespread throughout the world. Physella heterostropha is common in the Eastern U. S. It is found on sand or mud and also on hard substrates. It probably is a grazer of algae, but like many other snails it may also feed upon animal remains. Physella was found by the author in Ponds B and C and Par Pond and also in Lower Three Runs, Steel Creek and the Savannah River. This species has been reported in Lower Three Runs and the Savannah River by the Academy of Natural Sciences. It is probably found in all SRP waters except those severaly altered by production activities. The physids are eurythermal, capable of functioning normally over a wide range of temperatures, and are fairly tolerant of chemical pollution (van der Schalie and Berry, 1973). Eggs of unknown viability and active adults have been observed in Pond C (heated by reactors to up to 10° C above normal) by John C. Aho (SREL). Physella was found to be an intermediate host to parasites of mosquitofish and water birds and is currently being studied by SREL scientists to determine the effect of temperature on its role in parasitism.

Gyraulus parvus (Say)

Description

The shell is a flat spiral, with whorls elliptical in cross section. Whorls are not flattened or keeled as in *Menetus*. The aperture is oblique. The shell is finely striated and dark brown in color. The umbilicus is wide and deep and the apex is slightly depressed. Abnormal shells of *G. parvus* have been found in Massachusetts which were dextral as usual, but with elevated, separate whorls (Smith, 1976). No such deformities have been found for *Gyraulus* on the SRP, but similarly deformed *Helisoma trivolvis*, both field-collected and laboratory-reared, have been encountered. Adults are about 3 mm in shell diameter.

Ecology and Distribution

Found in still waters throughout North America. *Gyraulus* is common but obscure because of its small size. It is usually found on narrow-stemmed plants such as *Myriophyllum*. *Gyraulus* was reported in the Savannah River and Lower Three Runs by the Academy of Natural Sciences. It was found in the Savannah River by the author.

Menetus dilitatus (Gould)

Description

The shell is a flat spiral, and finely striated. The top edge of the whorls is slightly flattened. The umbilicus is narrow and deep and the apex depressed. The shell is amber or whitish yellow. Adults are about 4 mm in diameter. The whorls enlarge rapidly with growth but are not keeled above and below as in young *Helisoma anceps*. Specimens were deposited at ANSP (344898 and 344907).

Ecology and Distribution

Menetus dilitatus seems to be limited to the Southeast while small *Gyraulus* spp. dominate the Northern States. It is abundant around small aquatic plants at many SRP sites. It has been found in Par Pond (heated and unheated areas), Lower Three Runs and Steel Creek and has also been reported in the Savannah River by the Academy of Natural Sciences.

Helisoma anceps (Menke)

Description

The shell is flat, spiral, striated and amber in color. The upper and lower edges of the whorls are ridged, the aperture appears flared but is not bell-shaped and does not have a reflected lip. The umbilicus is deep and the apex deeply depressed. Adults in South Carolina are about 10 mm in maximum shell diameter; larger individuals are collected further north. The head and foot are brown and the mantle yellowish with large black spots. The viscera have a slight greenish tinge. Specimens were deposited at ANSP (344899, and 344906). A variant form of *H. anceps* was found among normal specimens in several collections. It was narrower and its aperture more oblique than normal specimens. It also had two reddish bands surrounding the whorls; these were especially visible on the inside of the shell. Specimens of this variant were also deposited at ANSP (344893).

Ecology and Distribution

Helisoma anceps is found in still waters of lakes and streams throughout the eastern U. S. as far south as Georgia. It is found on hard or soft substrates in 1 - 3 mm of water (Chaetum, 1934). The species produces a single annual generation in New York (Herrman and Harman, 1974) and in Ontario (Boerger, 1975). Adults mature at the age of one year and few survive beyond that age. The life cycle in South Carolina and Georgia is poorly known at present. Eggs are laid in flat amber capsules containing about 20 - 30 eggs each.

Limnologists of the Savannah River Laboratory (SRL) have discovered that normal form *H. anceps* are absent from heated waters on Par Pond but that it occurs with *H. trivolvis* in unheated areas (L. J. Tilly, personal communication). The SRL studies further revealed that *H. anceps* lays fewer eggs than *H. trivolvis* when the two species occur together (Johnson, 1975a). *Helisoma anceps* has been found to be slightly less tolerant of high temperatures than *H. trivolvis* in the laboratory (van der Schalie and Berry, 1973; Johnson, 1975 b). The distribution of the two *Helisoma* species in Par Pond serves as a model for the species' general distribution: the two occur together in the Northeastern United States, but only *H. trivolvis* is found in the warmer Midwest and Southwest regions.

