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SYSTEMATICS OF PHYLLUM BRYOPHYTA 1

Class:*Takakiopsida*

Bryophytes in the class Takakiopsida are rarely found due to the scarce number of species and their specific habitats. There is one order (*Takakiales*), one family (*Takakiaceae*), and one genus (*Takakia*). Habitats are typically humid and terrestrial. Terrestrial substrates include rocks and banks near waterfalls located at sea or alpine level.

The small gametophytic shoots are easily recognized by their bright green color. Growth of the shoots is acrocarpous. The misinterpretation in classification was partially due to the appearance of the leaves. Individual leaves are deeply lobed into 2-4 lobes and tapered at each apex. Further, the leaves are tristratose aiding in the cylindrical shape of leaves. Microscopically, the leaves contain oil droplets, common to liverworts (not mosses). There are also axillary hairs located at the base of leaves along the stem, likely aiding in mucilage production and moisture retention. However, the radial arrangement and transverse insertion of leaves on the stem differentiated these tiny bryophytes from being classified as a type of liverwort.

he stems stand erect on the substratum and are unbranched or only have a few branches. Similar to mosses, the stem is cutinized and has a weak conducting strand. However, there are no rhizoids. Rather, there is a intercalary rhizome system that is not cutinized and new erect gametophytes arise from. Along the rhizome system clusters of beaked mucilage cells are present that may aid in moisture retention.

As stated previously, the reproductive structures aided in classification of this moss. Common to other bryophytes, the reproductive structures are borne laterally close to the shoot apex. However, there are no modified perichaetial or perigonial leaves surrounding male and female reproductive structures. The archegonia are flask-shaped with a thick stalk

and a neck composed of six or more rows of cells. The only species found that have antheridia are *Takakia lepidozioides*.

The sporophytic features, discovered only on *Takakia ceratophylla* in 1993, further confirmed classification as a moss. The seta is cutinized, has a conducting strand composed of hydroids, and elongates prior to maturation of the sporangium and spores.

The sporangium has features distinctly unique from other bryophytes. A thin calyptra protects the developing sporangium atop the elongated seta. The endothecium develops into the columella and spores, while the amphithecium develops into the sporangial jacket. Stomata are not present on the sporangial wall, indicating stomata are not likely a homologous characteristic of tracheophytes, mosses, and hornworts.

When the sporangium is mature, hygroscopic movements of the seta and sporangium aid in spore dispersal. As the sporangium twists the tension causes a single spiral longitudinal line of dehiscence to open along the sporangium, and spores are shed. The spores are unicellular and the events of germination are unknown, however it is assumed there is no protonemal stage. Asexual reproduction is accomplished by cauducous leaves and shoot apices.

Class: *Sphagnopsida*

The morphology of the species in the class Sphagnopsida, also known commonly as "Peat moss", is quite different from that seen in the other classes of the phylum Bryophyta. These morphological differences may explain why this class is the most economically valuable class of mosses. Not only is *Sphagnum* used in soil to increase water retention and horticulture, but it has also been used to dress wounds to prevent infection caused by microbes.

The gametophyte of *Sphagnum* has two types of branches; pendant and divergent. The pendant branches hang down along the stem, which aid in the capillary movement of water,

while the divergent branches stick out from the stem at about a 90 degree angle. A fascicle comprises of both the pendent and divergent branches that emerge from the same point on the stem. The capitulum, which is a cluster of young developing fascicles, is located at the apex of the main shoot. As the stem continues to elongate, new clusters of branches form at the apex, thus maintaining the capitulum. Furthermore, the protonemal stage of *Sphagnum* is very brief and filamentous, and is quickly followed by a thalloid stage. The species exhibit rhizoids only when the gametophyte is young.

The leaves of the class *Sphagnopsida* are one cell thick (unistratose), arranged spirally and lack costa. Furthermore, the leaf tissue are characterized by being comprised of two cell types; chlorophyllose cells and hyaline (colorless) cells. The chlorophyllose cells, as the name suggests, possess chloroplasts and they form a network pattern in the leaves. The hyaline cells are dead at maturity and have one or more pores, which function to retain water and allows access to the environment.

