CHAPTER 4-3

ADAPTIVE STRATEGIES: PHENOLOGY, A *SPHAGNUM* CASE STUDY

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Figure 1. *Sphagnum fimbriatum* with operculate capsules in midsummer. Photo by Janice Glime.

Sphagnum: A Case Study

The easiest way to understand any phenomenon is to examine an example. The detailed phenological study by Pujos (1992) of ***Sphagnum fimbriatum*** in Haute-Normandie and ***S. fuscum*** in Québec provides us with this opportunity.

Most of us think of ***Sphagnum*** as living in wet places, but in fact, its growing tips are often under drought conditions. As the water level falls in the summer, the tops of hummocks are dry, and in winter, the water is frozen, thus creating desiccating conditions. Consequently, the apex of the moss often lacks sufficient water to carry on photosynthesis. This results in considerable variation within the genus regarding the months of photosynthetic activity and growth. Hulme and Blyth (1982) found that species that live in hollows, such as ***S. cuspidatum*** (Figure 2) and ***S. auriculatum*** var. ***inundatum*** (Figure 3), had a longer growing season (10-12 months) than did hummock species such as ***S. papillosum*** (Figure 4), ***S. magellanicum*** (Figure 5), and ***S. capillifolium*** (Figure 6) (5-7 months).

For ***Sphagnum fimbriatum*** (Figure 7) in Haute-Normandie and ***S. fuscum*** (Figure 8) in Québec, it appears that despite their ability to grow best at the warm temperatures of summer, they become sexual in the cooler, probably wetter, conditions of fall (Pujos 1992).

Figure 2. ***Sphagnum cuspidatum***, a species of hollows and bog pools. Photo by Michael Lüth, with permission.

Figure 3. ***Sphagnum auriculatum***, a species of inundated areas. Photo by Janice Glime.

Figure 4. ***Sphagnum papillosum***, a hummock species. Photo by Michael Lüth, with permission.

Figure 5. ***Sphagnum magellanicum*** forming a hummock. Photo by Michael Lüth, with permission.

Figure 6. ***Sphagnum capillifolium capillifolium*** on top of a hummock. Photo by Barry Stewart, with permission.

Figure 7. ***Sphagnum fimbriatum*** habitat. Photo by Dick Haaksma, with permission.

Figure 8. ***Sphagnum fuscum***, a hummock species, in its vegetative state. Photo by Michael Lüth, with permission.

Gametangia

In both species studied, antheridial branches (Figure 9) appear first at the end of summer, with the antheridial stalk forming before the antheridium. Although the antheridium develops rapidly, **spermatogenesis** (formation of sperm) spans two months. Like so many other perennial

bryophytes, archegonial development begins somewhat later in Haute-Normandie, in September, requiring about one month for development.

Figure 9. Antheridial branches displaying typical red color. Photo by Janice Glime.

Fertilization

Perichaetial leaves grow much larger than other leaves and protect not only the archegonia, but the developing capsule as well. However, fertilization is delayed until February, at least in Normandie, occurring as the temperature first begins to increase at the end of winter. Archegonial neck cells break down and form mucilage at about the same time the antheridia dehisce. Fertilization of ***S. fimbriatum*** (Figure 10) in Normandie in 1991 occurred in March.

Figure 10. ***Sphagnum fimbriatum***. Photo by Dick Haaksma, with permission.

Embryogenesis (formation of embryo)

By early April, the embryo begins penetrating the branch beneath it and by the end of April mucilage completely surrounds the embryo. It is not until mid-May to June that **sporogenesis** (formation of spores, starting with meiosis) occurs and still another month passes before the pseudopodium (gametophyte extension that becomes a stalk to support the capsule) emerges with the capsule at its apical end (Figure 11).

Figure 11. Mature capsules of ***Sphagnum palustre*** with capsules still enveloped in perichaetial leaves before the pseudopodium elongates. Photo courtesy of Zen Iwatsuki.

Spore Release and Germination

Spores mature in July and changes in temperature and humidity cause the capsule to shrink, forcing the operculum off (Figure 12). Spores in both species germinate immediately after release (in the lab), producing a thalloid gametophyte and ultimately a single upright plant. But again, we know nothing of what happens in the field. Is there a dormancy, perhaps brought on by temperature or humidity, that delays the spore germination? How long does the protonema persist before the leafy plant develops? How long does it then take the leafy plant to reach sexual maturity?

Figure 12. Capsules after dehiscence and dispersal, with elongated pseudopodium, in ***Sphagnum palustre***. Photo courtesy of Zen Iwatsuki.

Summary

In *Sphagnum fimbriatum* in Haute Normandy, as in most mosses, antheridia appear first, in this case late summer, developing over two months. Archegonia begin development in September and require only one month. Fertilization occurs in February or March at the end of winter. The capsule is mature in mid-May to June and sporogenesis occurs, but the pseudopodium requires another month before it elevates the capsule. Spores are released in July and can germinate immediately, but field behavior is unknown.

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Literature Cited

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