Helisoma anceps was found in the Savannah River by the Academy of Natural Sciences and by the author. It was also found in Pond B, Par Pond and Steel Creek by the author. It is usually abundant, especially in still waters during summer. This species has been given several names in the past, including *Helisoma antrosa* (Walker) and *Helisoma bicarinatum* (Conrad). Specimens given these various names are far from identical but can probably be considered subspecies of *H. anceps*. A narrow variant was found in Steel Creek and in the heated and unheated areas of Par Pond. It was common where found, but not as abundant as the normal form.

Helisoma trivolvis (Say)

Description

The shell is a flat spiral; apex can be seen in a flat circular depression, about 4 mm across. The shell is striated and light to dark brown in color. The aperture is D-shaped and is not oblique. The young appear flat-topped with a deep trough in the lower edge of the aperture but begin to resemble adults at about 7 - 8 mm in diameter (young described from laboratory-reared specimens). Adults mature at about 10 mm in diameter and grow to about 15 mm in South Carolina. Individuals grow to twice that size further north. One to three varices (circular ridges in the shell) may be present. The first varix appears in 8 mm snails. The head and foot are dark brown; the mantle is yellowish with black spots. Specimens were deposited at ANSP (344900, 344909 and 344914).

Ecology and Distribution

Helisoma trivolvis is found in still waters, including stream pools, across North America from Canada to Mexico (Clench, 1959). It seems to be a grazer of algae but will also eat animal remains. It produces one annual generation, maturing at two years, in Ontario and probably has a similar life cycle in other northern locations. It produces three annual generations, maturing at 3-5 months in Par Pond on the SRP (Wood and McFarlane, 1976). Par Pond *Helisoma* exhibited little annual variation in metabolism when measured at field temperatures (Johnson, 1975c). This was explained by an acclimation effect at the temperatures encountered (Wood, 1976a,b). Seasonal patterns of change in soft tissue and shell weight were observed in Par Pond but the differences due to distance from the thermal outfall were small or nonexistent (Wood, 1976b). Biochemical variation in *Helisoma trivolvis* may account for the metabolic adaptation. The variation may be long-term (evolutionary) or short-term (acclimatory) or a combination of the two processes. The biochemistry of *Helisoma* is currently being investigated by SREL in an attempt to identify the sources of variation. *H. trivolvis* was shown to be eurythermal by van der Schalie and Berry (1973). Its widespread distribution seems to be due to its wide thermal tolerance and because of this wide distribution, the species is valuable for studies of spatial variation in physiology and population genetics. The species was found in Lower Three Runs and the Savannah River by the author and the Academy of Natural Sciences. It was found by the author in Par Pond (all areas) Pond B and C, and Steel Creek and was abundant in Par Pond and Pond B and common elsewhere.

Valvata tricarinata (Say)

Description

The shell is dextral with loose elevated whorls. Each whorl is bordered by three prominent ridges. The aperture is small and circular and the operculum shows close spiral growth lines. The shell is thin and light amber in color; the mantle is dark but the head and foot are white. Adults are about 5 mm in shell diameter which is the same as the shell height. When the snail is crawling undisturbed, the gill, siphon and proboscis protrude from the aperture near the head. A specimen is deposited at ANSP (354174).

Ecology and Distribution

Valvata tricarinata is widely distributed in North America but is found mostly in the North (Clench, 1959). It was collected by the Academy of Natural Sciences in the Savannah River and Lower Three Runs, once at each station. It was not encountered by the author on the SRP.

Amnicola limosa Say

Description

The shell is dextral and smooth with rounded whorls. The inner lip of the aperture is folded back slightly and is separated from the body whorl. The umbilicus is deep and uncovered or only slightly covered by the aperture lip. The operculum has loose spiral growth lines, enlarging with counter-clockwise rotation. The shell is yellowish and rather thin. Adults measure about 3 mm in both shell length and diameter. The head and tentacles are white; the mantle is light yellow. Specimens were deposited at ANSP (344895).

Ecology and Distribution

Amnicola is found in lakes and along stream banks over most of North America (Clench, 1959). The species has poor temperature tolerance and is difficult to maintain in the laboratory. When successfully cultured, each adult lays several egg masses with one egg per mass (van der Schalie and Berry, 1973). The species spawns twice a year in early and late summer in New York State and over-winters in about 2 m of water, spawning near the shoreline during summer (Horst and Costa, 1975). It was found to be common in Lower Three Runs and the Savannah River by the Academy of Natural Sciences. It was also found by J. H. Thorp (SREL) and the author in Par Pond opposite the SRL Limnology Field Laboratory.

Amnicola sp.

