Chapter 2 Phylum Porifera

Sponges are multicellular animals with a **cellular level** of organization. They have no tissue or organs. The body is a loose aggregation of mesenchymal cells, and has either radial symmetry or asymmetry. The body is perforated with many tiny incurrent water pores (ostia) and few larger excurrent pores (osculum) (Fig. 1a). The pores are connected to **canal systems**. The epidermis consists of flat pinacocytes and the inner surface is lined with flagellated collar cells (**choanocytes**). In the simplest sponges the large cavity, which is lined with choanocytes, is called the spongocoel. Between pinacocytes and the choanocyte layer is the **mesohyl**, or gelatinous protein matrix, which contains amoebocytes, collocytes and skeleton structures. The skeletal structures are calcareous or siliceous **spicules** or protein collagen fibers (**spongin fiber**). The skeleton of freshwater sponges is made of siliceous spicules (Fig. 1b, 2).

General structure and function

There are three levels of sponge construction based on the canal system: asconoid, syconoid and leuconoid (Fig. 3-5), in order of increasing amount of surface area available for food collection.

The **asconoid** sponges are small and cylindrical shaped. Water enters through ostia into a large spongocoel (Fig. 3). The choanocyte flagella pull the water through the pores and expel it through an osculum.

The **syconoid** sponges are tube-shaped and have a single osculum, but the body wall is thicker and more complex than that of asconoids. Water enters through ostia into incurrent canals which bring it to the choanocyte-lined radial canals (flagellated canal), which then empty into the spongocoel. The spongocoel is lined with epithelial cells other than the choanocytes (Fig. 4).

The **leuconoid** type is the most complex sponge. Unlike asconoid and synconoid sponges, which are small sponges, the leuconoid sponges are adapted for increase in size and they usually form large colonial masses. Each colony has one ostium. Water goes through incurrent canals into flagellated chambers (lined with choanocytes) and is discharged into the excurrent canal before leaving through the osculum (Fig. 5).

Sponges have no digestive system. The flagella of the choanocytes beat to pull water through the sieve-like collar and force it out through the open top of the collar. Large particles that can not enter the collar will be trapped by secreted mucus from collar cells and are phagocytized by the cell body. The engulfed food is passed on to the archeocytes (originated from amoebocyte) for intracellular digestion. Digested foods are stored in archeocytes and transferred to other cells by diffusion and amoebocytotic transport.

Gas exchange and water-soluble waste products diffuse into the water surrounding the sponge. Water-insoluble wastes are given off by amoebocytes into the excurrent canals.

Some sponges are monoecious (having both male and female in one individual), and some are dioecious (having separate sexes). All sponges reproduce sexually and asexually. Internal fertilization takes place in the mesohyl, where ova are fertilized by motile sperms. The zygotes develop into flagellated larvae and are released from the parent. Larvae swim for a period of time before setting on the substrate and metamorphosing into the sessile young sponges. Sponges reproduce asexually by forming external buds that remain attached, to form colonies. Freshwater sponges and some marine sponges reproduce asexually by producing the highly resistant resting stages called **gemmules** (Fig. 2). The gemmule is a spherical structure with a dead, secreted outer layer, a covering of spicules and an internal mass of live archeocytes. The gemmules can survive a period of drought, and germinate in favourable conditions. The micropyle opens and the archeocytes in the gemmule escape to develop into a new sponge.

Ecological relationships and economic importance in the region

Most sponges are marine and often found on coral reefs. Sponges are host to many commensal or parasitic organisms. Some marine crabs attach pieces of sponge to their carapace for camouflage and protection.

Freshwater sponges have no economic value. They can grow over the nets of fish culture cages and obstruct water flow through the net.

Classification

Sponges are grouped into four classes, based largely on the chemical composition and morphology of the skeletal elements: Calcarea, Hexactinellida, Demospongiae and Sclerospongiae.

Class Calcarea

Calcarea have calcium carbonate spicules and are tubular or vase-shaped. Their structure may be asconoid, syconoid or leuconoid. All are marine.

Class Hexactinellida

Glass sponges are found in the deep sea. They bear six-rayed siliceous spicules bound together as a latticework. The canal systems may be syconoid or leuconoid and the outer layer is syncytial (having many nuclei contain in a single plasma membrane).

Class Demospongiae

Almost 80% of sponge species are in Demospongiae. They have a leuconoid canal system, and the skeleton may be of siliceous spicules, spongin fibers or both. All are marine forms,

except for the family Spongillidae which is found in freshwater. Freshwater sponges occur in well-oxygenated streams, rivers and ponds. They usually encrust old pieces of submerged twigs and woods or the nets of fish culture cages.

