DEPARTMENT OF THE INTERIOR

Fish and Wildlife Service

50 CFR Part 17

[Docket No. FWS–R4–ES–2014–0044; 4500030113]

RIN 1018–AY97

Endangered and Threatened Wildlife and Plants; Endangered Species Status for *Trichomanes punctatum ssp. floridanum* (Florida Bristle Fern)

AGENCY: Fish and Wildlife Service, Interior.

ACTION: Final rule.

SUMMARY: We, the U.S. Fish and Wildlife Service (Service), determine endangered species status under the Endangered Species Act of 1973 (Act), as amended, for *Trichomanes punctatum* ssp. *floridanum* (Florida bristle fern), a plant subspecies from Miami-Dade and Sumter Counties, Florida. The effect of this regulation will be to add this subspecies to the Federal List of Endangered and Threatened Plants and extend the Act's protections to this subspecies.

DATES: This rule becomes effective on November 5, 2015.

ADDRESSES: This final rule is available on the internet at *http://www.regulations.gov* and *http://www.fws.gov/verobeach/*. Comments and materials we received, as well as supporting documentation we used in preparing this rule, are available for public inspection at *http://www.regulations.gov*. All of the comments, materials, and documentation that we considered in this rulemaking are available by appointment, during normal business hours at: U.S. Fish and Wildlife Service, South Florida Ecological Services Office, 1339 20th Street, Vero Beach, FL 32960; telephone 772–562–3909.

FOR FURTHER INFORMATION CONTACT: Roxanna Hinzman, Field Supervisor, U.S. Fish and Wildlife Service, South Florida Ecological Services Office, 1339 20th Street, Vero Beach, FL 32960, by telephone 772–562–3909 or by facsimile 772–562–4288. Persons who use a telecommunications device for the deaf (TDD) may call the Federal Information Relay Service (FIRS) at 800–877–8339.

SUPPLEMENTARY INFORMATION:

Executive Summary

Why we need to publish a rule. Under the Act, a species may warrant protection through listing if it is endangered or threatened throughout all or a significant portion of its range. Listing a species as an endangered or threatened species can only be completed by issuing a rule. This rule will finalize the listing of the *Trichomanes punctatum* ssp. *floridanum* (Florida bristle fern) as an endangered species.

The basis for our action. Under the Act, we can determine that a species is an endangered or threatened species based on any of five factors: (A) The present or threatened destruction, modification, or curtailment of its habitat or range; (B) Overutilization for commercial, recreational, scientific, or educational purposes; (C) Disease or predation; (D) The inadequacy of existing regulatory mechanisms; or (E) Other natural or manmade factors affecting its continued existence. We have determined that the threats to *Trichomanes punctatum* ssp. *floridanum* consist primarily of destruction and modification of habitat (Factor A), proliferation of nonnative invasive species, natural stochastic events including hurricanes and tropical storms, and impacts from climate change including temperature shifts and sea level rise (Factor E), and that existing regulatory mechanisms have not reduced or removed such threats (Factor D).

Peer review and public comment. We sought comments from independent specialists to ensure that our designation is based on scientifically sound data, assumptions, and analyses. We invited these peer reviewers to comment on our listing proposal. We also considered all comments and information received during the comment period.

Previous Federal Actions

Please refer to the proposed listing rule for *Trichomanes punctatum* ssp. *floridanum* (79 FR 61136), published on October 9, 2014, for a detailed description of previous Federal actions concerning this subspecies.

Our proposed listing rule included a finding that designation of critical habitat was prudent, but that critical habitat was not determinable. In this final listing rule, we find that critical habitat is still not determinable (see Critical Habitat discussion below).

Background

Below we present updated and revised information, based on peer review and public comment received during the comment period on the proposed rule, as well as new information, related to the subspecies' life history, historical and current ranges, and habitat requirements.

Species Description

Trichomanes punctatum ssp. *floridanum,* commonly referred to as the Florida bristle fern, is mat-forming, has root-like structures, and contains trichomes (hairlike/bristlelike outgrowths), which extend from soral involucres (tubes containing sporangia (an enclosure in which spores, or reproductive cells, are formed)) on the tips of some fronds (leaves of ferns) when the plant is fertile (Wunderlin and Hansen 2000, pp. 153–154). This subspecies is very small in size and superficially resembles bryophytes, such as mosses and liverworts, making it difficult to observe in its natural habitat.

Wunderlin and Hansen (2000, pp. 153–154) described *Trichomanes punctatum* ssp. *floridanum* as having leaves, with the petiole (stalk by which a leaf is attached to a plant) 0.1–2.0 centimeters (cm) (0.04–0.79 inches (in)) long and typically shorter than the blade. The blade is fan-shaped, round, entire or irregularly lobed at the apex, and 0.5–2.0 cm (0.20–0.79 in) long and 0.2–1.1 cm (0.08–0.43 in) wide. *T. p.* ssp. *floridanum* has thin veinlets (small veins) that are not enlarged towards the margin while true veins are uniform in width to their apices (tips) (Nauman 1986, p. 179). This subspecies has few false veins, and fronds are considered simple (Morton 1963, p. 89).

One unusual characteristic of this plant is that it lacks cuticles (the protective layer that covers the epidermis, which is the outermost layer of cells that cover the leaves) or has highly reduced cuticles. The fern has differentiated epidermises and stomata (small openings in leaves and stems through which gases are exchanged), causing it to be dependent on elevated moisture conditions because a barrier is not present to prevent unregulated loss of water (Krömer and Kessler 2006, p. 57). This dependence restricts most *Trichomanes* ssp. to shaded areas within forested environments with high humidity, making them more vulnerable to changes in localized climatic conditions (Schuster 1971, p. 91; Nauman 1986, pp. 181–182; van der Heiden 2014, p. 5).

Taxonomy

The genus *Trichomanes* contains approximately 320 species of ferns that occur primarily in the tropics and for which we generally lack ecological information (Nauman 1986, p. 179; Nelson 2000, p. 77). The genus belongs to the family Hymenophyllaceae and the hymenophylloid clade, where ferns are also referred to as filmy ferns, which

describes the thin, filmy leaves of the species (Nelson 2000, p. 77). The common name, bristle fern, is used to reference the bristlelike structure that singularly protrudes from each soral involucre (a structure that holds and produces spores) (Nelson 2000, p. 77).

Five species commonly known as bristle ferns (*Trichomanes* ssp.) have been found in Florida (Krömer and Kessler 2006, p. 57). *Trichomanes punctatum* ssp. *floridanum* is a subspecies of *Trichomanes punctatum,* the current taxonomy of which is the result of monographic revision of *Trichomanes* sections (a taxonomic rank or position below the genus but above the species) *Didymoglossum* and *Microgonium* by Wessels Boer (1962, pp. 300–301). All U.S. species of *Trichomanes* now belong to the section *Didymoglossum,* except *T. boschianum* (Morton 1963). Wessels Boer, in reviewing specimens from throughout the American tropics, determined that all *Trichomanes punctatum* plants in Florida represented the same taxon, not two separate species, and that *T. sphenoides* (which he described as *T. punctatum* ssp. *sphenoides*) does not occur in Florida. He further determined that *Trichomanes punctatum* plants in Florida were different from those in the tropics and described them as a new subspecies, *Trichomanes punctatum* ssp. *floridanum* (Boer 1962, pp. 300–301). This treatment has been followed by almost all subsequent authors (Lakela and Long 1976, p. 53; Wunderlin 1982, p. 32; Lellinger 1985, p. 205; Nauman 1986, p. 181; Flora of North America Editorial Committee 1993, p. 196; Wunderlin 1998, p. 44; Nelson 2000, p. 81; Wunderlin and Hansen 2000, p. 153; Wunderlin and Hansen 2003, p. 44). The only exception is Long and Lakela (1971, p. 73), who treated the subspecies as *T. punctatum* without further explanation. Additionally, the following entities use the name *T. p.* ssp. *floridanum* and indicate that this subspecies' taxonomic standing is accepted:

- Florida Department of Agriculture and Consumer Services (2013, *https://www.flrules.org/gateway/RuleNo.asp?title=PRESERVATION%20OF%20NATIVE%20FLORA%20OF%20FLORIDA&ID=5B-40.0055*),
- The Integrated Taxonomic Information System (2011, p. 1),
- NatureServe (2013, *http://explorer.natureserve.org/servlet/NatureServe?loadTemplate=tabular_report.wmt&paging=home&save=all&sourceTemplate=reviewMiddle.wmt*),
- The online Atlas of Florida Vascular Plants (Wunderlin and Hansen 2008, (*http://www.florida.plantatlas.usf.edu/Plant.aspx?id=1122*),
- The Flora of North America (*http://www.efloras.org/florataxon.aspx?flora_id=1&taxon_id=233501316*), and
- The Florida Natural Areas Inventory (FNAI) (FNAI, 2013, *http://fnai.org/trackinglist.cfm*).

In summary, there is consensus that *Trichomanes punctatum* ssp. *floridanum* is a distinct taxon.

Currently there are two extant metapopulations (groups of spatially separated populations) of this subspecies (Gann *et al.* 2002, pp. 552–554), comprising four populations in Miami-Dade County and two in Sumter County, separated by a distance of approximately 400 kilometers (km) (249 miles (mi)). As noted by Small (1938, p. 50), the Sumter metapopulation is a considerable distance from where *T. p.* ssp. *floridanum* was first discovered (*i.e.,* south Florida) and resides in a climate and habitat unlike the Miami-Dade County metapopulation. These differences are likely why Morton (1963, p. 90) suggested that the previous determination of these two metapopulations be reviewed. In March 2014, the Service contracted researchers from Florida Atlantic University to determine if the two metapopulations were the same subspecies. Samples were collected from both metapopulations for genetic analysis. DNA was isolated from the samples, and sequencing was completed on five samples from each metapopulation. Researchers found no observable differences in the sequence between the five samples collected from Miami-Dade County and the five samples from Sumter County, indicating that both metapopulations are the same subspecies (Hughes 2014, pp. 1–4).

Life History

The life cycle of ferns is not commonly understood (Possley 2014c, pers. comm.). Information about the specific life cycle of *T. p.* ssp. *floridanum* is also lacking. Like all ferns, this taxon has two life-history stages, a gametophyte stage and a sporophyte stage, and only the sporophyte form is recognizable in the wild, while the gametophyte form is very cryptic (Possley 2013a, pers. comm.; van der Heiden 2013b, pers. comm.). Therefore, all reported populations of *Trichomanes punctatum* ssp. *floridanum* have been in the sporophyte stage.

Mature plants can reproduce sexually or asexually. The initial stage, when a spore germinates, is referred to as the gametophyte stage. The gametophyte contains separate sperm and egg-producing structures. In the presence of water or moisture, sperm reach the eggs for fertilization. Fertilized eggs, under the proper conditions, develop into sporophytes. The sporophytes produce spores, which in turn can germinate to produce new gametophytes (Nelson 2000, pp. 17–19). Reproduction may also occur in one other way: By division, when rhizomes (horizontal, underground plant stems capable of producing the shoot and root-like structures of a new plant) break, forming clones of the parent plant.

Although it has been suggested that plants sporulate (produce spores) mostly in the spring and summer (Nauman 1986, p. 182), field observations in Miami-Dade County have observed sporangia in the months of February, March, May, August, October, and December. The plants are likely fertile any time of year; however, during the dry season, sporophytes have been observed to desiccate and probably do not produce spores (Possley 2013d, pers. comm.). In Sumter County, sporangia have been observed from April through September; however, researchers suggest they are likely producing all year, with peaks in the wet season (van der Heiden 2013c, pers. comm.). For *Trichomanes punctatum* ssp. *floridanum,* specific reproductive and growth requirements, such as moisture levels needed for each stage of its life history, plant longevity, growth rates, recruitment rates, dispersal methods, and genetic variation, are currently unknown.

Organizations such as the Institute for Regional Conservation (IRC) and Fairchild Tropical Botanic Garden (Fairchild) are working together to understand the biology and life history of *Trichomanes punctatum* ssp. *floridanum.* In 2002, IRC and Fairchild collaborated with fern culture experts from Marie Selby Botanical Gardens (MSBG) in Sarasota, Florida, and tissue culture experts at the Lindner Center for Conservation and Research on Endangered Wildlife (CREW) in Cincinnati, Ohio (Gann *et al.* 2009, pp. 35–36). Currently, Fairchild maintains fewer than five healthy clusters of *T. p.* ssp. *floridanum* from plants obtained in local hammocks (tropical hardwood forests) that are monitored by their organization. The success of this effort to grow healthy *T. p.* ssp. *floridanum* has yet to be determined due to several factors, including: Slow growth rates, the formation of unusual linear fronds, the susceptibility to mold, and the lack of sporulation (Possley *et al.* 2013, pp. 43–45). However, researchers at CREW

have recently developed a successful method to culture *T. p.* ssp. *floridanum* in-vitro and cryopreserve (to preserve by freezing at low temperatures) sporophytes (V. Pence, submitted; Pence and Charls 2006, pp. 29–34). The new plants from CREW have recently been transferred to MSBG, and plans are under way to establish *T. p.* ssp. *floridanum* onto limestone rock, which could potentially be transferred to solution hole (see description under ''Habitat'' section, below) walls for eventual reintroduction to the wild (Holst 2014, pers. comm.).

It is important to note that the numerous efforts to cultivate *Trichomanes punctatum* ssp. *floridanum* ex-situ for possible future reintroduction have been only partially successful. Researchers have not been able to propagate *T. p.* ssp. *floridanum* via sexual reproduction. Although they have been able to maintain the subspecies in cultivation in the greenhouse for several months at a time, and temporarily establish rhizome growth onto limestone rock, the propagated fern eventually declines or becomes overrun with mosses. Even when there is vegetative growth, there is no sign of spore production (Holst 2014, pers. comm.).

Habitat

In southeastern North America, *Trichomanes* ssp. are considered rare because of their delicate nature and requirements for deeply sheltered habitats with almost continuous high moisture and humidity (Farrar 1993, pp. 190–197; Zots and Buche 2000, p. 203), restricting them from a more widespread pre-glaciation distribution. *Trichomanes punctatum* ssp. *floridanum* is considered strongly hygrophilous (growing or adapted to damp or wet conditions) and generally perceived as restricted to constantly humid microhabitat (Krömer and Kessler 2006, p. 57). *T. p.* ssp. *floridanum* occurs only in the United States in the State of Florida. In Florida, *T. p.* ssp. *floridanum* is known to occur only in Miami-Dade and Sumter Counties.

Both extant metapopulations occur in dense canopy habitats, with shady conditions that may be obligatory due to the poikilohydric (*i.e.,* possessing no mechanism to prevent desiccation) nature of some fern species (Krömer and Kessler 2006, p. 57). The canopy directly contributes to the surrounding humidity of an area. Dense canopies found in rockland habitats can minimize temperature fluctuations by reducing soil warming during the day and heat loss at night. In areas with greater temperature variations, as in Sumter County, this temperature minimization effect can help prevent frost damage to the interior of the hammock (FNAI 2010, p. 25). Mesic conditions are further maintained by the hammock's rounded canopy profile, which deflects winds, limiting desiccation during dry periods and reducing interior storm damage (FNAI 2010, p. 25). Changes in the canopy can impact humidity and evaporation rates, as well as the amount of light available to the understory.

In Miami-Dade County, *Trichomanes punctatum* ssp. *floridanum* is generally epipetric (a plant that grows on rocks) or epiphytic (a plant that grows non-parasitically upon another plant), typically growing in rocky outcrops of rockland hammocks, in oolitic (composed of minute rounded concretions resembling fish eggs) limestone solution holes (see description below), and, occasionally, on tree roots in limestone-surrounded areas (Phillips 1940, p. 166; Nauman 1986, p. 180; Whitney *et al.* 2004, pp. 105–106; Possley 2013e, pers. comm.; van der Heiden 2014b, pers. comm.). These rockland habitats are outcrops primarily comprising marine limestone representing the distinct geological formation of the Miami Rock Ridge, a feature that encompasses a broad area from Miami to Homestead, Florida, and narrows westward through the Long Pine Key area of Everglades National Park (ENP) (Snyder *et al.* 1990, pp. 233–234). Several endemic plant species have been identified to be closely associated with the rocklands of southern Florida; these plants are believed to have no adaptation for long-distance dispersal, suggesting a lengthy period of evolution on rocky substrate in southern Florida (Snyder *et al.* 1990, p. 236).