Description

The shell is dextral with somewhat rounded whorls. The umbilicus is fairly deep and partially covered by the inner lip of the aperture. The operculum has tight spiral growth lines. The shell is light brown in color. The head and tentacles have dark markings. Adults are about 2 mm in shell diameter. Specimens were deposited at ANSP (344896).

Ecology and Distribution

This species is found along pond shorelines and stream banks and was reported in Lower Three Runs and the Savannah River by the Academy of Natural Sciences and by the author. It was also found in Upper Three Runs by the author. Consider it different from *Amnicola limosa*.

Somatogyrus sp.

Description

The shell is dextral, imperforate or narrowly perforate; the inner lip of the aperture is straight and nearly covers the umbilicus. The whorls are slightly shouldered. The shell is smooth and light yellow but is covered with a black mineral deposit. The apex may be eroded even in small shells. Adults are about 4.5 mm in shell diameter.

Ecology and Distribution

Somatogyrus is found in shallow waters in the Southeast. It seems to be uncommon since it is rarely mentioned. The species was collected once in the Savannah River by the Academy of Natural Sciences (Patrick et al., 1967). A similar Somatogyrus sp. was found once at Silver Bluff by the author.

Pomatiopsis lapidaria (Say)

Description

The spire is tall with smooth, rounded whorls. The shell is thin and whitish to brown in color. The aperture is nearly circular and its inner edge partially overlaps the umbilicus. The aperture length is about one third the total shell length. The shell width varies with locality of collection, possibly due to environmental influences (Hubricht, 1960) (described from ANSP specimen 27847).

Ecology and Distribution

Pomatiopsis is found out of the water on mud flats and wet stream banks over most of eastern North America (Clench, 1959). Its amphibious habitat is interesting since it is a gill-bearer. Closing the operculum probably prevents desiccation during dry periods, and special respiratory structures may be present.

The species was found occasionally along the Savannah River by the Academy of Natural Sciences.

Goniobasis proxima (Say)

Description

The spire is tall and conical, the whorls are slightly rounded and the sutures are shallow. The lower lip of the aperture is rounded and slightly deflected downward. The inner edge of the aperture is straight. The shell is imperforate. The shell is dark olive drab outside with two brownish-red bands inside each whorl. These bands are visible as external ridges in young snails. The head and body are mostly dark with white areas, the viscera are bright green. Specimens were deposited as ANSP (344891, 344892 and 344894).

Goniobasis mutabilis (Lea, 1862) and *G. suturalis* (Haldeman, 1840) are synonyms of *G. proxima* (Say, 1825). The description of *G. carinifera* Lamarck, 1822) states that this species has granulose sutures. Tryon's monograph of the group show *G. carinifera* with beads between whorls. Accordingly, *G. carinifera* is distinct from *G. proxima*.

Goniobasis catenaria (Say), a similar species, was reported several times by the Academy of Natural Sciences but was not found by the author.

Ecology and Distribution

Many species of *Goniobasis* have been reported in Atlantic and Gulf Coast areas and many of those are thought to be extinct or endangered due to pollution or stream modification (Heard, 1970). The pleurocerids apparently require hard substrates and open, flowing waters. Dams eliminate this habitat and although bridges and jetties may replace the hard substrates, they cannot restore the stream flow. Where found, pleurocerids are abundant. The described species was found in Lower Three Runs by the author and in Meyer's Branch of the SRP by D. H. Nelson.

Campeloma decisum (Say)

Description

The shell is elliptical in outline with an elevated spire. The whorls are rounded, and slightly shouldered. The aperture is teardrop shaped, its lip not reflected. The shell is imperforate. The operculum is dark amber with concentric growth lines. Shell length of adults ranges from 15-30 mm. The shell is light olive and thick but may be covered with a reddish-brown deposit. The mantle is light blue, the foot white. The shell may be white or bluish inside. Shells are usually dextral but occasionally a sinistral individual is found (Bickerl, 1966).

The name, *Campeloma lima* (Anthony) has been used by the Academy of Natural Sciences. However, the author found only one basic shell form which was identified as *C. decisum*. The taxonomy of *Campeloma* is unsettled at present and many of the proposed new species may be identical to *Campeloma decisum*. Perhaps studies of the biochemistry and physiology of this group of snails will help to solve the species problem. Specimens were deposited at ANSP (344897, 344901, 344904 and 344905).

Ecology and Distribution

Campeloma decisum is found commonly throughout the eastern United States in lakes and streams (Clench, 1959). The species is ovoviviparous and has separate sexes. The females mature at two years in North Carolina and males are extremely scarce (Chamberlain, 1958).

