Control of snail:

Because of the economic, sociological, as well as scientific difficulties, snail control is regarded as the best means of control of trematode infections. Snails can be controlled indirectly by reducing their habitat or directly by removing them. Where these measures are not sufficient to eliminate snail populations, the use of molluscicides may be considered.

Management method:

The important management methods of controlling fluke infections are:

- Regular clearing of drainage channels because vegetation provides suitable sites for snail development.
- Good drainage and the building of dams at appropriate sites in marshy and low-lying areas may reduce the snail problem.
- To keep livestock away from pastures contaminated with metacercariae.
- Establish proper watering facilities to prevent animals from drinking from lakes, ponds, and streams.
- Animal grazing in high highland.
- Several plants have molluscicidal properties. Because snails and slugs favor seedlings and plants with succulent foliage, planting of these trees and shrubs along streams and irrigation channels can reduce the number of snails in a population.
- The introduction of large numbers of ducks into rice fields after harvest has been used to reduce the snail population. The ducks eat the snails, and the fluke species specific to the ducks compete with the fluke species of ruminants in the infection of snails. It is reported that snails infected with duck flukes will not become infected with flukes of livestock.

Chemical method:

The use of molluscicides for the control of snail intermediate hosts is a potential tool for the control of fluke infections. Before considering chemical control of snails, it should be noted that:

- Many habitats are topographically unsuitable for the use of molluscicides, and it is often very difficult to apply them effectively.
- They are toxic to the environment.
- Cooperation between neighboring properties is required for effective coverage.

- Regular (at least yearly) application is required because rapid repopulation of snails may occur.
- They are not species-specific and may destroy edible snails, highly valued as food in some communities.
- They are expensive.

Chemical control: use of molluscicide, repellents

1. Copper sulphate solution (30 ppm)
2. Copper sulphate powder with sand @10-35 kg/hectare of land
3. Niclosamide 70% powder
4. Sodium pentachlorophenate@ 5-10 ppm
5. N-tritylomorpholine (highly effective) @ 0.45 kg in 680 litres/hectare

Caution:

- Animals should not be allowed to graze on treated pasture until the next rainfall
- Toxic to fish

Application of chemicals is usually restricted to places frequently used by the local population for swimming, washing, bathing & so on. Currently, only one chemical molluscicide: Niclosamide, is acceptable for operational use in the snail control program. Because of its high cost, Niclosamide is used only seasonally in a few local control programs. At low cone. it is highly toxic to snails & their egg masses. For practical use, a conc. of 0.6-1my/bit, is recommended as the exposure time of 8 hrs. This compound is safe to handle, after dilution, is non-toxic to water plants and crops, but very toxic to fish. Fish killed by the molluscicide can be safely eaten.

Natural Enemies:

Snails and slugs have many natural enemies, including ground beetles, pathogens, snakes, toads, turtles, and birds, but most are rarely effective enough to provide satisfactory control in the garden. Domesticated fowl-such as ducks, geese, or chickens are kept penned in infested areas can be effective snail predators that significantly reduce problems.

Handpicking:

Handpicking can be very effective if done thoroughly on a regular/basis. At first, you should look for snails and slugs daily, paying careful attention to potential hiding places. Wear thick gloves and

gumboots to remove any old wooden boards and other garden rubbish. After the population has noticeably declined, a weedy handpicking can be sufficient. The best time is 2 hours after sunset by torchlight. Another option for killing slugs you have collected is to spray them with a solution of household ammonia diluted to 5 to 10% solution in water.

Traps:

You can trap snails and slugs beneath boards or upside-down flower pots, dark-colored plastic sheeting that you position throughout the garden scrape off the accumulated snails and slugs daily and destroy them; crushing is the most common method. Don't use salt to destroy snails and slugs, since it will increase soil salinity.

Barriers:

Several types of barriers will keep snails and slugs out of planting beds. The easiest to maintain are those made with copper flashing and screen. It is believed that copper barriers are effective because the copper reacts with the slime that snails and slugs secrete, disrupting their nervous system similar to an electric shock When erecting vertical copper screens, it is best to use ones that are at east 4 inches tall, so you can bury a portion of it a few inches below the soil to prevent slugs from crawling beneath the barrier.

Repellent sprays can be made at home from garlic or wormwood. Commercial garlic sprays are strong enough to kill slugs and young snails.

Copper foil (e.g. Snail Barr) wrapped around planting boxes, headers, or trunks will repel snails for several years.

The predatory decollate snail, Rumina decollata, has been released in southern California citrus orchards to control young brown garden snails and is providing very effective biological control. It feeds only on small snails, not full-sized ones.

Baits:

Several types of snail and slug bait products are available. Baits containing the active ingredient **metaldehyde** are most common; however, metaldehyde baits are particularly poisonous to dogs and cats, and the pellet form is especially attractive to dogs. Don't use metaldehyde snail baits where children and pets could encounter them. Metaldehyde baits containing 4% active ingredient

are more effective than those containing only 2%; however, they are also more toxic to dogs and wildlife. Avoid getting metaldehyde bait on plants, especially vegetables.

Iron phosphate baits- available under many trade names including Sluggo and Escar-go-have the advantage of being safe for use around children, domestic animals, birds, fish, and other wildlife, making them a good choice for an integrated pest management program in the garden. Ingesting even small amounts of the bait will cause snails and slugs to stop feeding, although it can take several days for the snails to die. You can scatter the bait on lawns or on the soil around any vegetable, ornamental, or fruit tree that needs protection. Iron phosphate baits can be more effective against snails than slugs overall, and more effective than metaldehyde during periods of higher humidity. Snails and slugs tend to hide before they die.

Sprinkle baits in areas that snails and slugs regularly frequent, such as around sprinkler heads. Placing baits repeatedly in the same area maximizes control because mollusks tend to return to food source sites. Never pile bait in mounds or clumps, especially those products that are more hazardous, because piling makes bait attractive to pets and children and is not as effective as sprinkling. Thick, liquid belts might persist better when it is rainy or in areas that receive sprinkler irrigation.