Rockland hammocks are a type of rich tropical hardwood forest on upland sites in areas where limestone is very near the surface and often exposed. Once numerous throughout South Florida, these rockland hammocks have a diverse closed canopy and shrub layer, where more than 120 native tree and shrub species are known to occur, including a number of rare plant and animal species, federally listed and candidate species, South Florida endemics, and tropical species at or near the northern limit of their ranges (Phillips 1940, p. 166; Snyder *et al.* 1990, p. 16; Gann *et al.* 2009, p. 3). The forest floor is characterized by leaf litter with varying amounts of exposed limestone and has few herbaceous species. Rockland hammocks generally consist of larger, mature trees in the interior, while the margins can be almost impenetrable due to dense growth of smaller shrubs, trees, and vines (FNAI 2010, pp. 24–27). The canopy cover is typically very dense where *Trichomanes punctatum* ssp. *floridanum* occurs. In Miami-Dade County, the hammocks consist of a mix of temperate and tropical hardwood trees, both canopy and understory, including *Ocotea coriacea* (lancewood), *Coccoloba diversifolia* (pigeon plum), *Quercus virginiana* (live oak), *Simarouba glauca* (paradise tree), *Ficus aurea* (strangler fig), and *Sideroxylon foetidissimum* (mastic) (see Snyder *et al.* 1990, p. 241, for complete list). Soils where *T. p.* ssp. *floridanum* is extant in Miami-Dade County generally consist of an uneven layer of highly organic soil overlying rock (Snyder *et al.* 1990, p. 238); soils are classified as Matecumbe Muck (moderately well-drained soils that are very shallow) (Florida Geographic Data Library 2013, *http://www.fgdl.org/*). Soils from historical and extant records consist of the following soil types: Krome Very Gravelly Loam, Cardsound Silty Clay Loam-Rock Outcrop Complex, Opalocka Sand-Rock Outcrop Complex, and Dania Muck.

The limestone solution holes are considered specialized habitat within these hammock areas that host *Trichomanes punctatum* ssp. *floridanum,* as well as several other fern species (Snyder *et al.* 1990, p. 247). The solution hole features that dominate the rock surface in the Miami Rock Ridge are steep-sided pits, varying in size, formed by dissolution of subsurface limestone followed by a collapse above (Snyder *et al.* 1990, p. 236). Limestone solution holes vary in size, from shallow holes less than 0.5 meter (m) (1.6 feet (ft)) deep to those that cover over 100 m^2 (1,076 ft^2) and are several meters deep (Snyder *et al.* 1990, p. 238). The bottoms of most solution holes are filled with organic soils, while deeper solution holes penetrate the water table and have (at least historically) standing water for part of the year (Snyder *et al.* 1990, pp. 236–238). Humidity levels are higher in and around the solution holes because of standing water and moisture retained in the organic soils. Many tropical, epipetric plant species are associated with the sinkholes and solution holes in rockland hammocks.

In Sumter County, *Trichomanes punctatum* ssp. *floridanum* is known to be epipetric, residing on limestone boulders in high atmospheric humidity hammocks (van der Heiden 2013a, pers. comm). The extant populations are located in mesic hammocks on limestone boulders 0.1–1.5 m (0.3–4.9 ft) tall (see ''Current Range'' section,

below). Mesic hammock is a developed evergreen hardwood and/or palm forest on soils that are rarely inundated (FNAI 2010, pp. 19–23) and commonly associated with hydric hammock and mixed wetland hardwoods. The difference between mesic hammocks and surrounding habitats is a slight difference in elevation. Mesic hammocks occur on higher ground within basin or floodplain wetlands; as patches of oak/palm forest in dry prairie or flatwoods communities; on river levees; in ecotones (transition area between two biomes or areas of distinct plant and animal groups) between wetlands and upland communities; and at the edges of lakes, sinkholes, other depressional or basin wetlands, and river floodplains where natural fires do not occur (FNAI 2010, pp. 19–23).

Recent field surveys (van der Heiden 2015a, p. 6; van der Heiden 2015b, unpublished data; van der Heiden 2015c, unpublished data) have provided additional information regarding potential suitable habitat in Sumter County. These surveys, conducted by IRC and funded by the Service, delineated suitable habitat within and around the Jumper Creek Tract of the Withlacoochee State Forest. Within surveyed areas, IRC mapped all suitable substrate found in areas having suitable canopy and hydrology to support growth of *Trichomanes punctatum* ssp. *floridanum*. The resulting map included limestone rocks and boulders in not only mesic hammock, but also hydric hammock, elevated hydric hammock, and (in a small number of instances) adjacent wetland (but non-hammock) habitats. The Service is still evaluating this information and working with IRC to further refine suitable habitat parameters for the fern in Sumter County. Despite extensive surveys through approximately 1,904 ha (4,705 ac) in and around the Jumper Creek Tract, van der Heiden (2015a, p. 9) did not find any new populations of *T. p.* ssp. *floridanum*.

Although there are several occurrences of *Trichomanes punctatum* ssp. *floridanum* in Sumter County where sunlight can be observed through the canopy, generally the habitat is shaded throughout the year, with the lowest amount of canopy cover recorded at approximately 65 percent (van der Heiden and Johnson 2014, p. 20; in Rocky Hammock). *T. p.* ssp. *floridanum* has been observed growing on small limestone rocks, as well as boulders with tall, horizontal faces with numerous other species, including rare State-listed species (*e.g., Asplenium cristatum* (hemlock spleenwort)) and widespread *Pecluma dispersa* (widespread polypody) (van der Heiden 2013b, pers. comm.; van der Heiden and Johnson 2014, pp. 15–16).

Within one occupied Sumter County hammock (Rocky Hammock), the majority of *Trichomanes punctatum* ssp. *floridanum* occur on the northern face of limestone boulders; however, those clusters found on non-north-facing limestone generally occur in close proximity to other boulders, trees, or within protected crevices (van der Heiden and Johnson 2014, p. 7). Van der Heiden and Johnson (2014, pp. 9–10) suggested that the northern aspect of limestone boulders is more often inhabited by this taxon because of the reduced exposure to sunlight, promoting cooler temperatures and higher moisture as compared to other sun-exposed sections of rock. This may also be the case for those clusters shielded by other boulders, by trees, or in crevices, allowing the plant to grow on any portion of the shielded rock as long as moisture levels remain high enough to prevent desiccation (van der Heiden and Johnson 2014, pp. 9–10). Additionally, both populations of *T. p.* ssp. *floridanum* in Sumter County grow within the northern quadrant of each hammock.

Soils of mesic hammock are sands mixed with organic matter, often containing a thick layer of leaf litter and generally well-drained. Although some areas maintain high-moisture soils due to the accumulation of leaf litter and extensive canopy cover, in general, mesic hammocks can occur across a broad gradient of soil moisture conditions, from somewhat xeric to almost hydric soils. Rock outcrops may also occur in mesic hammocks, especially where limestone is near the surface (FNAI 2010, pp. 19–23). Soil types for the extant metapopulation of *Trichomanes punctatum* ssp. *floridanum* in Sumter County include Okeelanta Muck, Frequently Flooded, and Mabel Fine Sand (*i.e.,* deep and very deep, somewhat poorly drained, slowly permeable soils that formed in sandy to clayey marine deposits, with a bouldery (abounding in rocks or stones) subsurface and 0–5 percent slopes (Florida Geographic Data Library 2013, *http://www.fgdl.org/*). Additionally, one historical record has Adamsville Fine Sand, Bouldery Subsurface, while another population containing a questionable record from an extirpated population has what is classified as Malabar Fine Sand, Frequently Flooded.

Plant communities associated with mesic hammocks vary depending on the latitude; tropical species gradually increase in frequency from the central to southern peninsular Florida. In south Florida, some high-elevation areas dry enough to support a semi-tropical mesic hammock do exist; however, most ''high hammocks'' are rockland hammocks occurring on limestone (FNAI 2010, pp. 19–23). *Q. virginiana* is common in mesic hammock communities. Oak species found in these hammocks tend to possess a broader tolerance of a range of conditions than do oaks in other habitats (FNAI 2010, pp. 19–23). Mesic hammocks do not contain wetland trees, as found in hydric hammocks; however, these two hammock types often occur as intermixed stands. Because mesic hammocks are often associated with hydric hammocks, with wetlands, or as a transition to uplands, they are sensitive to hydrologic alteration in the landscape. For example, changes in flooding frequency and/or duration can kill most mesic hammock tree species, while lowered water tables can shift vegetation towards xeric species or promote wildfires, destroying the hammock (FNAI 2010, pp. 19–23). Mesic hammocks may be distinguished from rockland hammocks by the dominance of temperate species in the canopy, whereas rockland hammocks are composed of predominantly tropical woody species.

Trichomanes punctatum ssp. *floridanum* in Sumter County can be found under a dense canopy including *Q. virginiana, Sabal palmetto* (cabbage palm), *Carpinus caroliniana* (American hornbeam), *Celtis laevigata* (sugarberry), *Acer negundo* (boxelder), *Liquidambar styraciflua* (sweetgum), and *Sapindus saponaria* (wingleaf soapberry) (van der Heiden 2013c, pers. comm.; van der Heiden and Johnson 2014, p. 19). The hammocks where *T. p.* ssp. *floridanum* has been found are also surrounded by a mosaic of wetlands dominated by *Taxodium distichum* (cypress trees). Field surveys of Sumter County populations recorded 18 canopy species in Rocky Hammock and 12 in Tree Frog Hammock (van der Heiden and Johnson 2014, p. 19). The average canopy closure for both populations in Sumter County has been estimated to be more than 75 percent, where it is heavily shaded, maintaining high humidity to reduce chances of desiccation (van der Heiden and Johnson 2014, p. 9). Van der Heiden and Johnson (2014, p. 9) speculate this dense, closed canopy can serve as a shield for *T. p.* ssp. *floridanum* to inhibit the growth of other plant species on the same part of an inhabited rock area.

Although it is believed this subspecies needs high temperatures (although likely not above 100 degrees Fahrenheit (°F); Possley 2014c, pers. comm.) and humidity, along with dense

canopy, there is limited information on optimal temperature and humidity ranges or thresholds for *Trichomanes punctatum* ssp. *floridanum* growth and survival. In Miami-Dade County where *T. p.* ssp. *floridanum* currently is found, the mean maximum temperature from 2004 to 2013 was 29.0 degrees Celsius (°C) (84.3 °F), and the mean minimum temperature for the same time period was 21.4 °C (70.5 °F) (*http://www1.ncdc.noaa.gov*). In contrast, yearly mean temperatures were lower for Sumter County with 23.4 °C (74.2 °F) recorded as the mean maximum temperature from 2004 to 2013, and 11.8 °C (53.2 °F) as the mean minimum temperature for the same time period (National Oceanic and Atmospheric Administration 2014, *http://www1.ncdc.noaa.gov*).

Recent field studies have provided some data on microhabitat conditions (*e.g.,* temperature and humidity) for *Trichomanes punctatum* ssp. *floridanum* populations in Sumter County. Van der Heiden and Johnson (2014, pp. 8, 21) found average relative humidity to be around 95 percent in both Rocky Hammock and Tree Frog Hammock, while average ambient temperature in both hammocks was approximately 21 °C (70 °F) from September 2013 to November 2013. However, during cooler periods (19–21 °C; 66–70 °F) when humidity levels dropped slightly (by approximately 2 percent), observed plant health declined, demonstrating the fragile nature of this taxon and its dependence on high-humidity conditions (van der Heiden and Johnson 2014, pp. 9, 21). Collection of humidity and temperature data within these same areas was subsequently continued through March 2015. From September 2013 to March 2015, average monthly temperatures in both hammocks were very similar and ranged from approximately 12 °C (53 °F; in January 2014) to 25 °C (78 °F; in August 2014) (van der Heiden 2015a, p. 17). The average relative humidity in both hammocks was 94.8 percent throughout the study (van der Heiden 2015a, p. 5). This type of information needs to be further explored to determine habitat requirements (*i.e.,* thresholds for humidity and temperature) for both metapopulations of this taxon.

Historical Range/Distribution

The historical range of *Trichomanes punctatum* ssp. *floridanum* included southern (Miami-Dade County; see Table 1, below) and central (Sumter County; see Table 2, below) Florida.

Miami-Dade County

In Miami-Dade County, the historical range of this subspecies extended from its southern limit in Royal Palm Hammock (now part of ENP) northeast to Deering-Snapper Creek Hammock, which includes the modern-day site of Smather's Four Fillies Farm residential area, near R. Hardy Matheson Preserve (derived from Gann *et al.* 2002, pp. 552–554), a range of at least 45 square kilometers (km^2) (17 square miles (mi^2)). Plants in Miami-Dade were known to historically occur in at least 11 hammocks: Deering-Snapper Creek Hammock, Castellow Hammock, Silver Palm Hammock (also known as Caldwell), Ross Hammock, Royal Palm Hammock (in ENP), Hattie Bauer Hammock, Shields Hammock, Nixon-Lewis Hammock, Fuchs Hammock, Addison Hammock (in the Deering Estate at Cutler), and Matheson Hammock. In the 1980s, *T. p.* ssp. *floridanum* was also documented in Meissner Hammock and Cox Hammock (now part of the tourist attraction ''Monkey Jungle'') (Small 1918, p. 6; Small 1921, p. 211; Morton 1963 p. 90; Fairchild Tropical Garden 1968, p. 1; Nauman 1986 p. 182; Gann *et al.* 2002, pp. 552–554; Gann 2013, *http://regionalconservation.org/ircs/database/plants/IRCSpAccount.asp?TXCODE=Tricpuncflor&GENUS=Trichomanes&SPECIES=punctatum&Author=Poir.&INFRA1=subsp.&INFRA1NAME=* ssp. *floridanum&INFRA1AUTHOR=Wess.%20Boer&CommonNames=Florida%20bristle%20fern*).

J.K. Small documented *Trichomanes punctatum* ssp. *floridanum* in 1901 at Deering-Snapper Creek. J.K. Small made subsequent collections of the subspecies in and around Miami-Dade County including one in 1903, probably located in or near present-day Castellow Hammock (Gann 2014d, pers. comm.). A.A. Eaton collected additional specimens from Castellow Hammock in 1903. More recent observations of *T. p.* ssp. *floridanum* in Castellow Hammock include documentation by G. Gann and K. Bradley in the late 1990s (Bradley and Gann 1999), and subsequent observations by J. Possley and others (Gann *et al.* 2002, pp. 552–554; Possley *et al.* 2013, pp. 43–45). *T. p.* ssp. *floridanum* was collected by A.A. Eaton in Silver Palm Hammock in 1903 and reported again in 1980; however, the 1980 report was not confirmed. The fern was collected from Ross Hammock by J.K. Small and colleagues in 1906. Since then, part of this hammock has been damaged, and what remains is currently protected as a Miami-Dade County Environmentally Endangered Lands (EEL) Preserve. In 1909, the subspecies was collected in Royal Palm Hammock (also known as Paradise Key), now within ENP, and later reported by W.E. Stafford in 1917 (Stafford 1919, p. 386; Gann *et al.* 2002, pp. 552–554).