The snail burrows in the mud, nearly concealing the shell. In streams, *Campeloma* avoids the channels but is abundant in pools and along muddy banks. It is abundant in Upper Three Runs, Four Mile Creek, Lower Three Runs, Steel Creek and the Savannah River. It is also common in the North Cove of Par Pond.

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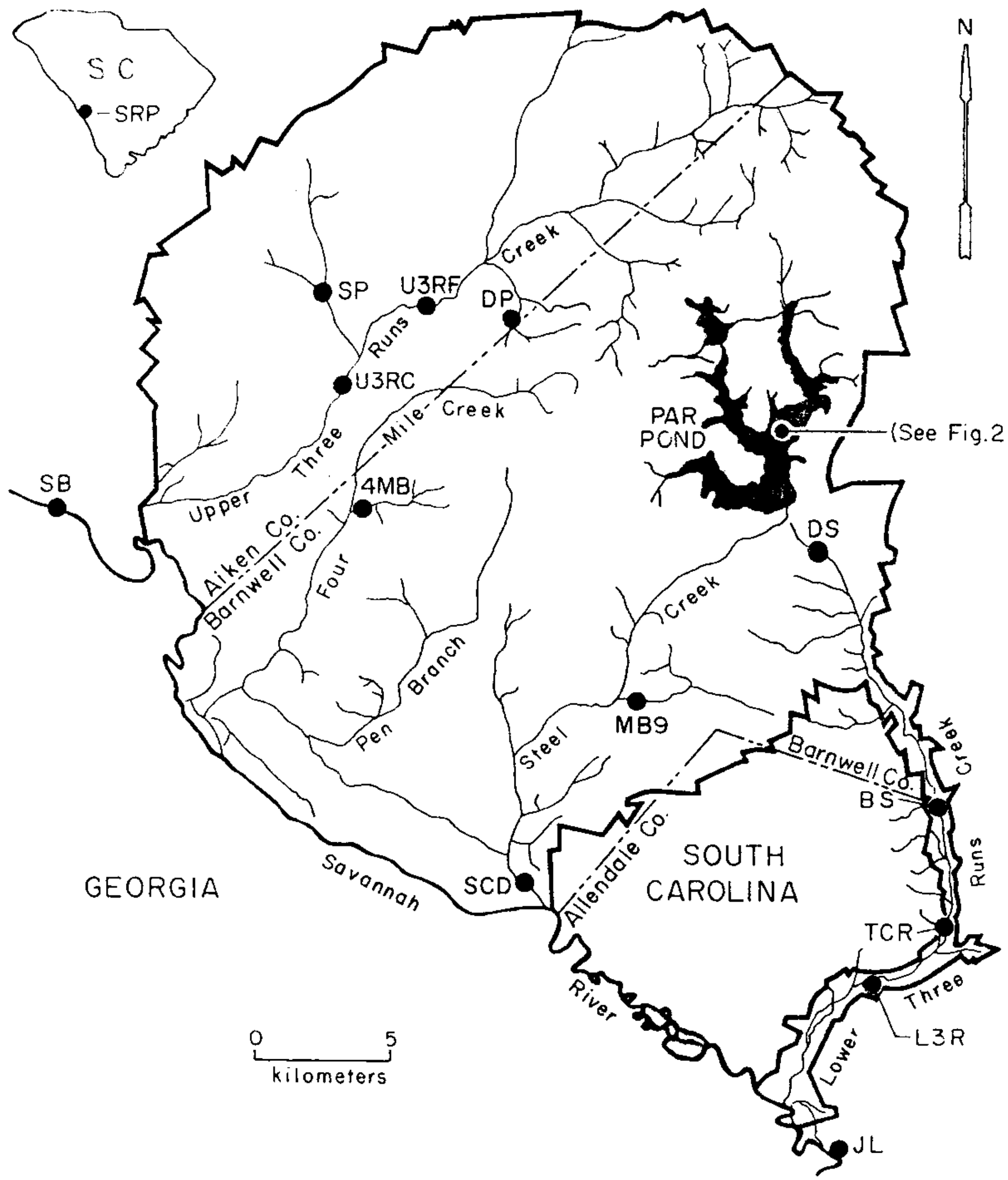


Figure 1. Collecting sites of the aquatic snails of the Savannah River Plant (SRP). BS = Boiling Springs, DP = Dick's Pond, DS = Donora Station, JL = Johnson's Landing, L3R = Lower Three Runs, 4MB = Four Mile Branch, MB9 = Meyer's Branch, SB = Silver Bluff, SCD = Steel Creek Delta, SP = Steed's Pond, TCR = Tabernacle Church Road, U3RC = Upper Three Runs Creek at Road C, U3RF = Upper Three Runs Creek at Road F.