The timing of any baiting is critical; baiting is less effective during very hot, very dry, or cold times of the year, because snails and slugs are less active during these periods. Irrigate before applying a bait to promote snail activity, and apply the bait in the late afternoon or evening. Sprinkle bait around sprinklers, close to walls and fences, or in other moist and protected locations, or scatter it along areas that snails and slugs cross to get from sheltered areas to the garden.

Malacology

Malacology is the branch of invertebrate zoology that deals with the study of the Mollusca. Mollusks include snails, slugs, clams, octopus, squid, and numerous other kinds, many of which have shells.

Conchology: Study of the Shell of Mollusk.

Malacologist - a scientist who studies mollusks (the Phylum of animals that includes land snails).

Anal pore-opening in the mantle to allow waste elimination.

Aperture - the opening of a snail shell from which the snail's soft body emerges, sometimes called the "mouth."

Apex- the top end of a shell's columella, opposite the umbilicus and furthest from the aperture.

Axial-a direction parallel to a shell's columella.

Callus-a thickening in the shell wall.

Columella-the central, structural axis of revolution a snail's shells. At the top of the columella is the shell's apex, and at the bottom, the shell's umbilicus (though it may be covered).

Dart - a tiny calcareous spear injected into a potential mate's flesh prior to copulation.

Denticle- a solid calcium carbonate deposit integral to a land snail shell, usually at the aperture or within the shell. Denticles are often referred to as "teeth" and are supposed to aid in shell positioning, predator deterrence, or calcium provisioning.

Whorl: each one of the complete rotations of the shell spiral/ each 360 revolutions of a snail's shell, measured from the apex.

Body whorl: the largest whorl in which the main part of the visceral mass of the mollusk is found

Sinistral: a direction meaning whorled to the left. A sinistral shell's aperture appears on the left to the observer when the shell is positioned with the apex up and the umbilicus down. None of Pennsylvania's land snails, excepting anomalies, exhibit this character.

Dextral: a direction meaning whorled to the right. A dextral shell's aperture appears on the right to an observer when the shell is positioned with apex up and umbilicus down and aperture toward the observer. All of Pennsylvania's and snails are normally dextral.

Genital pore - the opening to a land snail's reproductive organs, usually located on the right si the tentacle. Most of Pennsylvania's land snails are hermaphroditic.

Semelparous life history in which adult snails mate once and then die.

Keel - a longitudinal ridge on the top of a snail or slug's tail.

Mantle - the membrane-like organ that builds the shell in shelled snails, found around the aperture. The mantle is also present in slugs, where it serves as a dorsal covering.

Odontophore-cartilage structure in the mouth over which the radula is drawn to rasp food.

Operculum-a hardened cover that closes the aperture of a shell.

Pneumostome-an opening in the mantis to allow air passage. Also called the breathing pore.

Peristome: the part of the shell that is right around the aperture

Periostracum: a thin layer of organic "sin" which forms the outer layer of the shell of many species

Radula-a chitinous organ in the mouth of a snail, covered with a series of tiny teeth that function to rasp food.

Spiral-a direction parallel to a shell's direction of whorl growth

Spire - the part of a shell above the body, full whorl

Sculpture: ornamentation on the outer surface of a shell

Suture: The junction between whorls of most gastropods

Tentacle - one of two to four elongate, retractable sensory appendages at the snail's head; they are devoted to chemoreception and most have eyespots as well.

Umbilicus-the depression at the base of a snail shell, leading into the interior space of the columella. The space may be open, perforate, very tiny, or closed, covered by shell material.

Biological classification of snail

Kingdom: Animalia

Phylum: Mollusca

Class: Gastropoda

Order: Basommatophora

Family: Planorbidae	**Family: Lymnaeidae**	**Family: Pilidae**
Genus: Planorbis	**(Freshwater snail)**	**Genus:** Pila
Species: *Planorbis planorbis*	**Genus:** Lymnaea	**Species:** *Pila globosa*,
Genus: Indoplanorbis	**Species:** *Lymnaea auricularia*	*Pila virens*
Species: *Indoplanorbis exustus*	*L. luteola, L. acuminata L. stagnalis, L. truncatula*	**Genus:** Ampullaria
Genus: Bulinus.	**Genus:** Fossaria	**Species:** *Ampullaria globosa*
Species: *Bulinus* sp.	**Species:** *Fossaria* sp.	(Apple snail)
Genus: Segmentina		
Species: *Segmentina* sp.		
Genus: Hippeutis		
Species: *Hippeutis* sp.		

Order: Metagastropoda

Family: Viviparidae	**Family: Thiaridae**
Genus: Viviparous	**Genus:** Thiaria
Species: *Viviparous* sp.	**Species:** *Thiaria* sp.
Genus: Bellamya	**Genus:** Brotia
Species: *Bellamya bengalensis*	**Species:** *Brotia costula, Brotia costulata*
Species: *Hetisoma crassa/ dissimilis* (found in Bangladesh)	**Genus:** Melanoides
	Species: *Melanoides tuberculatus*

Ecology of Snails:

1. Snail habitat: snail differs in their choice of habitat. e.g, pulmonate snails require low water current, minimal pollution, aquatic vegetation, and low salinity. Pectinate snails prefer shaded or moist ground, edges of streams in low, flat alluvial plains suitable for lowland farming and rice culture. They require shade, moist soil, decaying vegetable matter, and a fluctuating water level.

2. Water, pH, and Temperature: pH and temperature of water play an important role in the activity of snails. Although they can survive underwater for several weeks, they usually prefer to live on the edges of water. They do not move in a definite direction, and some creep along the edges of water.

3. Soil: Snails may burrow in the mud to protect themselves against desiccation and are associated with hibernation; Some may burrow up to 40cm in depth. Usually, hibernation occurs when---

- Lack of water sources.
- Fall of temp below 23 degrees.
- Nutrient is not available.

4. Growth: The rate of growth in snails is greatly influenced by the supply and availability of food, and influences size and time to maturity. Snails attain maturity within 2-12 months. They usually die within a few weeks of cercarial release; some may survive up to 2 years.

