New England Botanical Club - Minutes of the 999th Meeting
10 September 2004

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The 772nd meeting of the New England Botanical Club, being the 999th since its original organization, was held on Friday, September 10, 2004, at the University of New Hampshire, Durham. There were 24 members and guests in attendance.

Member Garrett Crow began with a slide show to preview the salt marsh field trip, followed by photos meant to interest the crowd in his July 2005 trip to the Amazon in connection with the New York Botanical Garden. He then introduced the evening speaker, Dr. Christopher Neefus for the University of New Hampshire, who spoke about "Living on the edge: Acclimation and adaptation of an intertidal seaweed."

Chris began his talk with a photo of Louis H. Sullivan, who designed office buildings during the late 19th and early 20th centuries. Louis, who often added beautiful botanical ornamentation to the facades of his buildings, was considered the father of the modern skyscraper and was mentor to the famous architect Frank Lloyd Wright. More importantly, as Chris pointed out, he is credited with coming up with the concept of "form follows function," which Chris noted was an apt description of the evolution of intertidal seaweeds.

In the 1980s, Littler and Littler proposed a model of functional form for seaweeds, hypothesizing that physiological functions could be predicted via the seaweeds' morphological forms. Based on this model, there are six groups of seaweeds: Sheet, Filamentous, Coarsely Branched, Thick Leathery, Jointed Calcareous, and Crustose. In the shallow subtidal zone, the Thick Leathery Group is well represented – the species found there tend to be tough, rubbery, and thick. These seaweeds have adapted to deal with the mechanical stress caused by wave action and can tolerate changes in temperature, reducing enzymatic reactions when it is too hot or cold.

In the intertidal zone, seaweeds are submerged in ocean waters for only part of each tidal cycle and as a result have had to evolve to tolerate an extreme range of temperatures, from -20°C to 40°C. When exposed to the air, they may also have to deal with high light levels and strong ultraviolet radiation. Mechanical stress can be as high here as in the subtidal zone, but decreases with increasing elevation. Competition from other seaweeds and herbivory also decrease as elevation increases. Common species found in the intertidal zone include *Ascophyllum nodosum* and *Fucus vesiculosus*, both from the Thick Leathery group.

In the highest part of the intertidal zone, the environment is often too extreme for the adaptations described above. One species found there is *Porphyra linearis*, a winter annual. This seaweed is an alga from the Sheet group that grows in thin layers on the tops of rocks. Having a life cycle that is restricted to winter and spring allows *P. linearis* to avoid the highest temperatures of the season. When exposed to air at low temperatures, this species freezes to the rocks, but is able to recover. Perhaps even more amazing, *P. umbilicalis* and *P. rediviva* respond to extreme heat by drying out completely, and can resume growth when they are re-hydrated. Chris noted that there have been some amazing observations of *Porphyra* growth following the re-hydration of dried herbarium specimens!

Because these species live so high up in the intertidal zone, they may be submerged for less than one hour each day, meaning they only have a short amount of time to acquire nutrients. In response, some *Porphyra* species have adapted to have the greatest rate of nutrient uptake within the first hour of exposure to a nutrient source. These nutrients can be stored within the seaweeds as phycobilin-protein pigments that also serve as accessory photosynthetic pigments.

To deal with interspecies competition, some *Porphyra* species have adapted to grow epiphytically on organisms such as barnacles, or even on other seaweeds including *Fucus* species. The moist tissue of the *Fucus* helps hydrate the *Porphyra*, extending the time the plant can photosynthesize. Chris went on to describe other adaptations of seaweed morphology to the harsh environment of the intertidal zone. Species with linear and lanceolate forms have low drag, allowing them to handle high levels of mechanical stress. These species may be "wave-pruned," but are fast growing and recover quickly by virtue of their form – they tend to be composed mainly of undifferentiated tissue, meaning there is little impact to the plant if part of it is torn away. Chris ended the talk by noting what may be the important function of *Porphyra* – its form made it ideal to use as a wrapper for sushi.