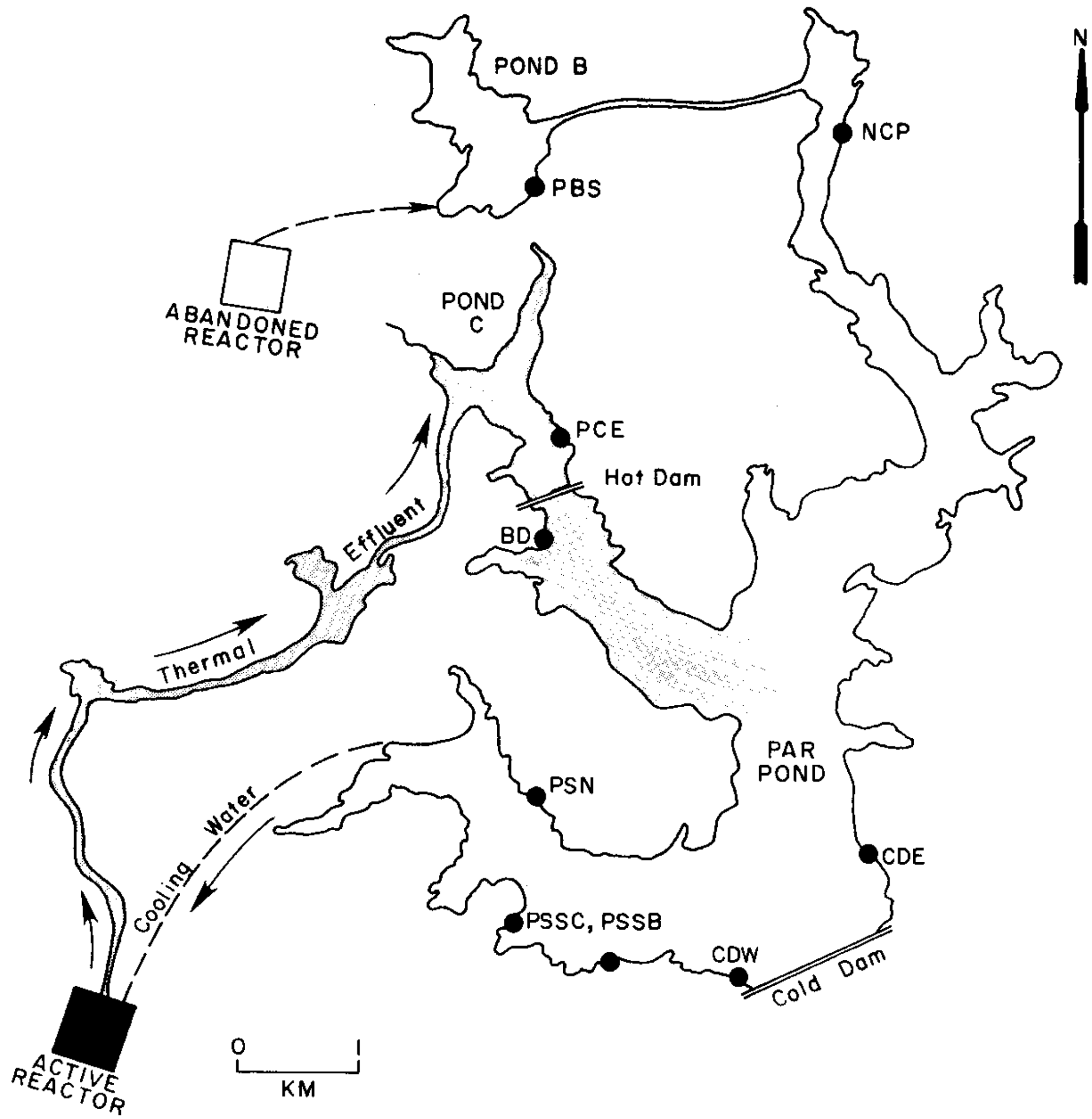


Figure 2. Collecting sites of aquatic snails from the Par Pond reservoir system of the Savannah River Plant (SRP). BD = Boat Dock, CDE = Cold Dam East, CDW = Cold Dam West, NCP = North Cove Par, PBS = Pond B South Shore, PCE = Pond C East Shore, PSN = Pump Station North Shore, PSSB = Pump Station South Shore Bank, PSSC = Pump Station South Shore Cattail Stand. Stippling indicates extent of influence of heated reactor effluents.