5. Physiology: Oxygen is required for normal functioning of all snails; their activity regarding reproduction and parthenogenesis, and shedding of cercariae is influenced by oxygen tension, temperature, and light. Anaerobic conditions reduce shedding cercariae. Snails produce 30 to 2,00,000 eggs in their lifetime, and these hatch within 3 weeks to 3 months.

Economic importance of mollusks

✓ Food-Jewelry-Conchology-Ecology-exchange medium (money)

Aesthetic value

➤ The colorful molluscan shells of varieties of shapes, sizes, forms, and textures have great aesthetic appeal to human beings of all ages.

➤ Shells like cowries have a long history of being used as currency, notably in Asia, Africa, the Indian Ocean, and the Bay of Bengal, including Bangladesh.

➤Cowries are considered jewels of the sea, as aristocrats as charms, amulets.

Commercial value

➤Commercial shells are used in the shell craft industry for preparing many value products.

➤Shell is used as a poultry feed ingredient to supplement calcium.

➤ Seashells are used in the preparation of ornaments like jewelry (necklace, rings, hairpins, bangles); household articles such as trays, table lamps, stands, toys, key rings, buttons, chains, etc.

➤Ornaments made of chunks and chunk blowing are a common custom to announce any auspicious, religious, or sacred event.

➤Shells like Kosturi and Jongra are used for producing edible lime, which is a good source of revenue.

➤The pearl is the most valuable gem produced by some bivalve molluscs. They are used as a means of jewellery.

➤The black pearl is rare, highly valued. Pink, creamy-white, and black pearl necklaces and earrings have much demand in the world market.

Gastronomic/food value

➤ Molluscs are important as human food, poultry and shrimp feed, and edible lime. A wide variety of molluscs, like snails, mussels. cockles, oysters, clams, cuttlefish, squids, and octopuses are considered a delicacy ill over the world, a special delicacy to the French.

➤ Snails are also an important item in the diet of frogs, lizards, birds, and many mammals.

Biomedical value

➤Pearl is used as medicine. Seed small pearls are used in the preparation of Ayurvedic medicine called Mukta Bhasma. Molluscs are also used in the preparation of Ayurvedic and homeopathic medicines in the form of extracts of oyster shell, cowry shell, and operculum of Pugilina. Ayurvedic drugs are used to treat skin disease, asthma, rickets, cough, and jaundice.

A new antibiotic has been isolated from the eggs of *Nassarius* sp.

Vitamin A has been reported from bivalves, gastropods, and cephalopods.

Geological importance

The hard and limy fossils of the mollusks are a chronological time clock to determine geological time. Through their fossils, geologists are also able to locate oil deposits below the Earth's surface.

Mollusca: Latin "Mollis", or "Molluscs", means "soft". Mollusca means soft bodies and was first used by Aristotle. Mollusca are soft-bodied, non-metameric, triploblastic, coelomate, bilaterally symmetrical invertebrates consisting of a head, foot, and a dorsal mass covered by an envelope called the mantle, sheltered in an external calcareous shell.

Different aspects of Mollusks:

Size and food habits: Molluscs range from fairly simple to the most complex invertebrate animals and in size from almost microscopic to the giant squid, weighing about 450 kg. Mollusks include some of the most sluggish (cowries), some very swift (loligo), and most active invertebrates. They include herbivores, grazers, predators, carnivores, scavengers, filter feeders, detritus feeders, pests, and parasites.

Feeding behavior: Marine gastropods include some that are herbivores, detritus feeders, predatory carnivores, scavengers, parasites, and also a few ciliary feeders in which the radula is reduced or absent. A few sea slugs are herbivores, and some are carnivores.

Habitat diversity: Molluscs can live almost anywhere on land, in fresh and marine waters. Thus molluscs are found in a wide range of habitats, from the tropical to the polar seas, at altitudes exceeding 7000m like the Himalayas, in flood plains, ponds, lakes, heels, haors, streams, paddy fields, forest beds, mud flats, mangroves, rivers and in the seas from the pelagic to benthic depths.

The land molluscs are usually adapted to all kinds of weather and dwell in ground habitats ranging from bushes, parks, gardens, vegetation, and forests, particularly in habitats that offer sufficient shady and moist places.

Freshwater molluscs are common in ponds, paddy fields, irrigation canals, lakes, hill streams and rivers. The hill streams' snails, like Paludomus, are, however, better adapted to submerged rocks and vegetation.

Marine mollusks live in a wide range of habitats, from the supratidal mark of a coast to extremely deep water. Most of the Bangladesh mollusks live on the Bay of Bengal coast and represent diversified lifestyles, including free-living bottom-dwellers, burrowers, and pelagic forms.

Biology:

Both snails and slugs are members of the mollusk phylum and are similar in structure and biology, except slugs lack the snail's external, spiral shell. These mollusks move by gliding along on a muscular "foot". This muscle constantly secretes mucus, which facilitates their movement and later dries to form the savory "slime trail" that signals the presence of either pest.

Snails and slugs are most active at night and on cloudy or foggy days. On sunny days, they seek hiding places out of the heat and bright light. Often, the only clues to their presence are their silvery trails and plant damage.

During cold weather, snails and slugs hibernate in the topsoil. During hot, dry periods or when it is cold, snails seal themselves off with a parchment-like membrane and often attach themselves to tree trunks, fences, or walls.

Snail	**Slug**
External prominent, coiled shell present	Reduced/rudiment covering/ absence of covering
Protection for itself	No protection
Active in summer	Active spring and winter
Feed on vegetables, fruits, grains, shrubs, and flowers	Feed on vegetables and flowers
Life span 2-5 years	Life span 1 year

Common Characteristics of Snail

1. Asymmetrical molluscus having torsion or detortion and Coiling.
2. Head is distinct with one or two pairs of tentacles and eyes containing a scraping redula.
3. Shell is univalved, often spiral or conical or absent.
4. A large ventral foot in the form of a creeping sole.
5. Gills one or two, or replaced by secondary gills or lungs.
6. One or two nephridia are present.
7. Sexes separated or united, gonad one
8. Snails can be divided into marine, freshwater, or terrestrial types.

Molluscan Classification:

Classification in general depends on shell, internal anatomy and physiology, and biochemical characteristics as described below.