The structure of the hyaline cells is strengthened by fibrils, which are thickenings of the cell walls. The arrangement of the chlorophyllose cells as well as the variations in the pore distribution seen in the hyaline cells provide useful information when classifying species in this class.

A cross section of a branch leaf can also be very useful in identifying a *Sphagnum* species. When observed carefully, one can see there is variation in how chlorophyllose cells are exposed. In some species the chlorophyllose cells are completely enclosed, while in others they can either be exposed more broadly on the concave surface (inner), the convex surface (outer) or equally exposed on both surfaces. Furthermore, the inner cell walls of the hyaline cells can further aid in the identification.

The stem leaves tend to fold down, with the apex of the leaves pointing away from the apex of the stem. A closer look at the stem leaves will reveal that they have a tapered tip and

an expanded base. Furthermore, chlorophyllose and hyaline cells are present, however it is worth noting that both these cells lack chlorophyll when mature. In some species, the presence of thickenings can be seen in the hyaline cells, giving the appearance that the cells are “divided”.

The central part of the stem has a cylinder that is called a “wood”. he outer layer of the stem, also referred to as the cortex, is also composed of hyaline cells, which are called cortical cells. In some species, the hyaline cells may have pores and fibrils present. Species in the class Sphagnopsida do not have hydroids or leptoids.

The perichaetial branches of the *Sphagnum* species are initially at the apex of the main stem, where the cluster of branches are found. Per each perichaetium, one can find multiple archegonia, however paraphyses are absent. The perigonial branches, which are modified divergent branches, can easily be identified because the tips are often tinged red.

Per each perigonial leaf there is only one antheridia, which is located at the leaf’s axil, and paraphyses are absent. The antheridia are nearly globose and have a stalk, as seen in this picture.

The sporangia of *Sphagnum* are similar to some extent to those seen in Bryopsida and Polytrichopsida in that an operculum is shed prior to the spores being dispersed. However, unlike these classes, *Sphagnum* species lack peristome. Furthermore, the sporangia in Sphagnopsida are elevated by a pseudopodium rather than by a seta. As seen in the liverworts, the stalk do not elongate until the sporangium has reached maturity. The sporangia in this class are round in shape and are often short-lived.

When the sporangium reaches maturity and the spores are ready to be shed, the columella (which is globose in *Sphagnum*) begins to degrade. The sporangial wall of the capsule then begins to constrict which causes the pressure inside the sporangium to increase. This pressure continues to build until it causes the operculum to be shed explosively, resulting

in the spores being dispersed all at once. Some species in Sphagnopsida can reproduce asexually via fragmentation. It is worth noting however that this class does not have gemmae.

Class: *Andreaeopsida*

The Andreaeopsida grow on siliceous rocks, and are distributed throughout the world predominantly in colder climates, such as at higher elevations or at higher latitudes. The species in this class are typically blackish to dark reddish-brown and form short and brittle brittle tufts or turfs. Unlike in some other classes, such as the Bryopsida, the protonema in the Andraeopsida are thalloid. Furthermore, all members of this class are autoicous, meaning that both the female and male reproductive organs occur in separate clusters on the same gametophyte.

Most species have unistratose leaves, with multistratosity confined to the midrib of costate species.

An important feature of this class concerns the unique structure of the sporangium. The sporangium has four (or more) lines of dehiscence, with the tips of the intervening segments remaining attached to one another at the “polar” ends. The resulting structure is reminiscent of a lantern, hence members of this class are popularly referred to as the “lantern mosses”.

Class: Andreaeobryopsida

Andreaeobryopsida is one of the two classes that are commonly referred to as the “lantern mosses”, the other being the class Andreaeopsida. Their distribution is between northern Canada and Alaska and they are found growing on calcareous rocks.

The species in this class differ from those in Andreaeopsida in that they are dioecious, which means the male and female reproductive organs are born on separate gametophyte, and they possess a seta (the pseudopodium is absent).

When the plants are young, the tissues are green and chlorophyllose. However, as they mature, they turn dark black to reddish brown, due to the dark pigments obscuring the photosynthetic pigments.

REFERENCES

1. Url1. https://blogs.ubc.ca/biology“Introduction to Bryophytes”