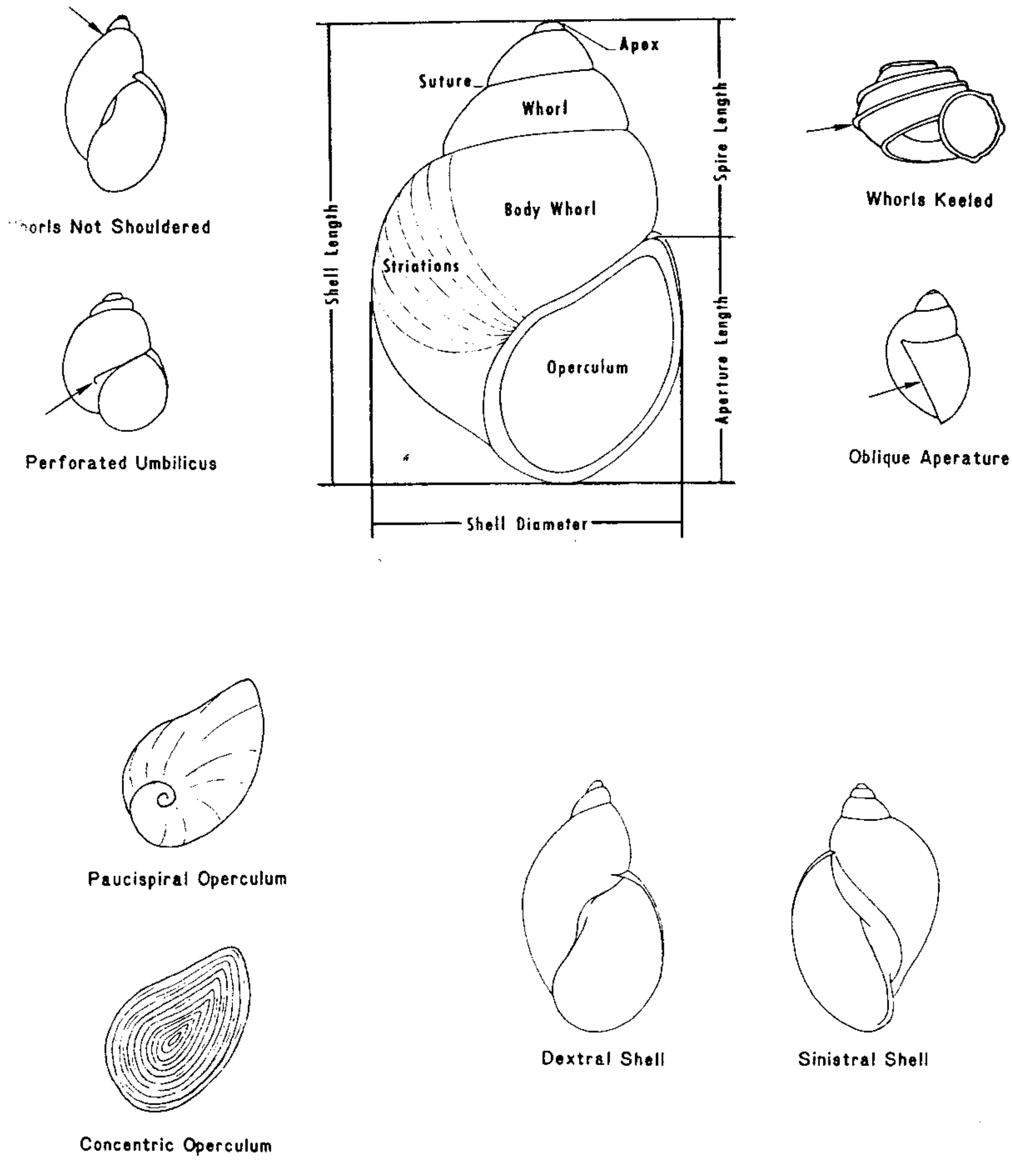
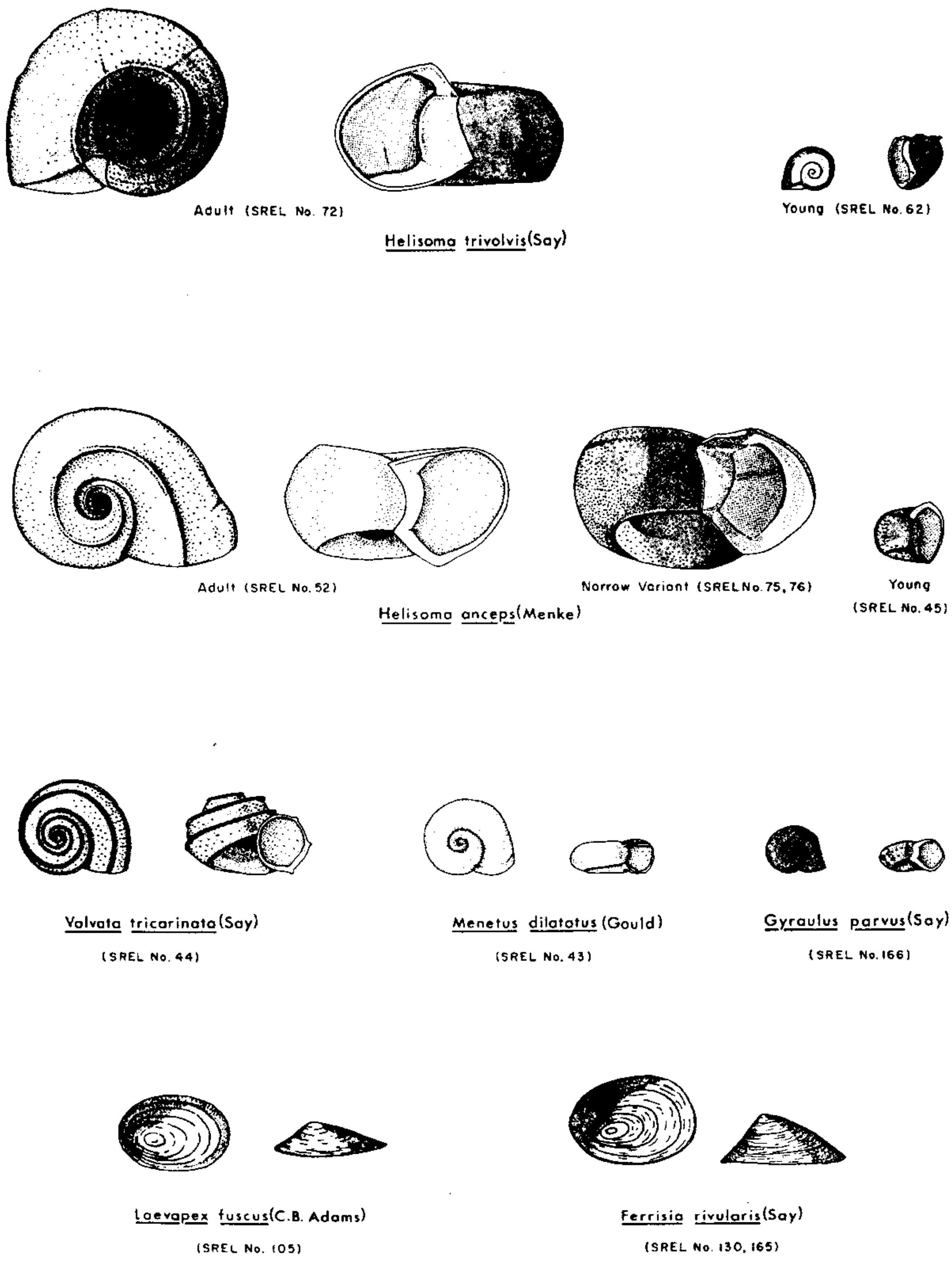