1. Class- Monoplacophora
2. Class- Polyplacophora chitons
3. Class- Scaphopoda "tusk shells, tooth shells"
4. Class- Bivalvia: mussels, clams, scallops, oysters, shipworms.
5. Class- Cephalopoda: squids, octopuses, nautiluses, cuttlefish
6. Class- Gastropoda: snails, limpets, slugs, whelks, conchs, sea slugs, sea hares, sea butterflies, nudibranchs

Largest molluscan group-40,000 living species.

Majorities are herbivores- grazers, browsers, plankton feeders; others are scavengers or predators

The radula is adapted for feeding habits

Phylum Mollusca

The second most diverse phylum of animals (after Arthropoda)

With some 55,000 living and 35,000 fossil species described. The total diversity is estimated to be much larger, may be up to 130,000 species.

The most common group is the Gastropoda (snails, 40,000 species), followed by Bivalvia (about 13,000 species).

➤The name Mollusca indicates a soft body.

➤A muscular, fleshy foot, which gastropods (snails) use to crawl, clams to burrow, and which in cephalopods is modified into tentacles (penis).

➤A visceral mass containing the digestive, respiratory, excretory, and reproductive organs.

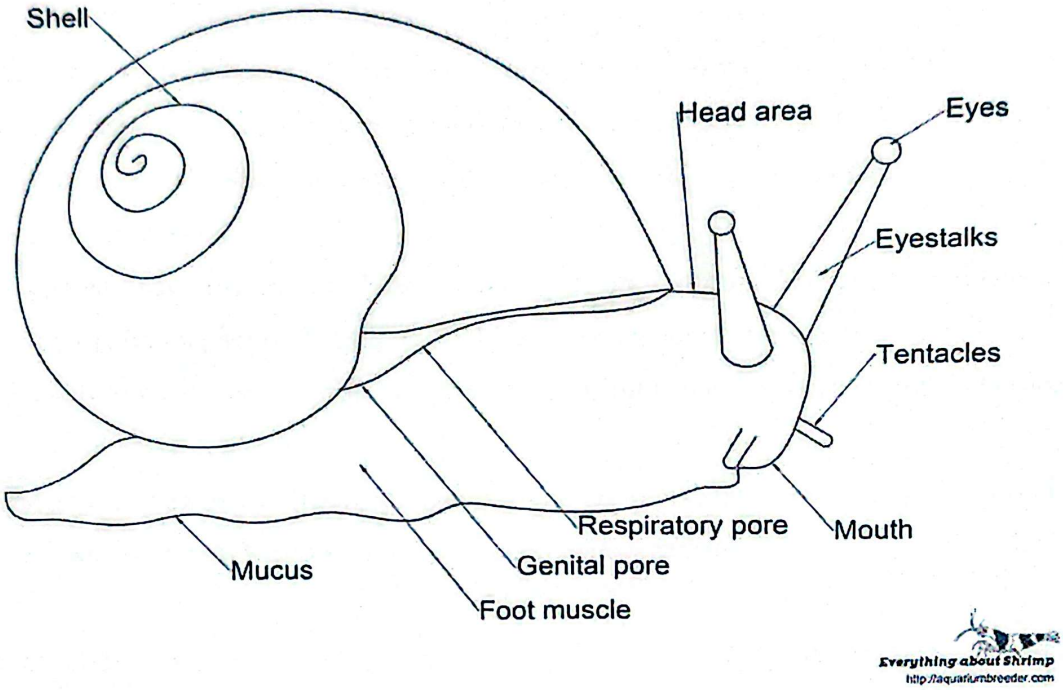
➤ A mantle, usually two folds that enclose the gills or lungs, and secretes the shell.

➤ A radula, a tongue-like organ equipped with rows of microscopic teeth that rasp food.

➤ A respiratory gill (the ctenidium or lung).

➤ A shell made of calcium carbonate.

The shell is not a skeleton; it encloses the soft body and protects it.



Molluscan body parts:

➤ Head-mouth, radula, sensory organs

➤Foot-variously modified for locomotion, attachment

1. bivalve foot 2. squid siphon

➤Visceral mass- internal organs

➤Mantle-glandular, secretes shell

➤Shell- $CaCO_3$ and protein; secreted by mantle

1. Outer: Periostracum
2. Middle-prismatic layer
3. Inner-nacreous layer

➤Radula (in most classes)

1. Rasping, protrusible ribbon with teeth
2. Wears away and grows continually

Molluscan Internal Structure and Function

Respiratory system: Lungs or gills. Almost all marine gastropods breathe with a gill, but freshwater and terrestrial species have lungs.

True circulatory system- open system with heart, blood vessels. The transport fluid is hemolymph. Hemocyanin is present in the hemolymph as the respiratory pigment.

Digestive system- simple and complete mouth, buccal cavity, radula, esophagus. stomach, intestine, rectum, anus, liver.

Excretory system- paired nephridia, kidneys- open into the coelom. The primary organs of excretion in gastropods are nephridia, which produce either ammonia or uric acid.

Nervous system- of gastropods consists central and peripheral nervous system, including several paired ganglia and nerve cords.

Reproduction mostly dioecious (Hermaphrodite), some gastropods monoecious. Fertilization is internal or external. External fertilization is common in marine species.

Gastropods:

Asymmetrical body, having a distinct head with tentacles and eyes; a broad foot, and a visceral hump, mouth with many or a few ribbon like 'radula' to take food. A horny or calcareous structure attached to the food is the operculum, a feature of many gastropods; body usually covered by a coiled, external shell in snails but in sometimes absent in slugs They respire through gills or lung, and are widely distributed in marine, freshwater and terrestrial habitats. They are monosexual or bisexual. They are, herbivores, carnivores, scavengers, and detritus feeders. There are about 80000 living species of which about 20000 are marine.