Several collections of *Trichomanes punctatum* ssp. *floridanum* were made in Miami-Dade in 1915, including: Hattie Bauer Hammock, Shields Hammock, Nixon-Lewis Hammock, Fuchs Hammock, and Deering-Snapper Creek Hammock. Hattie Bauer Hammock, now a Miami-Dade County conservation area, has numerous subsequent collection records by Small (1915, 1916), Correll (1936), and McFarlin (1934, 1940) as cited by Gann 2013, *http://regionalconservation.org/ircs/database/plants/IRCSpAccount.asp?TXCODE=Tricpuncflor&GENUS=Trichomanes&SPECIES=punctatum&Author=Poir.&INFRA1=subsp.&INFRA1NAME=* ssp. *floridanum&INFRA1AUTHOR=Wess.%20Boer&CommonNames=Florida%20bristle%20fern*. The last known collection in Hattie Bauer Hammock was recorded in 1960, by T. Darling, Jr. It was subsequently reported as extirpated by Gann *et al.* (2002, pp. 552–554), until it was rediscovered in this hammock in 2011 by Possley (Possley *et al.* 2013, pp. 1–2). Shields Hammock was destroyed prior to 1991 (Cressler 1991, Handwritten Notes). Fuchs Hammock is now part of the Fuchs Hammock Preserve (Gann *et al.* 2002, pp. 552–554), and the subspecies was vouchered (pressed plant samples taken for future reference) again in 1954, by L. J. Brass; in 1959, by T. Darling Jr.; and in 1969, by F.C. Craighead (The Institute for Regional Conservation, Herbarium Specimens, Floristic Inventory of South Florida Database, September 12, 2007). *T. p.* ssp. *floridanum* was also vouchered in Fuchs Hammock in 1993, following Hurricane Andrew (1992) by A. Cressler (Cressler 12 February 1993, handwritten notes), and it has been more recently observed by Possley and others over the years (Gann *et al.* 2002, pp. 552–554; Possley *et al.* 2013, pp. 43–45). *T. p.* ssp. *floridanum* was observed by G. N. Avery in 1983 in Meissner Hammock (immediately adjacent to Fuchs Hammock) and was since vouchered by K. Bradley in 1997 and 2002 and also observed by others (Gann *et al.* 2002, pp. 552–554; Possley *et al.* 2013, pp. 43–45).

In 1916, J.K. Small reported *Trichomanes punctatum* ssp. *floridanum* in Addison Hammock, now located within Deering Estate at Cutler,

currently Miami-Dade County Park; however, these reports were never vouchered (J.K. Small 1916; Gann *et al.* 2002, pp. 552–554). Surveys in recent years have yet to find any populations of *T. p.* ssp. *floridanum* in Deering Estate at Cutler, Matheson Hammock, or Silver Palm Hammock (Possley 2013i, pers. comm.). The subspecies was last reported from Cox Hammock in 1989, by A. Cressler, where plants were observed in a sinkhole in the tourist attraction ''Monkey Jungle'' (Cressler 1991, handwritten notes); it is not known if these plants still exist. Cox Hammock is located about 1.6 km (1.0 mi) northeast of Castellow Hammock Park. Additional hammocks existing today where the taxon formerly occurred include Ross and Royal Palm Hammock (in ENP) and Deering-Snapper Creek Hammock. A section of Deering-Snapper Creek Hammock was destroyed in 1912–1913, when the Snapper Creek Canal was constructed. Dredging of this canal drastically altered the water table in the area, depleting the freshwater springs, while a large spoil berm from excavation of the canal destroyed habitat (Metro-Dade County Park and Recreation Department 1991, p. 10). Other hammocks in the historical range that are presumed destroyed include Nixon Lewis Hammock, which is partially destroyed (Gann 2013, *http://regionalconservation.org/ircs/database/plants/IRCSpAccount.asp?TXCODE=Tricpuncflor&GENUS=Trichomanes&SPECIES=punctatum&Author=Poir.&INFRA1=subsp.&INFRA1NAME=*ssp. *floridanum&INFRA1AUTHOR=Wess.%20Boer&CommonNames=Florida%20bristle%20fern*) and a station presumably near the Matheson Hammock Park vouchered by G. Peterson in 1940.

TABLE 1—SUMMARY OF HISTORICAL REPORTS AND CURRENT POPULATION AND HAMMOCK STATUS OF EACH TRICHOMANES PUNCTATUM SSP. FLORIDANUM LOCATION IN MIAMI-DADE COUNTY

[Gann *et al.* 2002; The Institute for Regional Conservation, Herbarium Specimens, Floristic Inventory of South Florida Database, September 12, 2007; Florida Natural Areas Inventory element occurrences 9/12/2013; Possley 2013c, i–j, 2014a–c; Possley 2013, 2014a pers. comm.; Gann 2013, pers. comm.; van der Heiden 2013e, pers. comm.; Gann 2014a–f, pers. comm.; Gann *et al.* 2001–2014). Population locations (hammocks) are numbered in chronological order by *T. p.* ssp. *floridanum* initial discovery date.]

No.	Population location	Year(s) of initial report(s)	Observer	Number of specimens collected	Current population status	Current hammock status
1	Deering-Snapper Creek Hammock-Smather's Four Fillies Farm (R. Hardy Matheson Preserve).	1901	J.K. Small, G.V. Nash.	3	Extirpated	Protected Area, Partially Destroyed.
		1915	J.K. Small, C.A. Mosier.	1		
2	Castellow Hammock	1903	J.K. Small, J.J. Carter.	2	Extant	Protected Area.
		1903	A.A. Eaton	4		
3	Silver Palm Hammock	1903	A.A. Eaton	1	Extirpated	Protected Area.
4	Ross Hammock	1906	J.K. Small, J.J. Carter.	2	Extirpated	Protected Area, Partially Destroyed.
5	Royal Palm Hammock (ENP); aka Paradise Key.	1909	J.K. Small, J.J. Carter.	2	Extirpated	Protected Area.
		1917	W.E. Stafford	None		
		1915	J.K. Small, C.A. Mosier.	2		
		1915	J.K. Small	3		
		1915	J.K. Small, C.A. Mosier, G.K. Small.	5		
6	Hattie Bauer Hammock (Orchid Jungle).	1916	J.K. Small	1	Extant	Protected Area.
		1934	J.B. McFarlin	2		
		1936	D.S. Correll	2		
		1940	J.B. McFarlin	1		
		1960	T. Darling Jr.	1		
7	Shields Hammock	1915	J.K. Small, C.A. Mosier, G.K. Small.	1	Extirpated	Destroyed.
8	Nixon-Lewis Hammock	1915	J.K. Small, C.A. Mosier.	1	Extirpated	Protected Area, Partially Destroyed.
9	Fuchs Hammock (Sykes Hammock).	1915	J.K. Small, C.A. Mosier.	1	Extant	Protected Area.
		1954	L.J. Brass	1		
		1959	T. Darling Jr.	1		
		1969	A.F. Clewell, F.C. Craighead.	1		
10	Deering Estate at Cutler (Addison Hammock).	1916	J.K. Small	None	Unconfirmed [1].	Protected Area.
11	Matheson Hammock Park	1940	G. Peterson	2	Unconfirmed [2].	Protected Area.
12	Meissner Hammock	1983	G.N. Avery	None	Extant	Protected Area.
13	Monkey Jungle (Cox Hammock)	1989	A. Cressler	None	Unknown [3]	Privately Owned, Partially Destroyed.

[1] Initial report is questionable.
[2] Precise location of sample and associated report is questionable.
[3] It is not known whether the subspecies still occurs here.

Sumter County

In Sumter County, early collections and herbarium label data for *Trichomanes punctatum* ssp. *floridanum* are not accurate or precise in their location descriptions. The first documented collection in 1936, by R.P. St. John, simply states that *T. p.* ssp. *floridanum* was found 11.26 km (7.0 mi) east of Floral City. This collection is close to the extant populations in Sumter (in Rocky Hammock within Withlacoochee State Forest), which is east-southeast of Floral City, and is thought to be the location where *T. p.* ssp. *floridanum* existed on private land until it was cleared for cattle sometime after 1983. A specimen found 3 years later, by J.B. McFarlin in 1939, was originally thought to be *T. sphenoides;* the herbarium label data described this collection as ''South of Floral City, Florida. *T. sphenoides* is a misapplied synonym for *T. p.* ssp. *floridanum* according to FNAI. This is the only known station in the United States.'' It is believed that these label data may have been incorrectly recorded, indicating a direction of south from Floral City, when it should have been east. In all likelihood, McFarlin's collection probably referred to the population in the Wahoo area, where St. John previously collected because he states his collection was from the same locality where it was originally found in 1936. The specimen found by McFarlin eventually led to reports of the taxon in Citrus County (Wherry 1964, p. 232; Nelson 2000, p. 81); however, this was never confirmed beyond the initial report. Systematic surveys have not been conducted in Citrus County; therefore, the only documented occurrences of *T. p.* ssp. *floridanum* in this region of Florida have been in Sumter County, just north of Wahoo and east of the Withlacoochee River.

Several years later, in 1954, R. Garrett collected *Trichomanes punctatum* ssp. *floridanum* southeast of Floral City. It is thought to be the same location where St. John and McFarlin made their previous collections; however, label data were again minimal and the exact location is uncertain. In 1959, T. Darling Jr. found this subspecies near Floral City, 11.26 km (7.0 mi) south near a location called Battle Slough. This record has never been confirmed because it is located on private property. Another specimen was found in 1963, by O. Lakela in an area known as Indian Field Ledges. Lakela recorded his location and collection to be west of Withlacoochee River off State Road #48. This information is believed to be incorrect based on a site visit by Darling (1961, p. 7), stating that the Indian Field Ledges is north of Wahoo, a locality east of the Withlacoochee River. *T. p.* ssp. *floridanum* was not found again in Sumter County until 1983, when SW. Leonard made a collection on private property known as Rocky Point, north of Wahoo. This is presumed to be the same location where St. John, McFarlin, and Garrett collected their specimens. This population is now extirpated.

TABLE 2—SUMMARY OF PRESUMED EXTIRPATED, EXTIRPATED, AND UNCONFIRMED TRICHOMANES PUNCTATUM SSP. FLORIDANUM POPULATIONS IN SUMTER COUNTY

[Gann *et al.* 2002; The Institute for Regional Conservation, Herbarium Specimens, Floristic Inventory of South Florida Database, September 12, 2007; Florida Natural Areas Inventory Element Occurrences 9/12/2013; van der Heiden 2013d, 2014a, pers. comm.; Gann *et al.* 2001–2014). Population locations (hammocks) are numbered in chronological order by *T. p.* ssp. *floridanum* initial discovery date.]

No.	Population location	Year of initial report	Observer	Number of specimens collected	Current population status	Current hammock status
1	11.26 km (7 mi) East of Floral City [1].	1936	R.P. St. John	1	Presumed Extirpated	Privately Owned, Presumed Destroyed.
2	Floral City Area [1]	1939	J.B. McFarlin	1	Unconfirmed [2]	Unknown.
3	Southeast of Floral City [1].	1954	R. Garret	1	Presumed Extirpated	Privately Owned, Presumed Destroyed.
4	Floral City, 11.26 km (7 mi) south (Battle Slough) [1].	1959	T. Darling Jr.	1	Unconfirmed [2]	Privately Owned, Unknown.
5	East of Withlacoochee River, off State Road #48 (Indian Field Ledges) [1].	1963	O. Lakela	1	Extirpated	Protected Area.
6	Rocky Point, (north of Wahoo).	1983	S.W. Leonard	1	Extirpated	Privately Owned, Destroyed.

[1] Sumter County collections and herbarium label data for *Trichomanes punctatum* ssp. *floridanum* are inaccurate in location descriptions.
[2] Initial report is questionable.

Current Range

The extant metapopulation of *Trichomanes punctatum* ssp. *floridanum* in Miami-Dade County is approximately 400 km (249 mi) south of the extant metapopulation in Sumter County. Both metapopulations of *T. p.* ssp. *floridanum* are located entirely on public lands (see Table 3, below). In general, *Trichomanes punctatum* ssp. *floridanum* occurs in small areas within each hammock.

TABLE 3—SUMMARY OF KNOWN EXTANT OCCURRENCES OF TRICHOMANES PUNCTATUM SSP. FLORIDANUM.

[Possley 2013, pp. 1–2; Dozier 2014, Pers. Comm.; van der Heiden and Johnson 2014, pp. 5, 26]

Metapopulation location (county)	Population location	Land ownership	Number of subpopulations	Status
Miami-Dade	Meissner Hammock	State	2	Extant.
Miami-Dade	Fuchs Hammock Preserve.	County	4	Extant.
Miami-Dade	Castellow Hammock Park	County	3	Extant.

TABLE 3—SUMMARY OF KNOWN EXTANT OCCURRENCES OF TRICHOMANES PUNCTATUM SSP. FLORIDANUM.—Continued

[Possley 2013, pp. 1–2; Dozier 2014, Pers. Comm.; van der Heiden and Johnson 2014, pp. 5, 26]

Metapopulation location (county)	Population location	Land ownership	Number of subpopulations	Status
Miami-Dade	Hattie Bauer Hammock	County	1	Extant.
Sumter	Rocky Hammock, Withlacoochee State Forest's Jumper Creek Tract.	State	1	Extant.
Sumter	Tree Frog Hammock, Withlacoochee State Forest's Jumper Creek Tract.	State	1	Extant.

Miami-Dade County

The four populations that constitute the Miami-Dade County metapopulation are located in urban preserves managed by the County's EEL Program and the Natural Areas Management (NAM) Division of Miami-Dade County's Parks, Recreation and Open Spaces (PROS) Department (see *Factor A,* Conservation Efforts to Reduce Habitat Destruction, Modification, or Curtailment of Its Range, below). These EEL Preserves include: Castellow Hammock Park (39.5 hectares (ha)) (97.6 acres (ac)), Hattie Bauer Hammock (5.7 ha (14.0 ac)), Fuchs Hammock Preserve (15.7 ha (38.8 ac)), and Meissner Hammock (4.1 ha (10.1 ac)). Three of these preserves (76 percent of the land area) are owned by the County; the fourth, Meissner Hammock (24 percent), is owned by the State and leased to the County (Dozier 2014, pers. comm.). The population in Fuchs Hammock Preserve includes a new subpopulation that was found in July 2013 (Possley *et al.* 2013, pp. 43–45). Fuchs and Meissner Hammocks are immediately adjacent to each other, and Castellow Hammock Park is 10.5 km (6.5 mi) to the northeast. Although the fern was thought to be extirpated from Hattie Bauer Hammock in 1960, another population was re-discovered there in 2011 (8 ha (20 ac)) (Possley *et al.* 2013, pp. 43–45). Hattie Bauer Hammock is 4.02 km (2.5 mi) south of Castellow Hammock and approximately 8.05 km (5 mi) northeast of Fuchs and Meissner Hammocks.

No comprehensive survey has been conducted in rockland hammocks in Miami-Dade County where suitable *Trichomanes punctatum* ssp. *floridanum* habitat has been identified. Although these areas have been extensively explored by numerous botanists and plant enthusiasts, including sites where the subspecies was formerly found, due to the cryptic nature of this plant it may have been overlooked and new occurrences may yet be discovered (Possley 2013e, pers. comm.; van der Heiden 2013c, pers. comm.). Surveys conducted in the late 1990s, and as late as 2010, did not find *T. p.* ssp. *floridanum* in Silver Palm Hammock (Gann *et al.* 2002, pp. 552–554; Possley 2013f, pers. comm.). A sporophyte sample was collected in Nixon-Lewis Hammock by Small and Mosier in 1915; however, due to extensive disturbance of this hammock, subsequent surveys conducted in 2006, by IRC, could not find the taxon (Bradley and Gann 2005, unpublished data). Over the years, IRC has completed systematic surveys in ENP in Royal Palm Hammock and other hammocks on Long Pine Key (also in ENP); however, sporophytes have not been found there (Gann *et al.* 2009; pp. 1–66). In 2003, based on historical records, staff from ENP and IRC surveyed Royal Palm Hammock for *T. p.* ssp. *floridanum* without success; subsequent surveys conducted in rockland hammocks throughout Long Pine Key for other rare plants also were not successful in finding *T. p.* ssp. *floridanum* (Sadle 2013, pers. comm.).