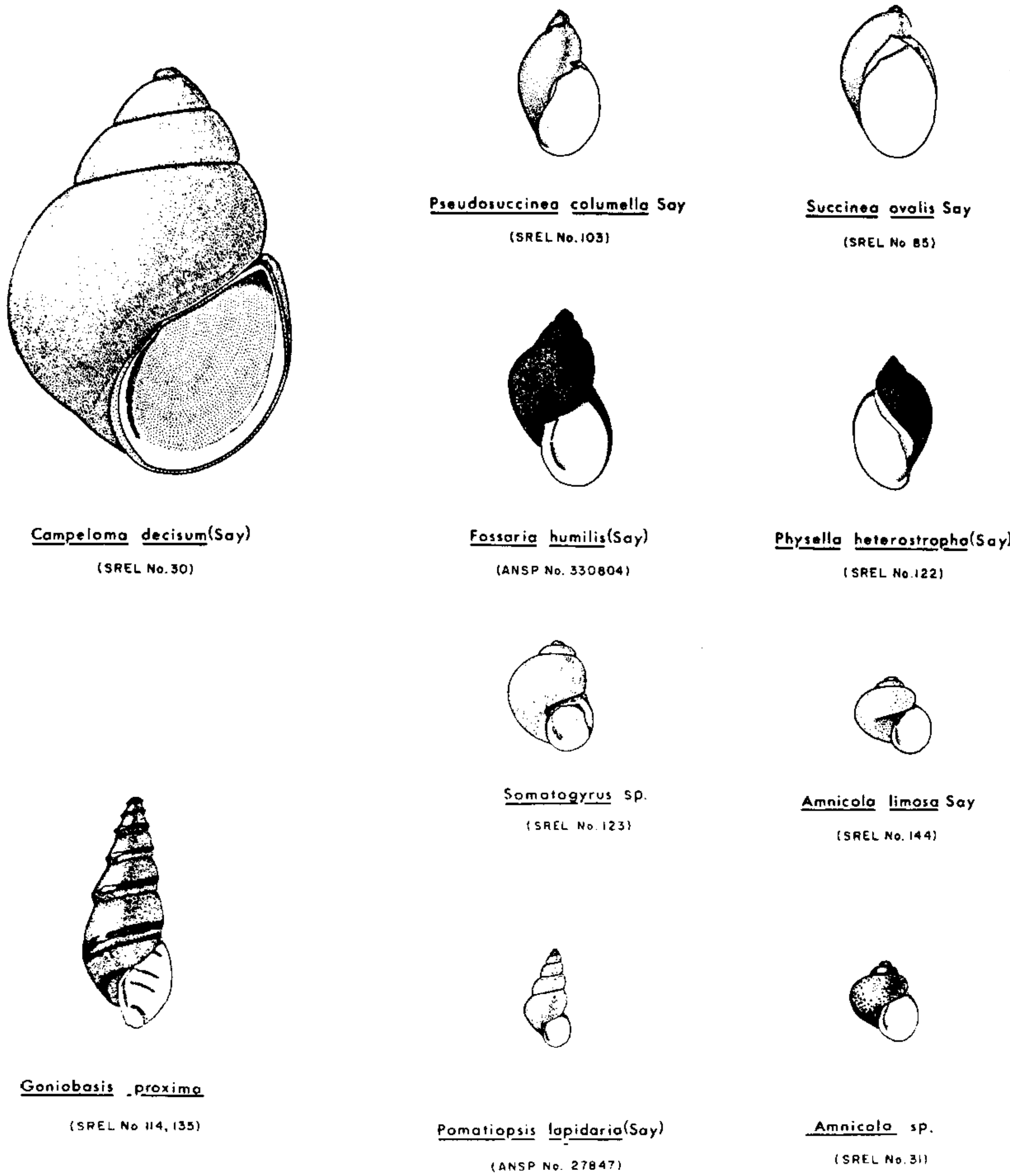