Family	Species	Parasites
Planorbidae	*Planorbis planorbis*	*Parumphistomum cervi P. microbothrium, Echinostoma* spp
	Indoplanorbis exustus	*Shistosoma indicum, S. spindale. S. nasalis, Parampitistomum* sp.
	Bulinus sp.	*P. microbothrium, Schistosoma* sp. *Ctylophoron cotylophorum, P. cervi*
	Segmentina sp.	*Fasciolopsis buski*
	Hippeutis sp.	*Fasciolopsis buski*
Pilidae	*Pila globosa, Pila virens*	
	Ampallaria globose	
Thiaridae	*Thiaria* sp.	*Paragominus westermanii*
	Brotia costulata, B. costulata	
	Melanoides tuberculata	
Lymnaeidae	*L. auricularia*	*Fisciola gigantica*
	L. luteola	*Schistosoma incognitum, S. nasalis Echinostoma sp Fasciola hepatica F. gigantica F. buski F. magna*
	L. acuminate	
	L. truncatula	
	L. stagnalis	
	Fossaria sp.	*Fascioloides magna, Echinostoma* sp., *Cotylophoron cotylophorum*
Viviparidae	*B. bengalensis, B. crassa*	
	Viviparous sp.	*Opisthorchis* sp
Physidae	*Physa* sp.	*Echinostoma* sp
Potamidae	*Pirnella* sp.	*Heterophyes heterophyes*
Hydrobidae	*Amnicola* sp.	*Prosthogonimus ovatus*
	Oncomelania sp.	
	Bithynia sp.	*Opisthorchis tenuicollis, O. felineus Clonorchis sinensis*

Snail host of trematodes of Veterinary and Medical importance are recorded in Bangladesh

Parasites	Intermediate Host	Location
Fasciola hepatica	*Lymnaea acuminata* *L. truncatula*	Bile duct of ruminant
Fasciola gigantica	*L. auricularia var rufescens*	Bile duct of ruminant
Fasciolopsis buski	*Planorbis, Hippeutis* *Segmentina*	Small intestine (man, pig)
Dicrocoelium dendriticum	*Zebrina detrila*	Bile duct/gall bladder
Platynosum fastomum (Lizard poisoning fluke of cat)	*Bulina* sp. (Land snail)	Gall bladder/Bile duct
Paramphistomum cervi	*Planorbis planorbis,* *Indoplanorbis exustus*	Rumen, reticulum, immature in duodenum
Cotylophoron cotylophorum	*Bulinus sp*	Rumen, reticulum
Schistosoma mansoni, S. hematobium, S. japonicum	*Planorbis planorbis,* *Indoplanorbis exustus,* *Lymnaea auricularia*	Mesenteric vein of small and large intesine
S. suis, S. nasalis	*L. luteola, L. accuminata*	Nasal septum
Opisthorchis sinensis	1st snail *Bithynia* spp 2nd Fish	Bile duct
Clonorchis sinensis (Chinese liver fluke in dog, cat)		Bile duct, Liver
O. tenuicolis/ Clonorchis tenuicolis (Cat liver fluke)	*1 snail Bithynia* spp. *2 Fish Hydrobidae* sp.	Bile duct
Prosthogonimus ovatus	*Bithynia leachi*	Bursa of Fabricius, oviduct, cloaca
Paragonimus westermanii	*Thiaria* sp.	Lungs
Echinostoma sp.	*Physa* sp.	Small intestine

Family: Pilidae (Apple-snail)

Species: *Pila globosa*

English name: Common Apple snail

Local name: Shamuk, Bara Shamuk

Description:

- Shell large, elongated, dextral with thick, globose, spacious, and hollow cone spirally coiled round a central axis.
- Suture not deep, spire depressed, apex rounded at the tip.
- Aperture large, expanded, whorls 5.
- Surface smooth, upper surface of the whorl obliquely flattened, umbilicus open.
- Head prolonged into two sides, labial pups or anterior tentacles.
- Mouth narrow, eyes arising on the outer side of the base of the tentacles.
- The lung is less capacious with a small opening, male smaller than female.
- Colour: Shell lemon-yellow, brownish or even blackish.

Habitats:

➤Abundant in ponds, tanks, and submerged rice fields, but also found in freshwater, brackish water of low salinity in rainy seasons.

➤ It is one of the largest freshwater snails

➤ It is herbivorous and amphibious

➤ A monosexual female selects a place above the water level where it makes a hole to deposit the eggs.

➤It prefers clean water containing succulent aquatic plants, which form its normal food.

Distribution:

Bangladesh, India, Pakistan, Sri Lanka, Malaysia, Myanmar, Vietnam, and Indonesia etc.

Economic importance:

➤Used as shrimp and poultry feed, and or lime production.

➤Also eaten by some tribals.

➤ It is a common intermediate host of various types of digenetic trematodes available in the freshwater bodies of Bangladesh.

Ecological role:

It helps in controlling aquatic environment pollution by consuming detritus

Pila virens

➤ Shell large, ovoid, semi-globose

➤Suture deeply impressed, canaliculated with a distinct carination of the whorls on the outside.

➤Spire elevated, prominent, and conical.

➤ Colour: shell, variable, generally green or olive brown

➤ Size: shell length is 45mm, with 1 mm aperture length and 35 mm width and 25 mm height, respectively.

Habitats:

Abundant in ponds, tanks and submerged rice fields, but also be found in freshwater streams, river and even in brackish water of low salinity in rainy seasons. But as ponds or rice fields dry up, the snail burrow into the moist soil underneath for aestivation.

Habit:

➤ It is one of the largest freshwater snails. It is herbivorous and amphibious, and oviparous.

Distribution:

Bangladesh, India, Pakistan, Sri Lanka, Thailand, Myanmar, Vietnam, and Indonesia etc.

Economic importance:

➤Used as shrimp and poultry feed and for lime production.

➤ Also eaten by some tribals.

➤ It is a common intermediate host of various types of digenetic trematodes available in the fresh water bodies of Bangladesh.

Ecological role:

It helps in controlling aquatic environment pollution by consuming detritus.

Family: Viviparidae

Genus: Bellamya

Species: Bellamya bengalensis

English name: Banded pond/ River snail

Local name: Guli Shamuk, Dorakata Torai

Description:

> Shell medium, thin, ovately conoid, more or less smooth with an acuminate spire.

>Distinct dark spiral bands

>Strongly inflated whorls, last whorls broader than high.

Shell blackish brown with yellowish brown (internal organ brown), dark and pale spiral bands, rim of aperture often black, columella bluish-white with clouded black, nucleus white internally orange-brown.