Sumter County

The Sumter County metapopulation consists of two extant populations of *Trichomanes punctatum* ssp. *floridanum* that have been reported north of Wahoo, in the Withlacoochee State Forest's Jumper Creek Tract; these populations are located in Rocky Hammock (located on 44 boulders) and Tree Frog Hammock (located on 4 boulders) (van der Heiden and Johnson 2014, p. 7). The population in Tree Frog Hammock was discovered as recently as April 2013, during regional surveys (van der Heiden 2013c, pers. comm.). Two additional populations were known from private land just south of the State Forest; however, these populations were subsequently extirpated due to the clearing of land for agriculture by the property owner (van der Heiden 2013c, pers. comm.).

Recent GIS analyses show the soil type associated with known extant occurrences of *Trichomanes punctatum* ssp. *floridanum* in the northern metapopulation to be Okeelanta Muck, Frequently Flooded; this soil covers approximately 1,478 ha (3,652 ac) in Sumter County. However, not all of these areas have been systematically surveyed. Surveys were conducted of a boulder field within Withlacoochee State Forest's Jumper Creek Tract (called the Indian Field Ledges) in August 2007 and April 2013 and were unsuccessful (van der Heiden 2013c, pers. comm.). The discovery of new populations may be possible in the area. Indeed, the population of this subspecies in Jumper Creek's Tree Frog Hammock is a new population that was discovered in April 2013, during additional hammock surveys within Withlacoochee State Forest and the surrounding area (van der Heiden 2013c, pers. comm.). However, IRC recently conducted extensive surveys through approximately 1,904 ha (4,705 ac) in and around the Jumper Creek Tract, and no additional populations of *T. p.* ssp. *floridanum* were located (van der Heiden 2015a, p. 9).

It is also possible that other subpopulations may exist in Sumter County. Indian Ledges, a hammock located on private land near Jumper Creek (not to be confused with Indian Field Ledges), just north of Wahoo, is believed to be suitable for *Trichomanes punctatum* ssp. *floridanum,* including a dense canopy and appropriate soil (Deangelis 2014a–b, pers. comm.). Over the years, many rare ferns and orchids have been observed in the Indian Ledges Hammock; unfortunately, this hammock was heavily damaged by hurricanes in 2004 (Deangelis 2014a, pers. comm.).

Portions of the Southwest Florida Water Management District (SWFWMD) property within the Green Swamp, more than 40.23 km (25 miles) southeast of the Jumper Creek Tract in Withlacoochee State Forest, may also contain appropriate habitat for *Trichomanes punctatum* ssp. *floridanum* based on existing habitat features such as dense canopy, high humidity microclimates, mesic hammock, and limestone outcroppings (Elliott 2014, pers. comm.). The SWFWMD property within the Green Swamp is the only area where land alteration has not occurred in Sumter

County (11,343 ha (28,030 ac)). Portions of Green Swamp owned by the SWFWMD also extend into three other counties: Lake, Polk, and Pasco. Future survey efforts, coordinating with local land owners and conservation organizations in this area, may prove successful in finding new populations of *T. p.* ssp. *floridanum.*

Population Estimates and Status

Trichomanes punctatum ssp. *floridanum* grows in dense mats and is rhizomatous (a horizontal stem that often sends out root-like structures from its nodes). Fronds are scattered in matted clusters along the stems, making it difficult to count clusters, or groups of plants in the same location, and nearly impossible to accurately count individual plants (Nelson 2000, p. 79). This issue has been encountered in other *Trichomanes* species, such as *Trichomanes boschianum* (Appalachian bristle fern) (Hill 2003, p. 11). As such, populations are typically described by the number of clusters (*i.e.,* groups of plants in various sinkholes, on tree roots, on boulders) and the total area covered by the cluster.

Miami-Dade County

In Miami-Dade County, there are four populations of the fern with a total of 10 subpopulations (*i.e.,* nine solution holes and one rocky outcropping on a tree root). Overall, this taxon occurs in small areas (*i.e.,* less than 0.5 ha (1.2 ac)) at each site, with 88 percent of the total area in three subpopulations in Castellow Hammock. Recent surveys (see Table 4, below) in Miami-Dade by Fairchild (Possley 2013, pp. 1–2) found the fern covering a total area of approximately 9.92 m^2 (106.56 ft^2) (Possley 2013, pp. 1–2).

TABLE 4—AREA COVERED BY EACH OF 10 KNOWN SUBPOPULATIONS OF TRICHOMANES PUNCTATUM SSP. FLORIDANUM IN MIAMI-DADE COUNTY, OCTOBER AND NOVEMBER 2013

[(Possley 2013, pp. 1–2) and in Sumter County, December 2013 (van der Heiden and Johnson 2014, pp. 7, 14)]

Metapopulation	Population	Subpopulation	Estimated area covered (m^2)	Number of clusters
Miami-Dade	Hattie Bauer Hammock	Hole (no tag)	0.078	2–10
Miami-Dade	Fuchs Hammock	Hole 532	0.017	2–10
Miami-Dade	Fuchs Hammock	Hole 533	0.038	2–10
Miami-Dade	Fuchs Hammock	Hole 1431	0.128	2–10
Miami-Dade	Fuchs Hammock	Root 1430	0.047	1
Miami-Dade	Meissner Hammock	Hole 2319	0.145	2–10
Miami-Dade	Meissner Hammock	Hole 3337	0.713	2–10
Miami-Dade	Castellow Hammock	Hole 2332	4.688	11–100
Miami-Dade	Castellow Hammock	Hole 2331	3.925	11–100
Miami-Dade	Castellow Hammock	Hole 944	0.141	2–10
Miami-Dade County Total			9.920	
Sumter	Rocky Hammock	N/A	4.355	44
Sumter	Tree Frog Hammock	N/A	0.132	4
Sumter County Total			4.487	
TOTAL Area Covered			14.407	

The largest known population of *Trichomanes punctatum* ssp. *floridanum* in Miami-Dade County is located at Castellow Hammock (Possley *et al.* 2013, p. 43), where it occurs in three of the larger subpopulations. In October of 2011, field surveys revealed extensive desiccation of this population after intensive nonnative vegetation removal (Possley 2013g, pers. comm.); however, by November 2013, these plants had recovered, and the total area covered by all clusters (*i.e.,* two or more plants next to each other) was estimated at 8.754 m^2 (94.227 ft^2). Meissner Hammock has two subpopulations; the clusters in this hammock cover an area of 0.858 m^2 (9.235 ft^2) and are considered healthy, with no signs of desiccation (Possley *et al.* 2013, pp. 43–45). There is one subpopulation in Hattie Bauer Hammock covering approximately 0.78 m^2 (8.4 ft^2), and three subpopulations of *T. p.* ssp. *floridanum* at Fuchs Hammock, with an additional one that was discovered in July 2013, totaling an area of 0.230 m^2 (2.476 ft^2) (Possley 2013, pp. 1–2; Possley *et al.* 2013, pp. 43–45).

Sumter County

In Sumter County, the Rocky Hammock subpopulation contains 44 clusters, while the newly discovered subpopulation (Tree Frog Hammock) is much smaller with only 4 clusters observed (van der Heiden and Johnson 2014, p. 7). Average cluster size for Rocky Hammock is estimated at 4.355 m^2 (46.877 ft^2) and 0.132 m^2 (1.421 ft^2) for Tree Frog Hammock.

Summary of Comments and Recommendations

In the proposed rule published on October 9, 2014, we requested that all interested parties submit written comments on the proposal by December 8, 2014. We also contacted appropriate Federal and State agencies, scientific experts and organizations, and other interested parties and invited them to comment on the proposal. Newspaper notices inviting general public comment were published in the *Miami Herald.* We did not receive any requests for a public hearing. All substantive information provided during comment periods has either been incorporated directly into this final determination or addressed below.

Peer Reviewer Comments

In accordance with our peer review policy published on July 1, 1994 (59 FR 34270), we solicited expert opinion from five knowledgeable individuals with scientific expertise that included familiarity with *Trichomanes punctatum* ssp. *floridanum* and its habitat, biological needs, and threats. We received responses from all five of the peer reviewers.

We reviewed all comments received from the peer reviewers for substantive issues and new information regarding the listing of *Trichomanes punctatum* ssp. *floridanum.* The peer reviewers

generally concurred with our methods and conclusions and provided additional information, clarifications, and suggestions to improve the final rule.

(1) *Comment:* One peer reviewer noted that he was unaware of any documentation that *Trichomanes punctatum ssp. floridanum* formed gemmae, as stated in the proposed rule. He commented that the works cited were in reference to other species of *Trichomanes* and Hymenophyllaceae, in general. Also, the peer reviewer pointed out a reference (Hughes 2014) in the proposal that the two metapopulations have no observable genetic differences. The peer reviewer noted that, in the Life History section, the proposal states many traits of the subspecies, such as ''genetic variation,'' are unknown, which contradicts the data from Hughes.

Our Response: We appreciate this information and have corrected and updated the rule as follows: (1) We removed the phrase that stated *Trichomanes punctatum* ssp. *floridanum* produces gemmae; and (2) the term genetic variation has been removed from a sentence discussing specific reproductive and growth requirements that are unknown for the subspecies, as it conflicted with previous information within the proposed rule.

(2) *Comment:* Two peer reviewers noted that, under the Species Description section, the proposed rule incorrectly compares physical characteristics of *Trichomanes punctatum* ssp. *floridanum* with ''other bryophytes.'' The phrase should only read ''bryophytes,'' not ''other bryophytes.''

Our Response: The word ''other'' has been deleted from the text within the Species Description section because *Trichomanes punctatum* ssp. *floridanum* is a fern and not a bryophyte.

(3) *Comment:* One peer reviewer noted, under the Life History section, that although it is true that the sporophyte form is recognizable and spores are invisible to the naked eye, that sentence does not align with the previous thought in the paragraph that there are two stages, a sporophyte and a gametophyte stage.

Our Response: We have restructured the sentence and noted that the gametophyte form is cryptic and invisible to the naked eye.

(4) *Comment:* One peer reviewer questioned why the two extant populations in Sumter County (that are listed in Table 3) are not listed in Table 2.

Our Response: Table 2 is a composite of populations that are presumed extirpated, extirpated, or unconfirmed (where the report was questionable). Table 3 is a summary of the known extant occurrences of *Trichomanes punctatum* ssp. *floridanum.* The title of Table 2 has been modified for clarity in the final rule.

(5) *Comment:* One peer reviewer noted that numerous efforts to cultivate *Trichomanes punctatum* ssp. *floridanum* ex-situ for possible future reintroduction have only been partially successful and provided information on ex-situ reproduction efforts. The reviewer noted that, given the problems with ex-situ reproduction, it is critical the extant wild populations be protected to the greatest extent possible.

Our Response: We have added text explaining propagation challenges and the importance of protecting extant populations in the wild.

Comments From the State

We received one comment from the Florida Natural Areas Inventory regarding a discrepancy between Table 2 and Table 3. That comment is addressed above under *Peer Reviewer Comments* in our response to Comment (4).

Public Comments

We received eight public comments, three of which were from the same individual, directly addressing the proposed listing. Most commenters suggested technical corrections pertaining to the Background and Summary of Factors Affecting the Species sections of the proposed rule, scientific names, species biology, and citations. Some commenters suggested we include additional information and correct minor errors. We did not receive any requests for a public hearing. The comments are appreciated, and most have been incorporated into the appropriate sections of the final rule.

(6) *Comment:* Two commenters noted an inaccurate statement in the proposed listing rule that states ''The life cycle of ferns is not well known'' (Woodmansee, 2013, pers. comm.). One of these commenters also noted that the second part of the same sentence mentions the life history of *Trichomanes punctatum* ssp. *floridanum* and then includes other members of the genus, which is inconsistent. One of these commenters also noted that the next sentence in this paragraph is incorrect and provided edits to describe the gametophyte form and the sporophyte form.

Our Response: We revised the language regarding the life cycle of the *Trichomanes punctatum* ssp. *floridanum* in the Life History section from not well known to not commonly understood, as suggested by one of the commenters. The second part of the sentence, which includes information on other members of the genus *Trichomanes,* is unnecessary and has been removed. We have also revised the last sentence in that paragraph to best describe the gametophyte and sporophyte forms.

(7) *Comment:* One commenter noted that *Trichomanes punctatum* ssp. *floridanum* bristles do not protrude from the sporangia, but rather one bristle protrudes from each soral involucre, which is the tube that also houses the sporangia.

Response: We have corrected this information in the Background section of this final rule.

(8) *Comment:* Two commenters noted that the four populations of *Trichomanes punctatum* ssp. *floridanum* within the urban preserves of Miami-Dade County are cooperatively managed by Miami-Dade County's EEL Program as well as the NAM Division of Miami-Dade County. One of these commenters suggested specific edits to sections about the EEL Program and the EEL Covenant Program. Both commenters provided additional information and clarification about the impacts of Hurricane Andrew on Hattie Bauer Hammock and the recovery of the hammock.

Our Response: We agree that the NAM Division of the Miami-Dade County PROS Department and the EEL Program are significant local partners in the conservation of *Trichomanes punctatum* ssp. *floridanum.* As such, their efforts have been acknowledged in the final rule. We have incorporated suggested edits about the EEL Program, the EEL Covenant Program, and Hattie Bauer Hammock.

(9) *Comment:* A commenter provided information clarifying the historical range of the subspecies. The text in the proposed rule reads ''In Miami-Dade, the range of this subspecies extended from Royal Palm Hammock (now in Everglades National Park (ENP)) at its southern limit, northeast to Snapper Creek Hammock, which is located in R. Hardy Matheson Preserve.'' The reviewer noted that portions of historical Snapper Creek are now developed and are a residential community called Smather's Four Fillies Farm, owned by the University of Miami. Smather's Four Fillies Farm is located in the northwestern 6.5 acres of what was historical Snapper Creek Hammock.

Our Response: We modified the historical range of the subspecies to

include the additional description of the Smather's Four Fillies Farm residential development within the Background section of the final rule.

(10) *Comment:* One commenter noted the proposed listing rule states, in the Species Description section, that the subspecies does not have roots and then later states, in the Life History section, that the subspecies sends out roots and shoots. The commenter requested clarification on this issue.

Response: The first paragraph in the Species Description section has been modified to state that *Trichomanes punctatum* ssp. *floridanum* is mat-forming, has root-like structures, and contains trichomes. The Life History section has been modified to reflect that *T. punctatum* ssp. *floridanum* is rhizomatous (having a horizontal stem and scale leaves, bearing aerial shoots from its tips, and producing root-like structures from its undersurface).

(11) *Comment:* One commenter noted that the proposed listing states the subspecies needs high temperatures and humidity for optimum growth. The commenter remarked that this information is vague and temperatures above 100 °F may be harmful to the subspecies.

Response: We have modified our statements regarding suitable temperatures for *Trichomanes punctatum* ssp. *floridanum.* In addition, we have included new humidity and temperature data recorded in two Sumter County hammocks where *Trichomanes punctatum* ssp. *floridanum* is found.

(12) *Comment:* One commenter reported that Ross Hammock continues to exist and was not destroyed by a hurricane in 1935. The same commenter reported the canopy of Hattie Bauer has also recovered after Hurricane Andrew.

Response: We have corrected these statements in the Background section of this final rule.

(13) *Comment:* One commenter noted that we cannot definitively state that *Trichomanes punctatum* ssp. *floridanum* is extirpated outside of the four known populations in Miami-Dade County. It is possible that gametophytes or undiscovered sporophytes exist outside the known extant range, particularly in the ''Monkey Jungle'' (Cox Hammock) area.