Class Sclerospongiae

Sclerospongiae is a small group of sponges that secrete a massive skeleton. All are restricted to caves, crevices, and other such cryptic habitats on coral reefs or in deep sea. They have a leuconoid canal system and the body is supported by siliceous, calcareous spicules and spongin fiber.

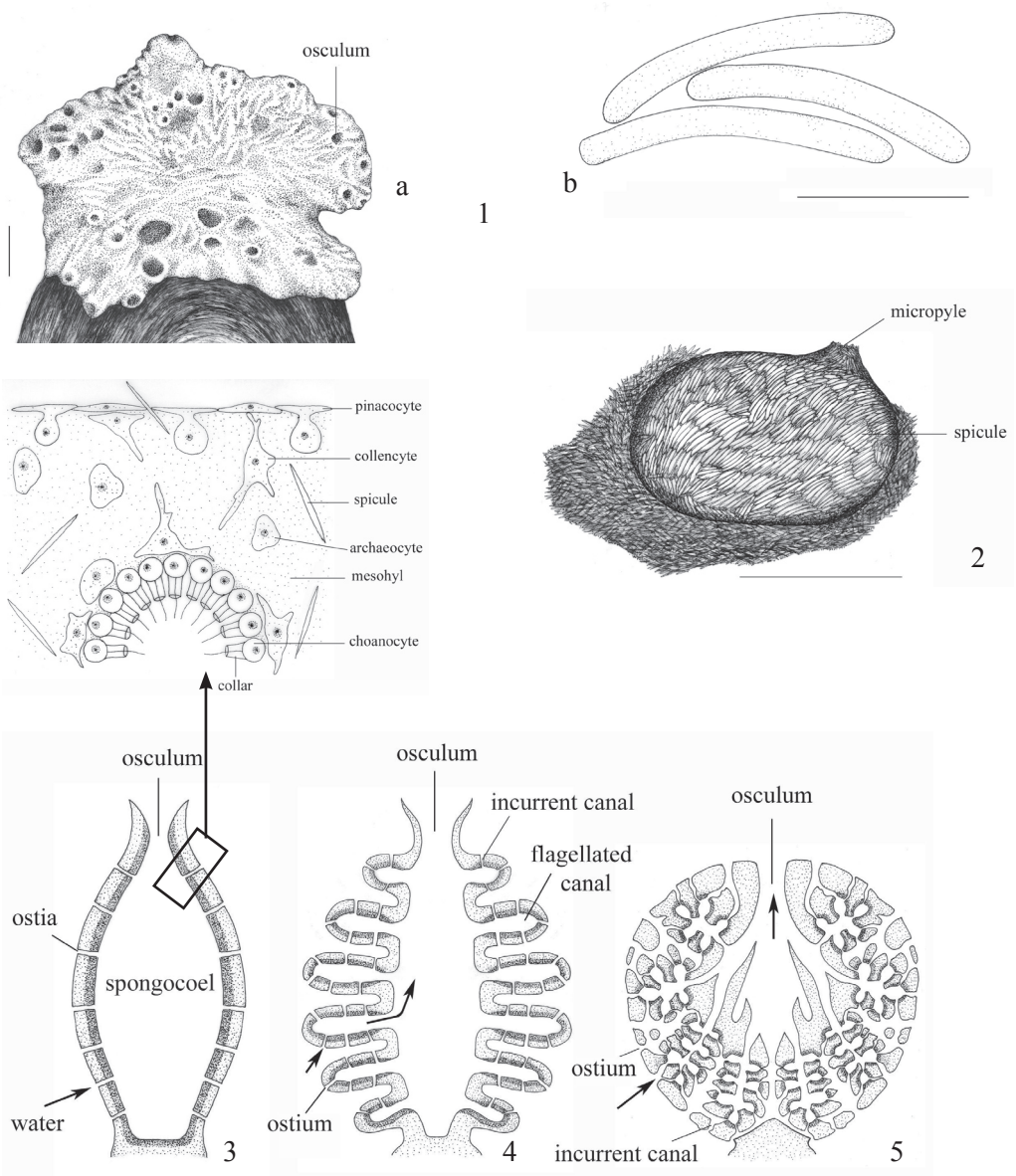

Fig.1–5 1. Typical structure of freshwater sponge (a) and its spicule (b) from the Chi River; 2. Gemmule of freshwater sponge from the Pong River; 3. Asconoid type; 4. Syconoid type; 5. leuconoid type (Fig. 3-5 modified from Barnes, 1963, fig. 4-6 A, B, D and Hickman & Roberts, 1995, fig. 5.6), arrows indicate water flow.
Scale: (1a) 1 cm; (1b, 2) 0.5 mm.