Figure 3. Gastropod shell terminology. For illustrative purposes the scale and orientation of the shells have been varied.



Figures 4a. Aquatic snails of the SRP. Snails were drawn from specimens of the SREL Museum Collection or the Academy of Natural Sciences of Philadelphia Museum Collection. Museum specimens used are listed below the taxonomic names as SREL no. or ANSP no., respectively.



Figures 4b. Aquatic snails of the SRP. Snails were drawn from specimens of the SREL Museum Collection or the Academy of Natural Sciences of Philadelphia Museum Collection. Museum specimens used are listed below the taxonomic names as SREL no. or ANSP no., respectively.

Appendix I. Glossary

Aperture . . . . The opening in the shell for the body.

Aperture length . . . The length of the aperture measured parellel with the axis of coiling.

Apex . . . . The uppermost point of the shell; the origin of growth.

Body Whorl . . . . . . The final whorl; the one containing the snail's body.

Dextral . . . . The aperture is on the observer's right when viewed with the apex uppermost (right handed).

Imperforate . . . . . Without a visible depression (umbilicus) opposite (below) the apex.

Keeled . . . . Having a sharp edge or ridge along the whorls.

Oblique . . . . Not on a plane parallel to the axis when viewed laterally.

Operculum . . . . . . A flat "door" which closes the aperture after the body withdraws; found only in prosobranchs.

Shell diameter . . . . The maximum width of the shell measured perpendicular to the axis of coiling.

Shell length . . . . . The maximum length of the shell measured parallel to the axis of coiling, from the apex to the lower margin of the aperture.

Shouldered . . . . . . Having a narrow "shelf" at the top edge of each whorl.

Sinistral . . . . . . The aperture is on the observer's left when viewed with the apex uppermost (left handed).

Spire . . . . The elevated portion of the shell above the aperture.

Striated . . . . Having fine ridges parallel to the direction of growth.

Sutures . . . . The junctions between whorls.

Umbilicus . . . . . . A depression in the shell opposite the apex.

Varix . . . . A region of closely spaced growth rings (annuli) forming a ridge perpendicular to the direction of growth.

Whorl . . . . A complete turn of the shell during growth.