Response: We have revised this statement in the Summary of Factors Affecting the Species section in this final rule.

Summary of Changes From the Proposed Rule

Based on the information we received from peer reviewers and public commenters, we made the changes listed below. Additional minor corrections and edits were made in the text of the rule. We also incorporated new temperature, humidity, and survey information from a recent study conducted by the IRC in Sumter County and added information about the Clean Water Act (CWA; 33 U.S.C. 1251 *et seq.*) under *Factor D. The Inadequacy of Existing Regulatory Mechanisms.*

Background Section

(1) We modified the information in the rule regarding the relationship between the bristles and the sporangia of *Trichomanes punctatum* ssp. *floridanum* and their functions.

(2) We clarified the sentence regarding the visibility of the sporophyte and the gametophyte of *Trichomanes punctatum* ssp. *floridanum.*

(3) We clarified information regarding the historical extent of the subspecies to include the addition of the current-day residential community, Smather's Four Fillies Farm, to the description of the Snapper Creek Hammock historical area.

(4) We added the NAM Division of Miami-Dade County's PROS Department as cooperative managers of EEL's preserves and clarified the difference between the EEL Program and the EEL Covenant Program.

(5) We clarified that *Trichomanes punctatum* ssp. *floridanum* does not have roots and that the subspecies is rhizomatous.

(6) We added information regarding challenges to propagation and the importance of protecting extant populations in the wild.

Summary of Factors Affecting the Species Section

(1) We revised the information about the impacts of the hurricane of 1935 on the habitat at Ross Hammock and the impacts of Hurricane Andrew on Hattie Bauer Hammock and *Trichomanes punctatum* ssp. *floridanum.* We also included additional information about the recovery and restoration of that habitat in Hattie Bauer Hammock after Hurricane Andrew.

(2) We added information regarding the potential existence of *Trichomanes punctatum* ssp. *floridanum* in Miami-Dade County outside of the four known populations, particularly in ''Monkey Jungle'' (Cox Hammock).

Summary of Factors Affecting the Species

Section 4 of the Act (16 U.S.C. 1533), and its implementing regulations at 50 CFR part 424, set forth the procedures for adding species to the Federal Lists of Endangered and Threatened Wildlife and Plants. Under section 4(a)(1) of the Act, we may list a species based on one or more of the following five factors: (A) The present or threatened destruction, modification, or curtailment of its habitat or range; (B) overutilization for commercial, recreational, scientific, or educational purposes; (C) disease or predation; (D) the inadequacy of existing regulatory mechanisms; or (E) other natural or manmade factors affecting its continued existence. Listing actions may be warranted based on any of the above threat factors, singly or in combination.

Information pertaining to *Trichomanes punctatum* ssp. *floridanum* in relation to the five factors provided in section 4(a)(1) of the Act is discussed below. In considering what factors might constitute threats, we must look beyond the mere exposure of the species to the factor to determine whether the species responds to the factor in a way that causes actual impacts to the species. If there is exposure to a factor, but no response, or only a positive response, that factor is not a threat. If there is exposure and a negative response, the factor may be a threat, meaning that it may drive or contribute to the risk of extinction of the species such that the species warrants listing as an endangered or threatened species as those terms are defined by the Act. This does not necessarily require empirical proof of a threat. The combination of exposure and some corroborating evidence of how the species is likely impacted could suffice. The mere identification of factors that could impact a species negatively is not sufficient to compel a finding that listing is appropriate; we require evidence that these factors are operative threats that act on the species to the point that the species meets the definition of an endangered or threatened species under the Act.

Factor A. The Present or Threatened Destruction, Modification, or Curtailment of Its Habitat or Range

Habitat modification and destruction, caused by human population growth and development, agricultural conversion, regional drainage, and canal installation, have impacted the range and abundance of *Trichomanes punctatum* ssp. *floridanum.* Secondary effects from hydrology and canopy changes have resulted in changes in humidity, temperature, and existing water levels; loss of natural vegetation; and habitat fragmentation. The modification and destruction of habitat where *T.p.* ssp. *floridanum* was once

found has been extreme in most areas of Miami-Dade County; while they have been less dramatic in Sumter County, clearing of land for agricultural conversion and historical logging has resulted in very few areas where the habitat has not been modified. These threats are discussed in detail below.

Human Population Growth, Development, and Agricultural Conversion

Miami-Dade County—Rockland hammocks are considered imperiled both locally and globally, with a limited distribution and an FNAI ranking of G2 (imperiled globally because of rarity (6 to 20 occurrences or fewer than 3,000 individuals) or because of vulnerability to extinction due to some natural or manmade factor)/S2 (either very rare and local in Florida (21–100 occurrences or fewer than 10,000 individuals) or found locally in a restricted range or vulnerable to extinction from other factors)) (FNAI 2010, pp. 24–26, FNAI 2013). The tremendous development and agricultural pressures in the rapidly urbanizing rockland hammock areas in south Florida have resulted in significant reductions of this habitat type, which is also susceptible to fire, frost, canopy disruption, and groundwater reduction (FNAI 2010, pp. 24–26).

Extensive land clearing for human population growth and development in Miami-Dade County has altered, degraded, or destroyed hundreds of acres of this once abundant rockland hammock ecosystem. Rockland hammocks once occurred across the Miami-Rock Ridge, usually in association with pine rocklands, or the edges of marl prairies (areas of thin, calcitic soil that has accumulated over limestone bedrock) or tidal swamps (Service 1999, p. 122). Destruction of rocklands, including rockland hammocks, has occurred since the beginning of the 1900s. Historical impacts to the environment were addressed by Small (1938, p. 50), who called attention to the demise of *Trichomanes punctatum* ssp. *floridanum* from habitat destruction, and Phillips (1940, p. 167) who expressed his concern for south Florida hammocks due to the obvious and vast amount of destruction of land in the region. Early settlers in Florida cleared hammocks for residential development, farming, and range for livestock, while industrial logging also occurred in the region (Snyder *et al.* 1990, pp. 271–272). Consistent burning of pinelands in Miami-Dade also encroached upon adjacent hammocks, as in the case of Castellow Hammock (Phillips 1940, p. 167). Habitat impacts were further exacerbated by natural stochastic events, such as the hurricane in 1935 that impacted Ross Hammock (Phillips 1940, p. 167).

Public conservation lands play a significant role in the recovery of rockland hammock habitat where future development and habitat alteration are less likely than on private lands. However, these lands could be sold off in the future and become more likely to be developed or altered in a way that negatively impacts the subspecies and its habitat. Additionally, rockland hammock may be found on private lands; however, the fate of this existing habitat is unknown, as it is dependent upon actions of individual property owners (see discussion under *Factor D*). Therefore, we find that habitat loss due to population growth, development, and agricultural conversion poses a threat to this subspecies in Miami-Dade County.

Sumter County—In Sumter County, human population growth and development has occurred, but to a lesser degree than in Miami-Dade County. However, Sumter County has a long history of agriculture dating back to the early 1860s. Generally speaking, all land that was feasible for agriculture was cleared at some point. In particular, mesic hammocks where *Trichomanes punctatum* ssp. *floridanum* occurs have experienced disturbances from human activities such as logging, understory clearing, cattle grazing, and introduction of feral hogs. These natural mesic canopies and soils have largely been destroyed due to their desirable locations for living, camping, and recreating. The global and State rank for mesic hammock habitat (G3/S3) signifies it is considered to have a restricted range or be vulnerable to extinction from other factors (FNAI 2010, p. 22).

Concerns exist regarding future population growth and development in those communities remaining in Sumter County and on lands where urbanization and agriculture have not yet been established. According to the Sumter County Comprehensive Plan, a growth management paradigm has been developed that focuses public resources on urban areas to protect existing undeveloped land for agricultural use (Sumter County 2012, Data and Analysis section). Currently, the threat with greatest impact to *T.p.* ssp. *floridanum* habitat in Sumter County is the potential for agricultural and residential clearing of mesic hammocks on small, fragmented private parcels.

Privately owned land in the area around Wahoo where *Trichomanes punctatum* ssp. *floridanum* is found has been zoned as ''agricultural'' on the Sumter County Future Land Use Map (Sumter County 2012, p. 42). The County exempts single-site residential development and agriculture from environmental review and does not regulate land clearing for a single residence. Therefore, any undocumented populations and suitable habitat on private lands are at risk due to land-clearing activities, agricultural conversions, and development. For example, one Sumter County subpopulation observed in 1999 on private land was extirpated due to pasture clearing on the property for livestock (van der Heiden 2013c, pers. comm.). A full survey for *T.p.* ssp. *floridanum* and associated suitable habitat is needed in Sumter County to determine the severity of potential habitat loss on this subspecies regionally, including the potential impact from future human population growth and development.

Due to existing agricultural and residential clearing of mesic hammocks and potential future clearing on private lands, habitat loss due to human population growth, development, and agricultural conversion poses a threat to *T.p.* ssp. *floridanum* in Sumter County.

Regional Drainage and Consumptive Use

Miami-Dade County—Landscape-level drainage has been extensive in Miami-Dade County. In the early 1900s, drainage initiatives were undertaken to modify land for agriculture and development. Impacts resulted in a region-wide drop in the water table (Nauman 1986, p. 182; Lodge 2005, p. 222), disturbing rockland hammocks and their flora (Service 1999, pp. 3–138), including *Trichomanes punctatum* ssp. *floridanum.* Additional stress from regional drainage for canal construction has also contributed to the decline of this metapopulation (Nauman 1986, p. 182; see also ''Historical Range/Distribution,'' *Miami-Dade County* section, above). As a consequence of the pervasive drainage throughout Miami-Dade County, solution holes, which often contained standing water during the rainy season, now hold much less, if any, water during much of the year, resulting in decreased ambient humidity levels (Phillips 1940, p. 171; Nauman 1986, p. 182; Adimey 2013a, field notes). Even though regional changes in hydrology have not caused extirpation of *T.p.* ssp. *floridanum* at most locations, they may have already induced stress by promoting vulnerability to other stressors, such as periodic long-term droughts, cold

weather exposure, and other stochastic events. Furthermore, groundwater levels in the vicinity of *T.p* ssp. *floridanum* are not targeted as part of the Comprehensive Everglades Restoration Plan (CERP) (a framework and guide to restore, protect, and preserve the water resources of central and southern Florida, including the Everglades), and, therefore, impacts from regional drainage are not expected to be ameliorated by CERP. Rockland hammocks in Miami-Dade County have been modified as a result of hydrology changes, reducing the amount of water available to these habitats. This is an ongoing threat to *T.p.* ssp. *floridanum,* as hammocks on limestone substrates are dependent on the underlying water table to keep humidity levels high, especially in limestone sinkholes (Service 1999, pp. 3–127).

Currently, the human population in Miami-Dade County is expected to grow to more than 4 million by 2060, an annual increase of roughly 30,000 people (Zwick and Carr 2006, p. 20). Although water demands will continue to rise with population increases, the extent of future impacts on existing habitat and the metapopulation of *Trichomanes punctatum* ssp. *floridanum* in Miami-Dade County is unknown at this time.

Sumter County—In Sumter County, water drawdowns have historically been minimal. Regional modeling conducted by SWFWMD indicates less than a 0.06-m (0.2-ft) current use of water in the Upper Floridan Aquifer (Deangelis 2014a, 2014c, pers. comm.). No surface water withdrawals are currently occurring in Sumter County; however, they are possible in the future. Minimum flows and levels (MFLs), which are water withdrawal standards to limit water use set by the regional water management districts, are already established for the Withlacoochee River portion of the Withlacoochee River watershed in Sumter County. Although increases in human population and development in Sumter County may increase water use, it is believed that changes due to drought conditions (*e.g.,* on the order of several feet) will have a far greater impact on the hydrology (Deangelis 2013a, pers. comm.).

Hydrology Changes

Hydrology is a key ecosystem property that affects distribution and viability of rare plants (Gann *et al.* 2009, p. 6). Hydrology changes have extensively modified and, in some cases, destroyed habitat in south Florida. As a result of human population growth, development, agricultural conversion, and regional drainage, the hydrology of *Trichomanes punctatum* ssp. *floridanum* habitat has changed drastically and has contributed to the alteration in ambient humidity and temperature.

For a hygrophilous (living or growing in damp places) subspecies thought to be restricted to a consistently humid microhabitat (Krömer and Kessler 2006, p. 57), high humidity is a critical factor to its survival, so any habitat modification or destruction that changes ambient humidity levels poses a threat to this subspecies (Nauman 1986, p. 182). As noted above, drainage efforts implemented in south Florida have significantly reduced historical water table levels, altering ambient humidity in the area. It is speculated that this subspecies may be living in discrete areas where humidity may be at the threshold for *T.p.* ssp. *floridanum* to survive. Minor drops in ambient humidity may limit reproduction and can negatively impact overall health of existing metapopulations, as well as inhibit the growth of new plants, impacting long-term viability (van der Heiden, 2013c, pers. comm.; Possley 2013e, pers. comm.). Van der Heiden and Johnson (2014, p. 9) recently observed this in Sumter County, where small drops in ambient temperature and humidity resulted in observed declines in the health of some clusters of *T.p.* ssp. *floridanum* within the local population.

Canopy Changes

Canopy also is an important habitat feature for *Trichomanes punctatum* ssp. *floridanum,* and, in most cases, is the primary factor controlling surrounding temperature and humidity levels that are critical to the survival of this subspecies. The proper amount of high shade and low light is critical for the persistence of this subspecies. These features help to maintain humidity and prevent desiccation from excessive light exposure (van der Heiden 2013c, pers. comm.; Possley 2013e, pers. comm.; Adimey 2013a–b, field notes). Currently, in both metapopulations, dense canopy cover is a necessity; however, the amount of canopy density needed to ensure survival is not yet known. Changes to existing canopies can result from land clearing and conversion, natural stochastic events, competition with nonnative species, and nonnative species control (see discussion under *Factor E*).

Historically, as land was developed, natural features of the landscape changed, directly eliminating *Trichomanes punctatum* ssp. *floridanum* and also eliminating surrounding vegetation and habitat features essential to this subspecies. Field observations in Miami-Dade County have found clusters of *T.p.* ssp. *floridanum* desiccated when the immediate canopy above the ferns was destroyed or substantially reduced, allowing high amounts of light into the understory (Possley 2013g, pers. comm.); however, over the course of many months, these clusters eventually recovered.

The loss of canopy can result in plant desiccation via increased sun and wind exposure, increased ambient temperatures, changes in ambient humidity, and the proliferation of exotic species (see *Factor E* discussion, below). Destruction or changes in canopy of any existing populations could result in elimination of an entire population. Therefore, we find the loss of canopy through habitat loss and modification to be a threat to *T.p.* ssp. *floridanum.*

Habitat Fragmentation

Habitat fragmentation limits dispersal and population size, and promotes vulnerability among existing populations. In Miami-Dade County, most remaining *Trichomanes punctatum* ssp. *floridanum* habitat (*i.e.,* Fuchs, Meissner, Castellow, Hattie Bauer hammocks) is surrounded by housing development and agricultural land, resulting in scattered and small natural areas. Regional drainage and hydrology changes may also have contributed to the fragmented habitat in Miami-Dade County. In Sumter County, the impacts of habitat fragmentation are not as severe, as conservation lands are on large, adjacent tracts. Future development in Sumter County could result in an increase in fragmented habitat and pose a threat for this northern metapopulation (van der Heiden 2013c, pers. comm.). However, data regarding the impacts and subsequent consequences from habitat fragmentation are incomplete for both metapopulations of *Trichomanes punctatum* ssp. *floridanum.* Information and understanding of dispersal mechanisms for this subspecies are also currently lacking. The best available data for other plant species regarding the impacts of habitat fragmentation suggest that habitat fragmentation is likely a stressor impacting this subspecies but does not indicate that it rises to the level of a threat.