> Impressed suture, whorls 6, ridges well developed

> Aperture semicircular, shell delicate and thin in the embryonic stage.

> Size: Shell length is 25 mm; width 14mm, aperture length and width 12mm and 10mm respectively.

For Bellamya crassa (Pond snail Guli Shamak)

➤ Shell small, thicker, globose with fine transverse striation.

➤ Umbilicus perforate, spire short and blunt

➤ Suture often canaliculated, columella arched

➤Outer surface sculptured with fine wavy spiral lines.

➤ Aperture suboval

➤Uniform colour without any bands

➤Color: olive brown or yellowish green

➤ Size: shell length is 23mm, width 8mm, aperture length and width 14 and 12min respectively.

Habitats:

➤ Prefers soft and clay bottom stagnant water with aquatic vegetation.

➤ Abundant in permanent and temporary water bodies, in the littoral zones of the ponds, canal and paddy fields.

Economic importance:

➤ It is a common intermediate host of various types of digenetic trematodes available in the freshwater bodies of Bangladesh.

➤ It is widely used as a poultry feed.

➤ Tribal also eat their flesh as a delicacy

Ecological role:

➤ It helps in controlling the aquatic environment pollution by consuming detritus and debris.

➤ Also serves as an agent of the biogeochemical cycle as well as the host of various larvae trematode parasites of Vertebrates.

Family: Lymnaeidae (Freshwater Limpets, Ramhorn Snails)

Shell size varies from 5mm to 50mm. thin, dextral, spire raised, more or less pointed, aperture wide, variable, distinctly twisted columellar axis. Tentacles flattened and triangular, without pseudobranch, stomach divisible into three parts; long penis, devoid of flagellum. Inhabits all types of freshwater with vegetation. Worldwide in distribution.

Synonyms: Lymnaea

English name: Pond snail, local name Patla Shamuk

Description:

Shell very thin, ovate, rather slender and delicate, narrow with a blunt apex, the outer lip very much expanded and convex in outline, spire short, acuminate, last whorl much inflated; whorl 4-6. Tentacles flattened and triangular. Colour: exterior light brown, peristome dark-brown, inside same as outside. Size: adult shell length, width, aperture length and width 19, 8,13 and 6mm, respectively; peristome length 10-15mm, width 4-7mm.

Habits: usually occur in permanent waterbodies with abundant vegetation. It feeds on aquatic vegetation, seedlings of rice as well as zooplanktons and early instar mosquito larvae. It is hermaphroditic and oviparous.

Habitat: found in all types of freshwater bodies in which molluscs can live. Prefers stagnant waterbodies and irrigated paddy fields. Dominant in habitats containing water from household drainage. It attaches itself to floating leaves, sticks, etc, and mostly remains close to the water's edge. Natural vegetation is a prerequisite for the occurrence of the species.

Distribution: common all over Bangladesh, India, Myanmar, and Pakistan. Worldwide in distribution.

Economic importance:

L. acuminata is of much medical and veterinary importance as it serves as the intermediate host of the larval forms of some important helminth parasites of sheep, cattle, and human beings. It has been recorded as the intermediate host of different flukes, viz., *Fasciola gigantica*, *F. hepatica*, *Schistosoma indicum, S. nasalis*, *S. spindalis*, *Clinostomum giganticum*, and *Echinostoma* spp.

Ecological Role: *L. acuminata* acts as a natural fertilizer-producing organism in irrigated paddy fields. It adds excess Mg++, NO3, and PO_4 to the water through the excretory product and feces.

Lymnaea auricularia

Pond Snail, local name: Shamuk

Lymnaea auricularia is a species of medium-sized freshwater snail, an aquatic pulmonate gastropod mollusk in the family Lymnaeidae.

Description:

The shell is thin, roundly ovate, and very inflated, such that the last whorl comprises 90% of its volume. The shell has a rounded and broad spire. The spire is short, conic, very small compared with the body whorl. There are 4-5 whorls with deep sutures between them. The whorls are convex, inflated, smooth, and rapidly increasing. The body whorl is large and spreading. The surface is shining, lines of growth are fine, wavy, crowded, with occasionally a heavy ridge representing a rest period. Sutures are deeply impressed. The color of the shell is yellow, beige, or tan. The ear-shaped aperture, which contains no operculum, is around 5 times higher than the spire. The aperture is very large, ovate; the peristome is thin and sharp. Usually, the umbilicus is narrow, deep, and nearly closed. The body is flecked with small white spots on the back of the head and tentacles, but not on the foot. The mantle is pigmented with a line of dark spots along its edge, irregular spots which show through the shell. The head is broad, auriculated. This species also has tentacles that are large, flat, lobate, triangular, fan-shaped, and wider than they are high. Size: average shell length, width aperture length and width 30, 25, 18 and 14 mm, respectively. Parasitized by larval trematodes *Lymnaea* spp becomes larger.

Habits:

Mainly herbivorous. Remains attached or floats upside down to the surface film of water and the foot glides. During summer, when the water in ditches, ponds, and paddy fields dries up, it buries itself in the mud bottom. Like all pulmonates, it is a hermaphroditic and oviparous snail.

Feeding habits

Lymnaea auricularia is in the family Lymnaeidae, which consists of scrapers and collectors. This species feeds on such items as detritus, Cladophora spp. (algae), and sand grains.

Habitat:

It is found in stagnant water bodies. It is a carrier of two known parasites, *Ornithobilharzia turkestanicum* and *Fasciola gigantica* were recorded to develop in this snail in the Srinagar area. It is a widely spread species inhabiting small puddles, pools, lakes, reservoirs, brooks, irrigation canals, water fields, brackish lakes, and spas. They can also live in water fields with deficient

oxygen and 6-9 pH. It has been found at more than 6,000 meters above sea level. This species is found in freshwater lakes, ponds, and slow-moving rivers with mud bottoms. *Lymnaea auricularia* can live on boulders or vegetation in low or high-flow environments, and is capable of tolerating anoxic conditions, but it tends to prefer very lentic waters in lakes, bogs or slow rivers where there is a silt substrate. Its average thermal preference is 19°C, but there is great fluctuation around this mean, depending on the photoperiod for the time of year.

