Present-day club-mosses, like ferns and horsetails, are from an ancient and diverse spore-bearing lineage which was globally dominant during the Paleozoic Era. These lingering remnants of the Coal Age are members of the Lycopodiaceae or club-moss family. The name *lycopod* means “wolf’s foot” in ancient Greek and refers to the resemblance of the branch tips to a wolf’s paw. Today, this family of creeping rhizomatous evergreens is comprised of about 400 species in 10-15 genera; the family is represented worldwide except Antarctica. In temperate and arctic areas, club-mosses inhabit various forest and wetland habitats and prefer acidic soils. In the tropics, club-mosses are often epiphytic. Individual plants can live for centuries and some species form fairy rings.

Though there are 27 species in North America and 11 in the Pacific Northwest, California has only two taxa: running-pine (*Lycopodium clavatum* L.) and the bog club-moss (*Lycopodiella inundata* (L.) Holub). Both species are on the California Native Plant Society (CNPS) List 2—“rare in California but more common elsewhere.” In North America, both species have bicoastal distributions, occurring in the Pacific Northwest as well as in the northeast including the Great Lakes region. The bog club-moss also occurs across Eurasia, and running-pine, the most cosmopolitan *lycopod*, has a near-global distribution. Like many plants which are rare in California but common elsewhere in the northern hemisphere, these taxa have Pacific Northwestern distributions which terminate in the cool climate and moist habitats of northern California.

As spore-bearing plants, club-mosses have two life forms, a minute subterranean gametophyte (gamete producer) and the more obvious mat-forming sporophyte (spore-producer). Spores, which are wind-dispersed, can persist in the soil for many years before germinating into gametophytes. (Incidentally, club-
moss spores are flammable and were the original flash powder in olden
day photography; they continue to have diverse industrial uses.) Ga-
metophytes as well as spores can be very long-lived, taking 10-15 years
or more to develop (Andrews 1947) and requiring a mycorrhizal symb-
iont to reach sexual maturity. Bi-
sexual gametophytes produce both
eggs and biflagellate sperm. Despite
their bisexuality, self-fertilization is
quite rare in many species (Gifford
and Foster 1987). Club-moss sperm
therefore swim underground
through wet soil to fertilize other
gametophytes—not a life stage usu-
ally considered in rare plant con-

**BOG CLUB-MOSS**

*Lycopodiella inundata*, which is
also rare in Oregon, has an enig-
matic distribution in California of
two disjunct populations. It occurs
at sea level in Humboldt County at
Big Lagoon County Park, and at
about 900 meters in elevation in
Nevada County at The North Co-

*mlopodiella inundata*, which is
also rare in Oregon, has an enig-
matic distribution in California of
two disjunct populations. It occurs
at sea level in Humboldt County at
Big Lagoon County Park, and at
about 900 meters in elevation in
Nevada County at The North Co-
lumbia Diggings, an abandoned
placer mine in the Sierra foothills.
The Big Lagoon site is a rare
coastal peatland or fen (known lo-
cally as Big Lagoon Bog). The
peatland formed in the swale
of a paleo-sand dune on a brackish
marsh on Big Lagoon and is
surrounded by Sitka spruce (*Picea
sitchensis*) forest. This small pop-
ulation occurs mostly on sparsely
vegetated organic soil (peat and
muck) of regularly inundated pool
edges and stream banks. Big La-
goon Bog is a biodiversity hotspot
with occurrences of several other
CNPS List 2 taxa: flaccid sedge
(*Carex leptalea*), green sedge
(*C. viridula*), and marsh pea
(*Lathyrus palustris*), the CNPS List
4 Buxbaum’s sedge (*Carex
buxbaumii*), and the locally rare sun-
dew (*Drosera rotundifolia*).
The Diggings is a 2,300-acre

![Closeup of running-pine cones.](image1)

![Stolon, or runner, and aerial branches of running-pine.](image2)

Running-pine (*Lycopodium clavatum*) cones produce flammable spores with a number of industrial and scientific uses. Spores can live for years underground before germinating.

V O L U M E  3 2 : 4 ,  O C T O B E R  2 0 0 4
former ponderosa pine foothill forest that was “moon-scape” by decades of intensive hydro-mining for gold in the late 1800s (Pendall 1984). Aside from the catastrophic sedimentation of the Yuba River and San Francisco Bay, this mine also resulted in the so-called Valley of the Moon, a barren wasteland of bare hillsides and a mineral-soil wetland slowly being colonized by acid-loving montane and peatland plants. A large bog club-moss population now occurs in this bare-soil wetland. How this species arrived is unclear but it is presumably the result of wind-borne spore dispersal. An unusual occurrence of cranberry (Vaccinium macrocarpon) occurs at the Diggings, and while at one time it was considered a rare disjunction (Pendall 1984), it is now thought to be introduced. Because the Diggings is still owned by mining interests, the present status of the bog club-moss is unknown and this population is potentially threatened by future gold mining.

**RUNNING-PINE**

*Lycopodium clavatum* is restricted to redwood and coastal mixed evergreen forests in Del Norte, Humboldt, Mendocino, and Sonoma counties. It forms a large meta-population in Humboldt County from Big Lagoon to the Elk River south of Eureka. In Mendocino County it is much less common, occurring in and around Jackson State Forest. It was only recently discovered in Del Norte and Sonoma counties, where it is quite scarce.

Running-pine almost exclusively inhabits gaps in forest canopy with partial shade such as roadsides, trails, and forest edges. The majority of occurrences are on managed redwood timberlands where large mats commonly occur with salal (*Gaultheria shallon*) and evergreen huckleberry (*Vaccinium ovatum*).

**CONSERVATION**

In the eastern United States, club-moss gathering for holiday garlands and the floral trade is a common hobby and “non-timber forest products” industry. However, overcollecting has resulted in local rarity of some taxa and is considered a threat to others (Nauertz 1999). In Wisconsin and Michigan alone over 85 tons of club-moss is harvested annually from local forests (Nauertz and Matula 2002).

In California, club-mosses are too rare for collecting. Conservation efforts focus on total avoidance of bog club-moss populations and on forestry practices that maintain running-pine populations in managed timberlands (Golec 2000). Club-mosses are difficult to cultivate and attempts to transplant running-pine as a mitigation strategy by Redwood National and State Parks and others have had little success. Cultivation and transplantation may be hampered by the disruption of its mycorrhizal relationship. Indeed, the development of the critical relationship between gametophytes and their fungal associates may be an important factor in the rarity of these species and in their habitat requirements. A lifecycle that can require more than 20 years to complete may also contribute to their rarity.

To conserve the bog club-moss in California, maintenance of water quality and hydrologic regimes and avoidance of other impacts, such as invasive plants, appears to be the best management strategy. Running-pine has low survivorship in clearcuts and after other forest stand replacement events. Because of its shallow root system it does not tolerate direct impacts from heavy equipment and extensive ground disturbance. The persistence of running-pine mats on managed timberlands necessitates partial canopy retention strategies and the avoidance of mats by heavy equipment. The California Department of Fish and Game is currently working with private timberland owners to develop strategies that best maintain this species and its habitat on the North Coast. These strategies include leaving shade trees, excluding heavy equipment, and not applying herbicide near running-pine occurrences.

**REFERENCES**


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