President’s Message:
Decline in Bryophyte Abundance in the United States*
by Richard Spjut

My field experience with bryophytes began with my MA thesis at Humboldt State University under Dan Norris — titled Mosses of the Marble Mountains Wilderness Area, Siskiyou County, California (1971). Abstract reported 177 species and varieties of moss, 37 new to California, most circumboreal with southernmost occurrence in the Klamath Mountains. Liverworts were also collected but not identified, on the advice of my major professor.

I recall rocks along most streams and canyon walls completely covered with bryophytes. I returned to the Marbles this century, and found riparian rocks — such as along the North Fork of the Salmon River — often appearing more bare than mossy. I also collected bryophytes for cancer research as an employee of the USDA Agricultural Research Service (ARS) in Beltsville, Maryland under a cooperative agreement with the National Cancer Institute (NCI). Our mission was to find plants with new chemicals for cancer chemotherapy, the methodology guided by taxonomy and pharmacology.¹

Antitumor activity in bryophytes was initially discovered from a 1–2 kg dried and mechanically cleaned sample of the moss Polytrichastrum (Polytrichum) ohioense that I collected in 1976 during my lunch hour where I worked at the USDA Beltsville agriculture station.² P. ohioense was a good candidate because bryophytes had rarely been collected for the NCI. An extract of the moss that I collected was first active in KB,³ a routine bioassay that had led to discovery of taxol in bark of western yew (Taxus brevifolia), which was first collected in 1962, and attained drug status 1992. Novel anticancer compounds were discovered in the moss by John Cassady and collaborators at Ohio State University, and the new active compounds were named “ohioensins.”⁴ In 1996, I named a lichen in Cassady’s honor, Vermilacinia john cassadyi.

Ed Terrell, a grass taxonomist for the ARS, and I often walked the Beltsville farm roads during lunch hour — where deciduous forests and open pastures were protected from outsiders by security police — to record the flora, bryophytes and lichens included.⁵ Shaded creek banks by secondary deciduous forests, at the time — in the late 1970’s and early 1980’s — were carpeted with mosses Plagiomnium cuspidatum and Thuidium erectum⁶. However, during the late 1980’s their growth diminished, while other species, Polytrichum commune and Polytrichastrum ohioense, along forest margins remained vigorous — especially P. ohioense where illegal dumping of broken bottles evidently became filled and buried from accumulation of soil over perhaps 30 years.

During March 1979, while collecting samples for the NCI in Baja California Sur, I received a phone call

* Based on Observations from Forays and Field Work for Cancer Research
from my brother in Mckinleyville CA that my dad — in advanced stages of colon cancer — was expected to live only a few days, and that he wanted me there. The vascular flora of northern California had already been extensively collected for the NCI. Thus, my only business for traveling 1,800 miles — to see my dad — was bryophytes. Soon after I arrived, my dad died. The day after, one of the moss samples I collected, Claoaopodium crispifolium, became a high priority collection for its anticancer activity. In 1981, I obtained 75 kg (dried), from northwestern California and Oregon. Ansamitocin P-3 was identified in the samples, a highly cytotoxic compound generally found in soil actinomycetes, but also known as maytansinoids i. shrubs of Gymnosporia spp. in East Africa, and Colubrina spp. in Texas and California. However, I also felt anticancer activity was due to associated cyanobacteria observed in the moss. This idea was supported by cyanobacteria found active from samples I collected dried on soil in woodlands and wet as nodules along open lake margins, and that the ansamitocin in the moss was not identified by bioassay-guided activity. Further, the scanty growth of Claoaopodium I left behind on the original rock — re-sampled by Dan Norris — was only marginally active, suggesting that the best activity in Claoaopodium occurred in the youngest parts, less associated with dead debris at base.

The NCI terminated their cooperative agreement with the ARS in Oct 1981-82 due to alleged lack of discoveries, while I was in Western Australia still making new discoveries such as concurrence later isolated from smokebush (Conospermum cf. incurvum) for its anti-HIV activity. Moreover, Dan Norris and I had had collected hundreds of bryophyte samples from California, Oregon, and the Eastern U.S. that yielded many new active species, and others new to science, e.g., Orthotrichum sp.utii. Through university contracts with World Botanical Associates, I obtained recollections of most active bryophytes during the mid 1980’s, from Maine to Tennessee, and from Washington to California, and continued to find bryophyte species not previously sampled, until the late 1980’s and early 1990’s when their abundance seemed to decline rapidly, reported as follows in an abstract that I submitted for a scientific meeting held in the Great Smoky Mountains National Park:

“Bryophytes (mosses, liverworts and hornworts) seem to be disappearing rather quickly from many areas within our national forests, state parks, and national parks in the United States. The diminishing growth has been most dramatic since 1985. Streams and lakes in many parts of the country, which were recalled as having a luxuriant growth only a few years ago, are now devoid of bryophytes. Large rocks on northern forested slopes, expected to have bryophytes, are often stark. This disappearance is not uniform, but it has been particularly evident in the White Mountains National Forest, and it is also evident in the Great Smoky Mountains National Park…

Acid rain due to pollutants from industrial metropolitan sources might naturally be suspected as the cause, but this does not appear to be the whole explanation. Pollution of streams by loggers, campers, swimmers, and miners is probably why bryophytes have disappeared from the streams. The high density of automobiles travelling on forest or park roads during lengthy periods of an existing atmospheric inversion layer may lead to increased buildup of toxic substances contributed by auto exhaust. During daylight, these pollutants may accumulate in the atmosphere more at the lower elevations, and later precipitate in the morning dew, or in rain, at concentration levels above the threshold tolerated by most bryophytes. This would account for the localized patterns of bryophyte disappearance at the foothill elevations, especially noticeable along major automobile routes…”

In July 2010, I returned to sites where I collected moss samples in 1979 to see if the species had grown back. At one site near Willow Creek, Boise Creek — where Claoaopodium crispi folium was collected—the original rock, ~3 m diam., was gone. In that same creek where I had collected 5.75 lbs of Scleropodium obtusifolium (dried) within a radius of 5 meters, no mosses were evident; I saw more S. obtusifolium in Mill Creek during our March 2017 field trip. It might be interesting to return to all the locations where I once collected bryophytes for the NCI and report on what remains or what has changed; see also http://www.worldbotanical.com/bryophytes.htm.