Conservation Efforts To Reduce Habitat Destruction, Modification, or Curtailment of Its Range

Conservation efforts to reduce habitat destruction are generally focused on the conservation of land on which both metapopulations occur. All known

extant populations occur on State- or County-owned land that is currently protected from future development. In Miami-Dade County, extant occurrences of *Trichomanes punctatum* ssp. *floridanum* have been protected through acquisition within the County's EEL Program.

Fee Title Properties

In 1990, Miami-Dade County voters approved a 2-year property tax to fund the acquisition, protection, and maintenance of natural areas by the EEL Program. The EEL (acquisition) Program purchases and manages natural lands for preservation. Land uses deemed incompatible with the protection of the natural resources are prohibited by current regulations; however, the County Commission ultimately controls what may happen with any County property, and land use changes may occur over time (Gil 2013b, pers. comm.). To date, the Miami-Dade County EEL Program has acquired a total of approximately 95 ha (236 ac) of tropical hardwood and rockland hammocks (Gil 2013b, pers. comm.). The EEL Program also manages approximately 639 ha (1,578 ac) of tropical hardwood and rockland hammocks known as EEL Preserves and owned by the Miami-Dade County PROS Department, including some of the largest remaining areas of tropical hardwood and rockland hammocks (*e.g.,* Matheson Hammock Park, Castellow Hammock Park, and Deering Estate Park and Preserves). The EEL Program may acquire lands that were once under an EEL Covenant (see description below). However, the existence of an EEL Covenant is not a requirement or precursor for acquisition of lands under the EEL Program.

EEL Covenant Program

In 1979, Miami-Dade County established the EEL Covenant Program to reduce taxes for private landowners who own natural forest communities (NFC), such as pine rocklands and rockland hammocks. Under the EEL Covenant Program, landowners agree not to develop their property and to manage it for a period of 10 years, with the option to renew for additional 10-year periods (Service 1999, pp. 3–177). The EEL Covenant Program currently protects approximately 119 rockland hammock properties, comprising approximately 315.65 ha (780 ac) of habitat (Joyner 2013b, pers. comm.).

Although these temporary conservation easements provide valuable protection for their duration, they are not considered under *Factor D,* below, because they are voluntary agreements and not regulatory in nature. Miami-Dade County currently has approximately 21 rockland hammock properties enrolled in this program, preserving 20.64 ha (51 ac) of rockland hammock habitat (Joyner 2013b, pers. comm.). The vast majority of these properties are small, and many are in need of habitat management, such as removal of nonnative, invasive plants. Although the EEL Covenant Program has the potential to provide valuable habitat for unknown or future populations of *Trichomanes punctatum* ssp. *floridanum,* the actual contribution of these designated conservation lands is largely determined by whether individual landowners follow prescribed EEL management plans and NFC regulations (see ''Local'' under *Factor D* below).

The County- and State-owned land areas that are protected by the EEL Program are critical to providing habitat for *Trichomanes punctatum* ssp. *floridanum,* as well as other native flora in Florida. Conservation efforts to prevent the future extirpation of *T. p.* ssp. *floridanum* and other fern species in Miami's EEL Preserves have been under way for many years. In Miami-Dade County, conservation lands are and have been monitored by Fairchild and IRC, in coordination with the EEL Program and the NAM Division of Miami-Dade County's PROS Department, to assess habitat status and determine any changes that may pose a threat to or alter the abundance of *T. p.* ssp. *floridanum* (Possley 2013k, pers. comm.; van der Heiden 2013f–h, pers. comm.). Impacts to habitat (*e.g.,* canopy) via nonnative species and natural stochastic events are monitored and actively managed in areas where the taxon is known to occur. These programs are long term and ongoing in Miami-Dade County; however, programs are limited by the availability of annual funding.

Other Efforts

To date, only one reintroduction of filmy ferns (no specific species was indicated) was attempted by F.C. Craighead in the early 1960s, in several hammocks within ENP within the Long Pine Key area. These efforts were unsuccessful, but no explanation was provided as to why they were unsuccessful (Gann 2013). Within-range reintroductions into unoccupied habitat have historically resulted in low success rates for plants (Maschinski *et al.* 2011, p. 159). Future reintroduction efforts will likely be attempted by MSBG from *Trichomanes punctatum* ssp. *floridanum* plants grown in-vitro from CREW.

In Sumter County, monitoring and management in Withlacoochee State Forest is provided through the Florida Forest Service (Werner 2013e, pers. comm.). Habitat is assessed annually for canopy changes that may alter ambient humidity levels and for impacts from nonnative plant species and feral pigs. Additionally, surveys on SWFWMD property are conducted periodically to assess habitat and search for rare plant species in the area (Deangelis 2013b, pers. comm.).

Summary of Factor A

Past human actions have destroyed, modified, and curtailed the range and habitat available for *Trichomanes punctatum* ssp. *floridanum.* Human population growth and development, agricultural conversion, and regional drainage have modified, or in most cases, destroyed, habitat where *T. p.* ssp. *floridanum* once occurred, thereby limiting the subspecies' current range and abundance in Florida.

In Miami-Dade County, habitat modification and destruction have severely impacted rockland hammocks that were once abundant. The *Trichomanes punctatum* ssp. *floridanum* metapopulation in Miami-Dade County is currently composed of four known populations, all on County-managed conservation lands. Historically, *T. p.* ssp. *floridanum* was found in an additional nine hammocks in Miami-Dade County. Most of these populations have been extirpated, and the historical range of the southern metapopulation has been reduced by nearly 80 percent. However, the subspecies was observed in ''Monkey Jungle'' (historically referred to as Cox Hammock) in 1989, and no thorough surveys have been conducted there since then. Upon recent visitation to the site (Adimey 2013a, field notes), the habitat features appeared to be similar to other hammocks where *T. p.* ssp. *floridanum* is currently known to occur (large solution holes, high humidity, dense canopy, standing water). Thus, much of the habitat has been destroyed, and while those fragments suitable for the plant remain protected in Miami-Dade County, habitat loss and modification from future development or conversion on private and conservation lands in Miami-Dade County poses a threat. In addition, the areas where *T. p.* ssp. *floridanum* currently exists are still vulnerable to activities in the surrounding areas, including agricultural clearing and hydrologic alterations.

The Sumter County metapopulation of *Trichomanes punctatum* ssp. *floridanum* is composed of two known

populations, both on State-owned land in the Jumper Creek Tract of the WSF. In central Florida, the subspecies was historically found in as many as seven additional locations. All of these historical populations have since been extirpated, primarily due to land conversion and clearing (including for cattle grazing) and the impacts of local and regional drainage. Land clearing and hydrological alterations on private lands adjacent to the Jumper Creek Tract continue to be threats to *T. p.* ssp. *floridanum* populations and habitat.

The destruction and modification of habitat have resulted in changes in canopy, humidity, hydrology, and fragmentation that have contributed to the declines of this taxon. High humidity and dense canopy cover are critical for *Trichomanes punctatum* ssp. *floridanum*'s survival. Therefore, any habitat modification or destruction that changes ambient humidity levels or canopy cover poses a threat to this subspecies. Data regarding the impacts of habitat fragmentation are incomplete for both metapopulations of *T. p.* ssp. *floridanum* because information on dispersal mechanisms of this subspecies is currently lacking. Habitat fragmentation is likely a stressor impacting this subspecies, but the best available data do not indicate that it rises to the level of a threat.

Conservation efforts are currently providing some benefits to this subspecies but are not sufficient to ameliorate the habitat threats. Therefore, based on the best information available, we have determined that the threats to *Trichomanes punctatum* ssp. *floridanum* from habitat destruction, modification, or curtailment are occurring throughout the entire range of the species and are expected to continue into the future.

Factor B. Overutilization for Commercial, Recreational, Scientific, or Educational Purposes

The best available data do not indicate that overutilization for commercial, recreational, scientific, or educational purposes is occurring and, therefore, we find that overutilization is not a threat to *Trichomanes punctatum* ssp. *floridanum.*

Factor C. Disease or Predation

No diseases or incidences of predation have been reported for *Trichomanes punctatum* ssp. *floridanum.* Therefore, the best available data do not indicate that disease or predation is a threat to the subspecies.

Factor D. The Inadequacy of Existing Regulatory Mechanisms

Under this factor, we examine whether threats to the subspecies discussed under the other factors are continuing due to an inadequacy of an existing regulatory mechanism. Section 4(b)(1)(A) of the Act requires the Service to take into account ''those efforts, if any, being made by any State or foreign nation, or any political subdivision of a State or foreign nation, to protect such species . . . .'' In relation to Factor D under the Act, we interpret this language to require the Service to consider relevant Federal, State, and tribal laws, regulations, and other such mechanisms that may minimize any of the threats we describe in threat analyses under the other four factors, or otherwise enhance conservation of the species. We give strongest weight to statutes and their implementing regulations and to management direction that stems from those laws and regulations. An example would be State governmental actions enforced under a State statute or constitution or Federal action under statute.

Having evaluated the impact of the threats as mitigated by any such conservation efforts, we analyze under Factor D the extent to which existing regulatory mechanisms are inadequate to address the specific threats to the species. Regulatory mechanisms, if they exist, may reduce or eliminate the impacts from one or more identified threats. In this section, we review existing Federal, State, and local regulatory mechanisms designed to address threats to *Trichomanes punctatum* ssp. *floridanum* to determine whether they effectively reduce or remove threats to the subspecies.

Federal

The only known extant populations of *Trichomanes punctatum* ssp. *floridanum* occur on State- or County-owned properties, and development of most of these areas is not likely to require a Federal permit or other authorization.

Section 404 of the Clean Water Act (CWA; 33 U.S.C. 1251 *et seq.*) establishes a Federal program for regulating the discharge of dredged or fill material into waters of the United States, including wetlands. Additionally, section 401 of the CWA forbids Federal agencies from issuing a permit or license for activities that may result in a discharge to waters of the United States until the State or Tribe where the discharge would originate has granted or waived certification. The State of Florida maintains regulatory programs providing a framework for issuance of section 401 certifications related to applications for section 404 permits. This legislation does not prohibit the discharge of these materials into wetlands; rather, it provides a regulatory framework that requires permits prior to such action being taken. The U.S. Army Corps of Engineers (Corps) reviews individual permits for potentially significant impacts; however, most discharges are considered to have minimal impacts and may be covered by a general permit that does not require individual review.

On June 29, 2015, the Environmental Protection Agency and Corps published a final rule (80 FR 37054), effective August 28, 2015, that revises the definition of ''waters of the United States.'' Specific guidance on implementation of this revised definition is currently lacking, but it appears that the revised definition is likely to include hydric hammocks in areas where *Trichomanes punctatum* ssp. *floridanum* occurs in Sumter County among waters of the United States. However, as noted above, section 404 of the CWA does not necessarily prevent degradation to such habitats from the discharge of dredge or fill material. It simply provides a regulatory program for permitting activities that would result in such a discharge. Further, discharges associated with normal farming, ranching, and forestry activities, such as plowing, cultivating, minor drainage, and harvesting for the production of food, fiber, and forest products are exempt from the requirement to obtain a permit.

State

FNAI considers the State status of *Trichomanes punctatum* ssp. *floridanum* to be S1, ''critically imperiled in Florida because of extreme rarity (five or fewer occurrences or less than 1,000 individuals) or because of extreme vulnerability to extinction due to some natural or man-made factor'' (FNAI, 2013; Element Tracking Summary). The IRC considers its status as ''critically imperiled'' (Gann *et al.* 2002, pp. 552–554).

The Florida Department of Agriculture and Consumer Services has listed *Trichomanes punctatum* ssp. *floridanum* on the Regulated Plant Index (Index) as endangered under Chapter 5B–40, Florida Administrative Code (State of Florida 2013, Florida Statutes). This listing provides little or no habitat protection beyond the State's Development of Regional Impact process, which discloses impacts from projects, but provides no regulatory

protection for State-listed plants on private lands.

Florida Statutes chapter 581.185, sections (3)(a) and (b), prohibit any person from willfully destroying or harvesting any species listed as endangered or threatened on the Index, or growing such a plant on the private land of another, or on any public land, without first obtaining the written permission of the landowner and a permit from the Florida Department of Plant Industry. The statute further provides that any person willfully destroying or harvesting; transporting, carrying, or conveying on any public road or highway; or selling or offering for sale any plant listed in the Index as endangered must have a permit from the State at all times when engaged in any such activities. Further, section (10) of the statute provides for consultation similar to section 7 of the Act for listed species, by requiring the Department of Transportation to notify the FDACS and the Endangered Plant Advisory Council of planned highway construction at the time bids are first advertised, to facilitate evaluation of the project for listed plant populations, and to ''provide for the appropriate disposal of such plants'' (*i.e.,* transplanting). However, this statute provides no substantive protection of habitat or protection of potentially suitable habitat at this time. Sections (8)(a) and (b) of the statute waive State regulation for certain classes of activities for all species on the Index, including the clearing or removal of regulated plants for agricultural, forestry, mining, construction (residential, commercial, or infrastructure), and fire-control activities by a private landowner or his or her agent.

The Florida Forest Service (FFS) is the lead managing agency for State forests, as outlined in the Management Lease from the landowner (Board of Trustees of the Internal Improvement Trust Fund of the State of Florida) with guidance provided in chapters 253, 259, and 589 of the Florida Statutes (State of Florida, 2013 Florida Statutes, Preservation of Native Flora and Fauna). FFS is responsible for the management and supervision of the multiple-use guidelines of Withlacoochee State Forest. For research on State forest lands, prior approval is required. Research deemed legitimate will be issued a State Forest Use Permit (FDACS–11228) or letter of authorization (The Florida Forest Service 2013, State Forest Handbook).

Although the MFLs established by the South Florida Water Management District (SFWMD) in southeast Florida (a separate entity from the SWFWMD described earlier) are not directly applicable in the area of Miami Rock Ridge where *Trichomanes punctatum* ssp. *floridanum* occurs, they do indirectly limit ground water withdrawals in other areas of south Florida, including other areas of the Miami Rock Ridge. Unfortunately, MFL thresholds in place that establish water withdrawal standards are set so low that protection measures are rarely triggered. These low water level standards may be further exacerbated during times of drought, resulting in even greater impacts to the water table and the overall regional hydrology. Furthermore, MFL standards also do not apply to wells on private property or for consumptive use. The lowering of ground water and associated changes in local ambient humidity have already occurred throughout south Florida and have likely contributed to the decline of *T. p.* ssp. *floridanum* and possibly limited distribution and resilience (*i.e.,* ability to withstand stochastic (random) events and recover from disturbances) of the subspecies (Grossenbacher 2013, pers. comm.). Plants are likely to be further stressed by the continued lowering of ground water if additional large wells are created on private property for such activities as agriculture or during extended periods of drought because these types of circumstances are not regulated by the water withdrawal standards established by the SFWMD. In general, this regulatory mechanism has not been sufficient to reduce or remove the threat to *T. p.* ssp. *floridanum* posed by changes in hydrology discussed under *Factor A* by ensuring that current water levels will persist into the future.

Sumter County MFLs identified and adopted by the SWFWMD protect the Withlacoochee River and the Tsala Apopka lake chain, which connects to the Withlacoochee in the vicinity of Jumper Creek Tract where *Trichomanes punctatum* ssp. *floridanum* occurs. Maintaining designated MFLs will have a direct bearing on the design of future water supply development projects, of which there are several already proposed in Sumter County (Deangelis 2014c, pers. comm.). However, it is uncertain how these future projects would impact extant occurrences of *T. p.* ssp. *floridanum* or suitable habitat for the subspecies.