Distribution:

Common all over Bangladesh; widely distributed in all low lands. Elsewhere in Asia the species is present in Afghanistan, India, Moldova Oman, Russia and Ukraine. In India, it has been reported from Maharashtra, Uttarakhand, Himachal Pradesh and Jammu and Kashmir. In Europe it is found as far north as Sweden and as fa south as Spain and Italy. The species is introduced in the United States

Economic importance:

L. auricularia is an edible freshwater gastropod, used as a food by the tribal people of Bangladesh and West Bengal, especially by the workers of tea gardens. Meat may also be used as a fish bait and poultry feed; the shell is used for decoration and lime production. It is also a host of the helminth parasite Cercaria indica. One of the important snails serving as an intermediate host of some Helminth parasites of Cattle, pigs, and dogs, like *Fasciola gigantica*, *Echinostoma revolutum*, and *Echinoparyphium recurvatum*. Meat may be used as fish and poultry feed. It is also considered a pest of paddy and Azolla.

Lymnaea luteola

Lymneid Snail, local name: Shamuk

Description: a small aquatic mollusc with a round foot. Shell not very much pointed, ovate, spire distinct, conoid, not very much pointed Body whorl much inflated, little compressed with a big aperture. Aperture ovate, less expanded, Shell dextral. Outer lip almost straight. Operculum absent. Head with one pair of flattened, non-invaginated, triangular tentacles with eyes at the base. Central tooth of the radula is unicuspid. Whorls 4-5. Colour, exterior dark greenish sometimes reddish. Aperture blackish-white. Size: crage shell length, width, aperture length and width 19. 10,13 and 7 mm, respectively, by larval trematodes Lymnaea spp becomes larger in size.

Habits: Mainly herbivorous. Remains attached or floats upside down to the surface film of water, and the foot glides. During summer, when the water in ditches, ponds, and paddy fields dries up.

it buries itself in the mud bottom. Like a pulmonate, it is a hermaphroditic and oviparous snail. Eggs are laid in a gelatinous, elongated a cylindrical mass on waterweeds.

Habitat: Generally, it occurs in the littoral regions of shallow water bodies like ponds, ditches. Stagnant and temporary water bodies are abundant with aquatic vegetation. Also occurs in shady places under large trees on the shore.

Distribution: Common all over Bangladesh; widely distributed in all lowlands. Elsewhere in India, Myanmar, and Sri Lanka.

Economic importance: One of the important snails serving as an intermediate host of some Helminth parasites of Cattle, pigs, and dogs. Meat may be used as fish and poultry feed. It is also considered a pest of paddy and Azolla

Ecological role: Decaying plants and debris remain of macrophytes are an important diet of the snail. Thus, *L. luteola* is an excellent eco-friend of the freshwater biome.

Lymnaea stagnalis

Synonyms: *Helix stagnalis*

English name: Lymnaeid Snail, Stagnant Pond snail

Local name: Lomba Shamuk

Description:

Body whorl large, expanded outwards with a big ovate aperture. Spire distinct, pointed, conoid, exceptionally elongated and acuminate. Columellar callus well expanded, umbilicus closed. Head with one pair of flattened. invaginable, triangular tentacles with eyes at the base. Whorl 4-6. Colour: exterior golden-greenish to creamy; sometimes reddish-white. Size: average shell length, width, aperture length, and width 30, 15, 22, and 12mm, respectively.

Habitat: Aquatic snail, found in ponds, ditches, tanks, and paddy fields with dense vegetation: abundant in water bodies where other Lymnaea spp are not usually present. i

Distribution: Common all over Bangladesh: widely distributed in all lowlands. Elsewhere in India, Pakistan, Myanmar, and Sri Lanka

Economic importance: Meat is used as fish and poultry feed. It also acts as an intermediate host of the Helminth monostome and Ophthalmocercus cercariae.

Ecological role: Acts as a bio-filter of lentic waters like ditches, ponds, tanks, and paddy fields. This lymnaeid snail is a good predator of the freshwater biome.

Family: Planorbidae (Horn snails)

Shell is small to moderately large. Fattened, discoidal or planispiral, with a small aperture, spire depressed, apex above the plane, toes not projecting, openly umbilicate, simple foot, elongate and tapers to a point posteriorly. Veum is situated above the foot in its anterior region, bearing the head with filiform and flattened tentacles bearing eyes on the inner basis. The columellar axis is not twisted. Radula with a bicuspid central tooth, large bi- or tricuspid lateral teeth, and long, narrow and multicuspid marginal teeth. The left side bears the excretory and respiratory organs. Main breathes through a lung, supplemented by an extra-pulmonary appendage, the pseudobranch false gill. Inhabitants of shallow littoral stagnant or sluggish waters.

Genus: Indoplanorbis

Shell large, thick, with convex whorls, rounded at periphery, deeply impressed suture, aperture ear-shaped. Sinistral animal, spire sunken below the plane. The foot relatively broad and short, leaf-shaped, broadly rounded anteriorly and pointed posteriorly, branchial process lobed.

Indoplanorbis exustus

English name: Ram's Horn snail

Local name: Chapta Pachano Shamuk

Description: Shell moderately large, thick, sinistral, depressedly coiled, whorls 3, rounded, apex shunken, last whorl large; rounded at the periphery, suture deeply impressed, aperture ear-shaped, foot relatively broad, short and leaf-shaped, posteriorly pointed branchial process lobed. In newly hatched offspring, the width is greater than the length. But after 7 to 10 days, the width and length of the snail become equal. The width again becomes greater than the length after about 20 days. In around 30 days, the length becomes half of the width. Colour: exterior golden with creamy spiral bands, golden color gradually me greenish from the aperture to the apex.

Habits: ***Indoplanorbis exustus*** lives in shallow freshwater bodies containing different kinds of aquatic vegetation. It prefers weeds. It is hermaphroditic.

Habitat: Commonly found in stagnant water throughout Bangladesh; abundant in ponds. ditches, canals, and paddy fields.

