Laboratory 7 - Lycophyta: Vegetative and Reproductive Morphology of Isoetes

I. General Organography of Isoetes and Stylites

Examine the following living, herbarium and preserved specimens as available:

- *Isoetes melanopoda*
- *I. storkii*
- *I. triqueta*

Compare the diversity found in these species of *Isoetes* with the diversity in *Lycopodium* and *Selaginella*. What is it about *Isoetes* which could cause this lack of organographic diversity? The name "*Isoetes*" comes from a Greek word meaning "leek". To what extent does *Isoetes* resemble an onion? Examine the available photographs of *Stylites*. Compare the corm size between *Stylites* and *Isoetes*. Examine the diagrams from the article by Rauh and Falk. What mode of branching is expressed by the stem of members of the *Isoetes*? To what extent is this branching exhibited in fossil members such as *Pleuromeia* and *Nathorstiana*?

II. Anatomy of the Corm

A. Obtain living specimens of *Isoetes*

Ninety percent of the confusion in understanding the morphology of *Isoetes* is in deciphering the spatial arrangements of the cambia, furrows and meristems. Place one under the dissecting scope and carefully dissect off the leaves and roots one by one noting the arrangement of leaves and roots and their position on the corm. Be sure to remove all the decaying brown material. Observe the corm. Locate the lobes and the furrow. Where is the apical meristem? Do roots arise in the furrow? Where is the furrow (sagittal) plane? Where is the frontal plane? Which plane is the transverse plane? Take one corm (for the class) and make a frontal section with a razor blade. Examine this section closely under the dissecting microscope. Locate the apical meristem and the xylem core. Sketch this arrangement for future reference. Locate the area of the basal meristem. Can you see root traces? Leaf traces? Take the second corm and make a sagittal section. Again locate the apical meristem, xylem core and basal meristem. Describe the morphology of the xylem core and locate the area of the lateral meristem and prismatic layer.

B. Obtain prepared slide of a longitudinal section of the corm of *Isoetes*

First, observe this slide under the dissection scope and place next to it a section of live material, comparing structural similarities. Now, observe the prepared slide under the compound microscope. Locate the shoot apex. Where are the lateral and basal meristems? Which tissues compose the prismatic layer? Where is the primary xylem? Locate the leaf traces if any are present. Locate the root producing meristem and the root primordia. Where is the secondary phloem? Describe the action, morphology and derivatives of the lateral cambium. Why could *Isoetes* be called a "steady state plant"? Obtain a prepared slide showing a transverse section of the corm. Locate the tissues of the lateral cambium, prismatic layer, xylem and phloem.
III. Anatomy of the leaf and root

A. Leaf

Observe one of the leaves you have removed from the corm of *Isoetes*. How much of the leaf is bifacial and how much is unifacial? Make a longitudinal section. Describe the morphology of the internal structure. Where are the septa (diaphragms)? Describe both the longitudinal and lateral segmentation of the leaf. Are the leaves fertile at this stage? Is there a distinct difference between sterile and fertile leaves in *Isoetes* as in *Lycopodium* or *Selaginella*? Obtain a prepared slide showing the leaf of *Isoetes* in cross section. (Look among your various corm sections for this.) How many chambers are present? Where are the vascular tissues located? What is the function of the chambering of the leaf?

B. Root

1. Anatomy

Carefully analyze the morphology of the root system of *Isoetes*. Describe the morphology of the branching system of the root. Is it dichotomous? Locate the root cap. Obtain a prepared slide showing the root in transverse section. Diagram the root's internal structure labeling epidermis, cortex, internal cavity and vascular cylinder. Diagram the endodermis, xylem and phloem. Isn't this strange? Obtain a prepared slide of the rootlet of *Stigmaria ficoides*, an extinct member of the Lepidodendrales from the early Carboniferous. Examine this specimen under the dissecting scope. Notice that the basic morphological pattern of *Stigmaria* is very similar to that of *Isoetes*. Examine the vascular system of *Stigmaria* under the compound microscope. What does this say about the morphological nature of the root in *Isoetes*?

2. Rhizotaxis

Obtain a corm of *Isoetes* and remove all but 1/8 inch of the leaves and roots. On a piece of graph paper, draw a line representing the furrow and then place a dot representing the place of emergence of a root from the stem. Compare the resulting diagram with Figures 17 and 18 from the article by Paolillo. How do they compare? Are roots in *Isoetes* arranged irregularly or do they follow a definite rhizotaxis? Calculate the number of roots possible for your plant by calculating

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x = yz (z + 1)
\]

where x = total number of roots
    y = number of lobes
    z = series on each lobe flank

How does this method correlate with your actual observations?

IV. Reproductive Morphology

A. Microsporophyll

Obtain a prepared slide showing the microsporophyll of *Isoetes*. Locate the microsporangium on the adaxial side of the sporophyll. Locate the velum and determine its origin. Locate the ligule and determine were the foot is. Is a sheath or glossopodium present? Is the ligule in *Isoetes* in the same morphological position as that of *Selaginella*? Examine the microsporangium. Is it eusporangiate?
Locate the trabeculae and the tapetum. Are the trabecula similar to those found in *Selaginella*? Examine the microspores. Are they tetrahedral or bifacial? From what types of cells do the trabeculae arise? The tapetum? The spores?

B. Megasporophyll

Obtain a prepared slide of a megasporophyll of *Isoetes* and examine it under the dissecting microscope. Locate the ligule, velum, and sporangium. How many megaspores are present in the megasporangium?

C. Gametophyte and embryo

Gametophyte development is similar to *Selaginella*. The embryo, although endoscopic, does not have a suspensor. We do not have very much (or good) material showing embryogenesis in *Isoetes*. Please examine photographs showing these processes. Notice that the embryo of *Isoetes* in general resembles that of *Lycopodium* and *Selaginella*, although the specific ontogeny of parts differs.