Local

In 1984, section 24–49 of the Code of Miami-Dade County established regulation of County-designated NFCs. These regulations were placed on specific properties throughout the County by an act of the Board of County Commissioners in an effort to protect environmentally sensitive forest lands. The Miami-Dade County Department of Regulatory and Economic Resources (RER) has regulatory authority over these County-designated NFCs and is charged with enforcing regulations that provide partial protection of remaining upland forested areas designated as NFC on the Miami Rock Ridge. NFC regulations are designed to prevent clearing or destruction of native vegetation within preserved areas. Miami-Dade County Code typically allows up to 10 percent of a rockland hammock designated as NFC to be developed for properties greater than 5 acres and requires that the remaining 90 percent be placed under a perpetual covenant for preservation purposes (Joyner 2013a, 2014, pers. comm; Lima 2014, pers. comm.). However, for properties less than 5 acres, up to one-half an acre can be cleared if the request is deemed a reasonable use of property; this allowance often can be greater than 10 percent of the property (Lima, 2014, pers. comm.). NFC landowners are also required to obtain an NFC permit for any work, including removal of nonnatives, within the boundaries of the NFC on their property. When discovered, unpermitted work is pursued by RER through appropriate enforcement action, and restoration is sought when possible. The NFC program is responsible for ensuring that NFC permits are issued in accordance with the limitations and requirements of the county code and that appropriate NFC preserves are established and maintained in conjunction with the issuance of an NFC permit when development occurs.

Although the NFC program is designed to protect rare and important upland (non-wetlands) habitats in south Florida, it is a regulatory strategy with limitations. For example, in certain circumstances where landowners can demonstrate that limiting development to 10 percent does not allow for ''reasonable use'' of the property, additional development may be approved. Furthermore, Miami-Dade County Code provides for up to 100 percent of the NFC to be developed in limited circumstances for parcels less than 2.02 ha (5 ac) in size and requires coordination with the landowners only if they plan to develop property or perform work within the NFC designated area. As such, many of the existing private forested NFC parcels remain fragmented, without management obligations or preserve designation, as development has not been proposed at a level that would

trigger the NFC regulatory requirements. Often, nonnative vegetation over time begins to dominate and degrade the undeveloped and unmanaged NFC landscape until it no longer meets the legal threshold of an NFC, which requires the land to be dominated by native vegetation. When development of such degraded NFCs is proposed, Miami-Dade County Code requires delisting of the degraded areas as part of the development process. Property previously designated as NFC is removed from the list even before development is initiated because of the abundance of nonnative species, making it no longer considered to be jurisdictional or subject to the NFC protection requirements of the Miami-Dade County Code (Grossenbacher 2013, pers. comm.).

Although *Trichomanes punctatum* ssp. *floridanum* is currently afforded some protection from outright destruction on public conservation land, changes in the surrounding landscape that affect the subspecies are not regulated. For example, the private property known as ''Monkey Jungle'' (historically referred to as Cox Hammock) is a public attraction and is home to a considerable number of primate species. Upon recent visitation to this site (Adimey 2013a, field notes), the habitat features appeared to be similar to other hammocks where *T. p.* ssp. *floridanum* currently is known to live (*i.e.,* large solution holes, high humidity, dense canopy, standing water). Although much of the hammock has been altered to accommodate captive animals and visitors, a significant portion of the hammock still remains untouched and overgrown with extensive nonnative, invasive plant species. ''Monkey Jungle'' receives limited protection under the Miami-Dade County Environmental Protection Ordinance as an NFC, where only portions of NFCs can be cleared once a permit is obtained from the County.

Additionally, Miami-Dade County has oversight of any work or research completed within the local preserve areas; permits are required for any outside work or research on County-owned lands in order to further protect the habitat from potential direct or indirect impacts (Gil 2013a, pers. comm.).

Under section 13–644(a)(1) of the Sumter County code, ''[m]ajor developments shall identify and protect habitats of protected wildlife and vegetation species,'' and in section 13–644(a)(1)2.b.2, ''[n]o permit will be issued for development which results in unmitigated destruction of specimens of endangered, threatened or rare species.'' Therefore, the County code prevents unmitigated destruction of endangered, threatened, or rare species only when associated with ''major developments.'' Current zoning in the Wahoo area limits development to one unit per 4 ha (10 ac); therefore, ''major developments'' do not seem to be likely in that area. In general, existing county ordinances do not prevent the conversion of habitat to agricultural use or building on sites with endangered, threatened, or rare plant species. Without complete survey information for Sumter County, it is difficult to assess the extent to which unknown occurrences and suitable habitat on private lands are at risk. Agriculture and development are ongoing and promoted in this County, and no regulatory mechanisms exist that protect *T. p.* ssp. *floridanum* and its habitat on private lands.

Summary of Factor D

Currently, *Trichomanes punctatum* ssp. *floridanum* is only known to occur on State and County lands; however, there are no regulatory mechanisms in place that provide substantive protection of habitat or protection of potentially suitable habitat at this time. In addition, subsections of applicable statutes waive State regulation for private landowners or their agents, allowing certain activities to clear or remove species on the Index. Little, if any, protection is afforded to *T. p.* ssp. *floridanum* by the established MFLs in south Florida, as they are set very low, are rarely triggered, and are not applicable in the portion of the Miami Rock Ridge where the subspecies currently lives. Established MFLs in Sumter County can positively impact areas where *T. p.* ssp. *floridanum* occurs, provided that these designated MFLs are maintained when future water supply development projects are undertaken. The NFC program in Miami is designed to protect rare and important upland (non-wetland) habitats in south Florida. However, this regulatory strategy has several limitations that can negatively affect *T. p.* ssp. *floridanum.* Sumter County code prevents unmitigated destruction of endangered, threatened, or rare species only when associated with ''major developments'' and does not prevent conversion of habitat to agricultural use or building on private property.

Although all known extant populations of *Trichomanes punctatum* ssp. *floridanum* are afforded some level of protection because they are on public conservation lands, existing regulatory mechanisms have not led to a reduction or removal of threats posed to the subspecies by a wide array of sources (see discussions under Factors A and E).

Factor E. Other Natural or Manmade Factors Affecting Its Continued Existence

Other natural or manmade factors affect *Trichomanes punctatum* ssp. *floridanum* to varying degrees. Specific threats include the spread of nonnative, invasive species; potentially incompatible management practices (*e.g.,* inadvertent spraying of *T. p.* ssp. *floridanum* while controlling for nonnatives); direct impacts to plants from recreation and other human activities; small population size and isolation; climate change; and the related risks from environmental stochasticity (extreme weather). Each of these threats and its specific effect on *T. p.* ssp. *floridanum* is discussed in detail below.

Nonnative Species

Nonnative species can stress, alter, or even destroy native species and their habitats. The threat of nonnative plant species is ongoing due to their: (1) Number and extent, (2) ability to out-compete native species, (3) abundant seed sources, and (4) extensive disturbance within habitats. Further challenges exist due to limitation of resources to combat this threat, as well as the difficulty in managing fragmented hammocks bordered by urban development, which often can serve as seed sources for nonnative species (Bradley and Gann 1999, p. 13). Nonnative, invasive plants compete with native plants for space, light, water, and nutrients, and they limit growth and abundance of natural vegetation and can make habitat conditions unsuitable for native plants.

In south Florida, at least 162 nonnative plant species are known to invade rockland hammocks. Impacts are particularly severe on the Miami Rock Ridge (Service 1999, pp. 3–135). Nonnative plant species have significantly affected rockland hammock and mesic hammock habitats where *Trichomanes punctatum* ssp. *floridanum* occurs and are considered one of the threats with greatest impact to the subspecies (Snyder *et al.* 1990, p. 273; Gann *et al.* 2002, pp. 552–554; FNAI 2010, pp. 22, 26). Nonnative plants outcompete and displace *T. p.* ssp. *floridanum* in solution holes, and may form dense strata (layers) in the hammock, where it is possible that the fern may be blanketed and smothered (Possley 2014c, pers. comm.). It has also been suggested that the insular nature of south Florida, as well as the hammocks themselves, predispose this habitat to

invasion by nonnative plants (*e.g.,* the proximity of seed sources, which increases the volume of nonnatives and accelerates the time it takes for the arrival and establishment of nonnatives) (Horvitz *et al.* 1998, p. 961).

In many Miami-Dade County parks, nonnative plant species comprise 50 percent of the flora in hammock fragments (Service 1999, pp. 3–135). Horvitz (*et al.* 1998, p. 968) suggests the displacement of native species by nonnative species in conservation and preserve areas is a complex problem with serious impacts to biodiversity conservation. Problematic nonnative invasive plants in Miami-Dade County associated with *Trichomanes punctatum* ssp. *floridanum* include *Schinus terebinthifolia* (Brazilian pepper), *Bischofia javanica* (bishop wood), *Syngonium podophyllum* (American evergreen), *Jasminum fluminense* (Brazilian jasmine), *Rubus niveus* (mysore raspberry), *Thelypteris opulenta* (jeweled maiden fern), *Nephrolepis multiflora* (Asian swordfern), *Schefflera actinophylla* (octopus tree), *Jasminum dichotomum* (Gold Coast jasmine), *Epipremnum pinnatum* (centipede tongavine), and *Nephrolepis cordifolia* (narrow swordfern) (Possley 2013g–h, pers. comm.).

In Sumter County, the most problematic nonnative invasive species occurring in *Trichomanes punctatum* ssp. *floridanum* habitat are *Tradescantia fluminensis* (small leaf spiderwort) and *Paederia foetida* (skunkvine) (Werner 2013d, pers. comm.). Furthermore, *Citrus aurantium* (bitter orange) is found in this locale and is considered problematic due to its tendency to attract feral hogs, another nonnative species associated with extensive habitat destruction (see below). Agricultural fields in proximity to the Sumter metapopulation are a nonnative seed source, increasing potential encroachment of nonnative plants to the area (Werner 2013b–c, pers. comm.).

In some instances, management of nonnative vegetation may also be detrimental, in that nonnative species may actually provide the necessary canopy to limit sunlight exposure and control humidity, so that removing the nonnative species exposes the fern. In Castellow Hammock, the majority of the shade near two of the large solution holes containing *Trichomanes punctatum* ssp. *floridanum* is provided by giant *Schinus terebinthifolia* trees; eliminating these trees could likely result in detrimental effects to *T. p.* ssp. *floridanum* residing in the underlying solution holes. In hammocks such as Castellow, desiccation from excessive sun exposure due to the removal of *S. terebinthifolia* canopy has already occurred. In this case, the subpopulation of *T. p.* ssp. *floridanum* below the *S. terebinthifolia* tree turned brown; however, *T. p.* ssp. *floridanum* could eventually revitalize if sufficient canopy is reestablished to limit sunlight exposure (Possley 2013d, pers. comm.). Additionally, nonnative plant control may also become a threat when *T. p.* ssp. *floridanum* is inadvertently sprayed while authorities conduct local nonnative removal efforts (Possley 2013d, pers. comm.).

Nonnative plant species are also a concern on private lands, where often these species are not controlled due to associated costs, lack of interest, or lack of knowledge of detrimental impacts to the ecosystem. Overall, active management is necessary to control for nonnative species and to protect unique and rare habitat where *T.p.* ssp. *floridanum* occurs (Snyder *et al.* 1990, p. 273). Treatment of nonnative plant species should consider canopy and humidity needs of *T.p.* ssp. *floridanum.*

Nonnative feral hogs living in the Withlacoochee State Forest are also considered a threat to this plant. Surveys in Sumter County have revealed evidence of hogs lying against or rubbing their bodies against large rocks, removing existing vegetation in the process. Recently, van der Heiden and Johnson (2014, p. 11) found one small rock where *Trichomanes punctatum* ssp. *floridanum* had been scraped off when a hog rubbed itself on the rock after wallowing in the mud. Furthermore, rooting from hogs can destroy existing habitat by displacing smaller rocks where *T.p.* ssp. *floridanum* is found to grow and potentially damaging or eliminating a cluster (Werner 2013d, pers. comm.). In Withlacoochee State Forest, damaged areas from feral hogs are also more susceptible to invasion from nonnative plant species, such as *Urena lobata* (Caesarweed) and *Tradescantia fluminensis* (small-leaf spiderwort) (Werner 2013a, pers. comm.). If feral hogs continue to forage in areas where *T.p.* ssp. *floridanum* lives, it is possible that entire clusters inhabiting one rock/boulder could be eliminated.

In recent years, scientists in south Florida have noticed an increase in sightings of the nonnative genus *Zachrysia* (Cuban tree snails). Although snail grazing has not been observed on *Trichomanes punctatum* ssp. *floridanum,* it has been documented on other rare ferns living in the same habitat and could possibly become a threat in the future, either by this snail or another introduced species (Possley 2013b, c, pers. comm.).

Climate Change

Climatic changes, including sea level rise (SLR), are occurring in the State of Florida and are impacting associated plants, animals, and habitats. The term ''climate,'' as defined by the Intergovernmental Panel on Climate Change (IPCC), refers to the mean and variability of different types of weather conditions over time, with 30 years being a typical period for such measurements, although shorter or longer periods also may be used (IPCC 2013, p. 1450). The term ''climate change,'' thus, refers to a change in the mean or variability of one or more measures of climate (*e.g.,* temperature or precipitation) that persists for an extended period, typically decades or longer, whether the change is due to natural variability, human activity, or both (IPCC 2013, p. 1450). A recent compilation of climate change and its effects is available from reports of the IPCC (IPCC 2013, entire).

Various changes in climate may have direct or indirect effects on species. These effects may be positive, neutral, or negative, and they may change over time, depending on the species and other relevant considerations, such as interactions of climate with other variables (*e.g.,* habitat fragmentation) (IPCC 2007, pp. 8–14, 18–19). Projected changes in climate and related impacts can vary substantially across and within different regions of the world (*e.g.,* IPCC 2007, p. 8–12). Therefore, we use ''downscaled'' projections when they are available and have been developed through appropriate scientific procedures (see Glick *et al.* 2011, pp. 58–61, for a discussion of downscaling). As to *Trichomanes punctatum* ssp. *floridanum,* downscaled projections suggest that SLR is the largest climate-driven challenge to low-lying coastal areas in the subtropical ecoregion of southern Florida (U.S. Climate Change Science Program (USCCSP) 2008, pp. 5–31, 5–32). All Miami-Dade County populations of *T.p.* ssp. *floridanum* occur at elevations 2.83–4.14 m (9.29–13.57 ft) above sea level, making the subspecies highly susceptible to increased storm surges and related impacts associated with SLR, whereas the Sumter County populations are at approximately 10.40 m (34.12 ft) above sea level and significantly farther from the coast.

The long-term record at Key West shows that sea level rose on average 0.229 cm (0.090 in) annually between 1913 and 2013 (National Oceanographic and Atmospheric Administration

(NOAA) 2013, p. 1). This equates to approximately 22.9 cm (9.02 in) over the last 100 years. IPCC (2008, p. 28) emphasized it is very likely that the average rate of SLR during the 21st century will exceed the historical rate. The IPCC Special Report on Emission Scenarios (2000, entire) presented a range of scenarios based on the computed amount of change in the climate system due to various potential amounts of anthropogenic greenhouse gases and aerosols in 2100. Each scenario describes a future world with varying levels of atmospheric pollution leading to corresponding levels of global warming and corresponding levels of SLR. The IPCC Synthesis Report (2007, entire) provided an integrated view of climate change and presented updated projections of future climate change and related impacts under different scenarios.

Subsequent to the 2007 IPCC Report, the scientific community has continued to model SLR. Recent peer-reviewed publications indicate a movement toward increased acceleration of SLR. Observed SLR rates are already trending along the higher end of the 2007 IPCC estimates, and it is now widely held that SLR will exceed the levels projected by the IPCC (Rahmstorf *et al.* 2012, p. 1; Grinsted *et al.* 2010, p. 470). Taken together, these studies support the use of higher end estimates now prevalent in the scientific literature. Recent studies have estimated global mean SLR of 1.0–2.0 m (3.3–6.6 ft) by 2100 as follows: 0.75–1.90 m (2.50–6.20 ft; Vermeer and Rahmstorf 2009, p. 21530), 0.8–2.0 m (2.6–6.6 ft; Pfeffer *et al.* 2008, p. 1342), 0.9–1.3 m (3.0–4.3 ft; Grinsted *et al.* 2010, pp. 469–470), 0.6–1.6 m (2.0–5.2 ft; Jevrejeva *et al.* 2010, p. 4), and 0.5–1.4 m (1.6–4.6 ft; National Research Council 2012, p. 2).