Distribution: Common to fresh water bodies of Bangladesh; Elsewhere Iran, India, Pakistan, Myanmar, Malaysia, Vietnam, Thailand, Java, and Sumatra.

Economic importance: It is one of the most important snails from the medical and veterinary points of view as the trematode parasites of horse, goat, sheep, camel, dog, buffalo and other livestock develop to the cercarial stage in this snail, which serves as the intermediate host.

Ecological role: This snail helps in maintaining the ecosystem as a consumer of green and semi-decayed aquatic vegetation, as well as serving as a host to many Helminth parasites.

Genus: Gyraulus

Shell small, thin, paucispiral, deeply umbilicate, greatly depressed with 3 or 5 rapidly increasing whorls, pale translucent or transparent, with or without peripheral keel.

Gyraulus convexiusculus

English name: Horn snail

Local name: Choto Pachano Shamuk

Description: Shell small, thin, flattened discoidally, greatly depressed, pale translucent or semi-transparent, with 4-5 whorls, without strong transverse ribs, last whorl periphery subangulate. Periostracum with or without short hair-like projections, with or without peripheral keel, whorls distinct, aperture ovate-lunate, oblique, lit simple. Colour: yellowish-brown. Size: shell length. width aperture length and width 4, 5, 3 mm. respectively.

Habits: Feeds on detritus, algae, semi-decayed debris, zooplankton, etc. It is hermaphroditic, and the right tentacle of the male acts as the pers. It needs to be done twice a year and is viviparous.

Habitat: Occurs in natural and artificial ponds, ditches, canals, paddy fields, and grasslands. vegetable and flower gardens. It prefers weeds but can equally colonise at ease in the muddy substratum of a transient freshwater habitat. During the dry season, this snail migrates to ponds from the temporary water bodies. But in the rainy season, when ponds become over-flooded. it migrates towards canals and temporary waterbodies.

Distribution: Indo-Pacific, from India, Pakistan, Sri Lanka, Thailand, Myanmar, Malaysia, Vietnam, Indonesia to the Philippines and the Ethiopian regions. Abundant in Peninsular and Northern India, West Bengal, and almost northern districts of Bangladesh.

Economic importance: This species is 2 common intermediate host of various types of digenetic trematodes available in the freshwater bodies of Bangladesh. It is used as poultry feed.

Ecological role: It helps in controlling aquatic environment pollution by feeding on detritus.

Family: Thiaridae

Genus: Melanoides

Species: Melanoides tuberculata

English name: Screw snail

Local snail: Pachano Shamuk

Description:

➤ Shell with high spire, narrowly rounded, with a moderately large body whorl.

Whorls are moderately convex, evenly rounded with dark or red brown dots and flames either irregularly distributed or longitudinally arranged on the shell surface.

Shell surface sculptured with verbal ribs and spiral striate, distinct and raised on the upper whorls.

Colour: dark brown with red brown cots, flames, and bands.

➤ Size: shell length is 35mm, width aperture length and 7 widths, and 5 mm respectively.

Habitats:

Stagnant and slow-moving, pond water, streams, rivers, irrigation canals, and often extending brackish water habitats tear the sea. It occurs in abundance in muddy drains, sediment lakes, ponds, and poorly throughout the year, including the summer, with very little water flow.

Habits:

➤ Scavenger snail living on semi-decayed organic matter and debris with sand grains, which slope down from the banks of ponds and settle on the bottom mostly within the range of 1-50cm depth of water. It uses temporary water bodies, it burrows in the semi-dry substratum during the dry season to overcome the unfavourable situation. But during the rainy season when ponds are over-flooded, it migrates towards the shady or wetly moistened drainage basins of the ponds where it remains firmly attached to the rocky substrate. It remains nocturnal and during the day hides in the gravel and continues its speech for food. Sexes are separate.

Distribution

➤ Almost all the districts of Bangladesh have a wide and varied range from freshwater ponds to hill streams. Widely distributed throughout Asia, Africa, Central and South America, etc.

Economic importance:

Eaten by the tribals.

➤ Several fluke cercariae have been recorded from *M. tuberculata*, which serves as an I/H host.

Ecological role:

It plays a vital role in maintaining the balance of the aquatic ecosystem by stirring up the gravel, which prevents clogging and also eats food remains that would otherwise decay and pollute the water.

Genus: Brotia

Brotia costula

Synonyms: *Melania costula*

English name: Brotia snail

Local name: Lomba Shamuk, Leza Shamuk

Description: Shell elongate, conoid, large, very thick, rough, and turreted. Spire somewhat convex, elongated suture, impressed apex decollated. Body whorl large, slightly convex and slightly increased in width, almost equal to one and a half the spire length of the shell. Whorls 12-14, regularly increasing each sculpture with vertically arranged curved ridges. prominent axial ribs with spines. Shell dextral and decollated. Aperture almost rhomboid, and smooth within; outer lip of the aperture thin, irregular and sharp. Inner lip thick, smooth. regular. Lower end of the body whorl provided with circular ridges. Operculum oval, thin and concave on the outer surface, with a basal nucleus. A large aquatic mollusc with a round foot at the rear. The head bears one pair of large filiform tentacles and one pair of sessile eyes. Ctenidium monopectinate, colour, generally brick red or dark brown, aperture purple, inner lip yellowish.

Habits:

Mainly herbivore remains are attached to the submerged plants or on the bottom in the littoral region of the water. Unisexual and oviparous snail. Fertilization occurs throughout the year.

Habitat:

Occurs in muddy, sandy bottoms of lotic freshwater like rivers, canals, streams, and also stagnant waters. Clean water with a line offers a suitable habitat for *B. costula*. It is mostly found in ponds and flowing streams.

Distribution:

All over Bangladesh in slow-flowing waters. Elsewhere: India, Myanmar, the Malay Archipelago, and Indonesia.

Economic importance:

B. costula is an edible freshwater gastropod, used as a food by the tribal people of Bangladesh and West Bengal, especially by the workers of tea gardens. Meat may also be used as a fish bait and poultry feed; the shell is used for decoration and lime production. It is also a host of the helminth parasite Cercaria indica.

Ecological role:

Helps in cleansing the suspended particles of water. So it may be considered a biofilter of the slow-running waters.