Other processes expected to be affected by projected warming include temperatures, rainfall (amount, seasonal timing, and distribution), and storms (frequency and intensity) (see ''Environmental Stochasticity,'' below). Models where sea level temperatures are increasing also show a higher probability of more intense storms (Maschinski *et al.* 2011, p. 148). The Massachusetts Institute of Technology (MIT) modeled several scenarios combining various levels of SLR, temperature change, and precipitation differences with human population growth, policy assumptions, and conservation funding changes (see ''Alternative Future Landscape Models,'' below). All of the scenarios, from small climate change shifts to major changes, indicate significant effects on coastal Miami-Dade County. The Science and Technology Committee of the Miami-Dade County Climate Change Task Force (Wanless *et al.* 2008, p. 1) recognizes that significant SLR is a serious concern for Miami-Dade County in the near future. In a January 2008 statement, the committee warned that sea level is expected to rise at least 0.9–1.5 m (3.0–5.0 ft) within this century (Wanless *et al.* 2008, p. 3). With a 0.9–1.2 m (3.0–4.0 ft) rise in sea level (above baseline) in Miami-Dade County, spring high tides would be at about 1.83–2.13 m (6.0–7.0 ft); freshwater resources would be gone; the Everglades would be inundated on the west side of Miami-Dade County; the barrier islands would be largely inundated; storm surges would be devastating to coastal habitat and associated species; and landfill sites would be exposed to erosion, contaminating marine and coastal environments. Freshwater and coastal mangrove wetlands will be unable to keep up with or offset SLR of 0.61 m (2.0 ft) per century or greater. With a 1.52-m (5.0-ft) rise, Miami-Dade County will be extremely diminished (Wanless *et al.* 2008, pp. 3–4).

Prior to inundations from SLR, there will likely be habitat transitions related to climate change, including changes to hydrology and increasing vulnerability to storm surge. Hydrology has a strong influence on plant distribution in coastal areas (IPCC 2008, p. 57). Such communities typically grade from salt to brackish to freshwater species. From the 1930s to 1950s, increased salinity of coastal waters contributed to the decline of cabbage palm forests in southwest Florida (Williams *et al.* 1999, pp. 2056–2059), expansion of mangroves into adjacent marshes in the Everglades (Ross *et al.* 2000, pp. 101, 111), and loss of pine rockland in the Keys (Ross *et al.*1994, pp. 144, 151–155). In Florida, pine rocklands transition into rockland hammocks, and, as such, these habitat types are closely associated in the landscape. A study conducted in one pine rockland location in the Florida Keys (with an average elevation of 0.89 m (2.90 ft)) found an approximately 65 percent reduction in an area occupied by South Florida slash pine over a 70-year period, with pine mortality and subsequent increased proportions of halophytic (salt-loving) plants occurring earlier at the lower elevations (Ross *et al.* 1994, pp. 149–152). During this same time span, local sea level had risen by 15 cm (6 in), and Ross *et al.* (1994, p. 152) found evidence of ground water and soil water salinization.

Extrapolating this situation to hardwood hammocks is not straightforward, but it suggests that changes in rockland hammock species composition may not be an issue in the immediate future (5–10 years); however, over the long term (within the next 10–50 years), it may be an issue if current projections of SLR occur and freshwater inputs are not sufficient to maintain high humidities and prevent changes in existing canopy species through salinization (Saha *et al.* 2011, pp. 22–25). Ross *et al.* (2009, pp. 471–478) suggested that interactions between SLR and pulse disturbances (*e.g.,* storm surges) can cause vegetation to change sooner than projected based on sea level alone. Patterns of human development will also likely be significant factors influencing whether natural communities can move and persist (IPCC 2008, p. 57; USCCSP 2008, p. 7–6).

Impacts from climate change, including regional SLR, have been studied for coastal hammocks, but not rockland hammock habitat. Saha (*et al.* 2011, pp. 24–25) conducted a risk assessment on rare plant species in ENP and found that impacts from SLR have significant effects on imperiled taxa. This study also predicted a decline in the extent of coastal hammocks with initial SLR, coupled with a reduction in freshwater recharge volume and an increase in pore water (water filling spaces between grains of sediment) salinity, which will push hardwood species to the edge of their drought (freshwater shortage and physiological) tolerance, jeopardizing critically imperiled and/or endemic species with possible extirpation. In south Florida, SLR of 1–2 m (0.30–0.61 ft) is estimated by 2100, which is on the higher end of global estimates for SLR. These projected increases in sea level pose a threat to coastal plant communities and habitats from mangroves at sea level to salinity-intolerant, coastal rockland hammocks where elevations are generally less than 2.00 m (6.1 ft) above sea level (Saha *et al.* 2011, p. 2). Loss or degradation of these habitats can be a direct result of SLR or a combination of several other factors, including diversion of freshwater flow, hurricanes, and exotic plant species infestations, which can ultimately pose a threat to rare plant populations (Saha *et al.* 2011, p. 24).

Saha (*et al.* 2011, p. 4) suggested that the rising water table accompanying SLR will shrink the vadose zone (the area that extends from the top of the ground surface to the water table); increase salinity in the bottom portion of the freshwater lens (a convex layer of fresh ground water that floats on top of denser saltwater), thereby increasing brackishness of plant-available water; and influence tree species composition

of hardwood hammocks based upon species-level tolerance to salinity and/or drought. Evidence of population declines and shifts in rare plant communities, along with multi-trophic effects, already have been documented on the low-elevation islands of the Florida Keys (Maschinski *et al.* 2011, p. 148). Altered freshwater inputs can lead to the disappearance or decline of critically imperiled coastal plant species. Shifts in freshwater flows, annual precipitation, and variability in SLR can impact salinity regimes. Although it is unknown if salinity changes will impact existing habitat where *T. p.* ssp. *floridanum* currently lives, it should be noted that salinity-intolerant plants can become stressed within a few weeks from exposure to saline conditions, and persistent conditions can promote colonization by more salinity-tolerant species, thereby leading to an irreversible composition change, even if the salinity is lower over subsequent years (Saha *et al.* 2011, p. 23).

In some areas of south Florida, precipitation is the main source of fresh water. Predictive climate change models demonstrate periods of drought will pose a threat to existing populations of *Trichomanes punctatum* ssp. *floridanum.* Saha (*et al.* 2011, pp. 19–21) found that during times of drought and resultant salinity stress, coastal hardwood tree density from the canopy was lost, while other species showed an increase. Areas with a deeper freshwater lens, such as rockland hammocks, may be able to sustain vegetation during periods of drought; however, whether this theory is true is currently unknown. Some tree species in coastal hammocks have the ability to access pockets of fresh water and tolerate mild salinities. These initial responses to salinity increases may trigger responses similar to drought, while prolonged exposure may cause irreversible toxicity caused by accumulation of salts (Munns 2002, p. 248), causing a reduction in canopy or mortality (Maschinski *et al.* 2009, entire paper). Impacts from climate change causing shifts in local plant communities and invasion of additional nonnative plant species may be lessened by the ability of hardwood hammocks (such as rockland hammocks) to harvest rainfall water and retain it in the highly organic soil and lower their transpiration (*i.e.,* the process of water movement through a plant and its evaporation from leaves and stems) during the dry season (Saha *et al.* 2011, p. 24).

Drier conditions and increased variability in precipitation associated with climate change are expected to hamper successful regeneration of forests and cause shifts in vegetation types through time (Wear and Greis 2012, p. 39). With regard to *Trichomanes punctatum* ssp. *floridanum,* any weather shifts causing less precipitation would likely impact the viability of existing populations and could potentially limit future reproduction if droughts were to become a common occurrence. Ecosystem shifts would result in rockland and mesic hammocks having drier conditions, regular droughts, and changes in humidity, temperature, and canopy. Increases in the scale, frequency, or severity of droughts and wildfires (see ''Fires'' section, below) could have negative effects on this taxon considering its general vulnerability due to small population size, restricted range, few populations, and relative isolation.

Climate change impacts specifically for *Trichomanes punctatum* ssp. *floridanum* may be numerous and vary depending on factors such as severity, the speed at which climate changes occur, timing, health of the species, and habitat and tolerance of species. Overall, management of healthy ecosystems can support greater biodiversity, which is considered one of the best strategies to combat impacts of climate change. Removing nonnative plants and minimizing natural disturbance impacts and other external stresses can improve the subspecies' response to climate change impacts (Maschinski *et al.* 2011, p. 159). In general, the best ways to prepare and protect rare species, such as *T. p.* ssp. *floridanum,* from impacts of climate change include actively managing habitats to improve population growth and potential for natural dispersal, and controlling for nonnative species. Efforts to actively manage for *T. p.* ssp. *floridanum* are currently limited for both metapopulations due to logistical feasibility (*e.g.,* dense forest, difficulty locating populations), insufficient funding and research, small and fragmented existing populations, and lack of successful reintroduction efforts into the wild.

Alternative Future Landscape Models

To accommodate the high uncertainty in SLR projections, researchers must estimate effects from a range of scenarios. Various model scenarios developed at MIT and GeoAdaptive Inc. have projected possible trajectories of future transformation of the peninsular Florida landscape by 2060 based upon four main drivers: Climate change, shifts in planning approaches and regulations, human population change, and variations in financial resources for conservation (Vargas-Moreno and Flaxman 2010, pp. 1–6). The scenarios do not account for temperature, precipitation, or species habitat shifts due to climate change, and no storm surge effects are considered. The current MIT scenarios in Florida range from an increase in sea level of 0.09–1.0 m (0.3–3.3 ft) by 2060.

Based on the most recent estimates of SLR and the best available data at this time, we evaluated potential effects of SLR using the current ''worst case'' (*e.g.,* the highest range for SLR) MIT scenario, as well as comparing elevations of remaining rockland hammock fragments in Miami-Dade County and mesic hammocks in Sumter County with extant populations of *Trichomanes punctatum* ssp. *floridanum.* The ''worst case'' MIT scenario assumes SLR of 1.0 m (3.3 ft) by 2060, low financial resources, a 'business as usual' approach to planning, and a doubling of human population.

Based on the 1.0-m (3.3-ft) scenario, none of the rockland hammocks in Miami-Dade County where extant populations of *Trichomanes punctatum* ssp. *floridanum* occur would be inundated. However, all four populations would be within 9.66 km (6.0 mi) of saltwater, increasing the likelihood of localized vegetation shifts within the rockland hammocks and vulnerability to natural stochastic events such as hurricanes and tropical storms. The 1.0-m SLR scenario shows existing rockland hammocks in Miami-Dade County (that do not contain *T.p.* ssp. *floridanum*) directly adjacent to saltwater. Although these existing hammocks are located in higher elevation areas along the coastal ridge, changes in the salinity of the water table and soils, along with additional vegetation shifts in the region, are likely. A few remaining rockland hammocks further inland (*e.g.,* Big and Little George Hammocks) are located in highly urbanized areas; these hammocks are small and fragmented, reducing the chances of further development due to SLR in the area. Actual impacts may be greater or less than anticipated based upon the high variability of factors involved (*e.g.,* SLR, human population growth) and the assumptions made in this model.

A projected SLR (using elevation data) of 2.0 m (6.6 ft) appears to inundate much larger portions of urban Miami-Dade County. This evaluation was not based on any modeling, as opposed to the previous 1.0-m scenario; rather, this scenario examines current elevation based on LiDAR (remote sensing technology that measures distance by

illuminating a target with a laser and analyzing the reflected light) data. Under this 2.0-m (6.6-ft) SLR scenario, none of the four hammocks where *Trichomanes punctatum* ssp. *floridanum* is known to occur will be inundated, but all will be within approximately 2.41 km (1.5 mi) of saltwater in the inundated transverse glades joining the enlarged Biscayne Bay. Castellow Hammock will be the least impacted at approximately 2.41 km (1.5 mi) from saltwater, while Hattie Bauer will be adjacent to saltwater. Fuchs and Meissner hammocks will be 1.61 km (1.0 mi) from saltwater and will be surrounded by more wetlands. This scenario will leave all these locations extremely vulnerable to vegetation shifts, natural stochastic events, and loss of existing habitat and land protection. Of the remaining rockland hammocks not containing *T.p.* ssp. *floridanum* in south Florida, most would be fully or partially inundated after a 2.0-m (6.6-ft) SLR, except for the hammocks located on the higher elevated coastal ridge, which would still be adjacent to saltwater.

Due to the higher elevation and inland location of Sumter County in north Florida, existing populations of *Trichomanes punctatum* ssp. *floridanum* and associated habitat will not be impacted by 1.0- and 2.0-m (3.3- and 6.6-ft) rises in sea level. The 2.0-m (6.6-ft) SLR scenario would still leave the Sumter occurrences approximately 37.0 km (23.0 mi) from saltwater. Regional shifts in water table salinity, soils, or vegetation are not expected.

Environmental Stochasticity

Endemic species whose populations exhibit a high degree of isolation, such as *Trichomanes punctatum* ssp. *floridanum,* are extremely vulnerable to extinction from both random and nonrandom catastrophic natural or human-caused events. Small populations of species, without positive growth rates, are considered to have a high extinction risk from site-specific demographic (variability in population growth rates arising from random differences among individuals in survival and reproduction within a season) and environmental (unpredictable changes in environmental conditions such as weather, food supply, or predators) stochasticity (Lande 1993, pp. 911–927). Populations at the edge of a species' range, as may be the case with *T.p.* ssp. *floridanum* in Sumter County, may be particularly vulnerable to environmental stochasticity, as they may also be at the edge of their physiological and adaptive limits (Baguette 2004, p. 216).

The climate in Florida is driven by a combination of local, regional, and global events, regimes, and oscillations (*e.g.,* El Niño Southern Oscillation with a frequency of every 4 to 7 years, solar cycle every 11 years, and the Atlantic Multi-decadal Oscillation); however, the exact magnitude, direction, and distribution of these climatic influences on a regional level are difficult to project. There are three main ''seasons'' in Florida: (1) The wet season, which is hot, rainy, and humid from June through October; (2) the official hurricane season that extends 1 month beyond the wet season (June 1 through November 30), with peak season being August and September; and (3) the dry season, which is drier and cooler, from November through May (Miller 2013, pers. comm.). In the dry season, periodic surges of cool and dry continental air masses influence the weather with short-duration rain events followed by long periods of dry weather.

Florida is considered the most vulnerable State in the United States to hurricanes and tropical storms (Florida Climate Center, *http://coaps.fsu.edu/climate_center*). Based on data gathered from 1856 to 2008, Klotzbach and Gray (2009, p. 28) calculated the climatological probabilities for each State being impacted by a hurricane or major hurricane in all years over the 152-year timespan. Of the coastal States analyzed, Florida had the highest climatological probabilities, with a 51 percent probability of a hurricane (Category 1 or 2) and a 21 percent probability of a major hurricane (Category 3 or higher). From 1856 to 2008, Florida experienced 109 hurricanes and 36 major hurricanes. Given the few isolated populations and restricted range of *Trichomanes punctatum* ssp. *floridanum* in locations prone to storm influences (*i.e.,* Miami-Dade County), this subspecies is at substantial risk from hurricanes, storm surges, and other extreme weather events.

Natural stochastic events can pose a threat to the persistence of *Trichomanes punctatum* ssp. *floridanum* through the destruction of existing habitat. Some climate change models predict increased frequency and duration of severe storms, including hurricanes and tropical storms (McLaughlin *et al.* 2002, p. 6074; Cook *et al.* 2004, p. 1015; Golladay *et al.* 2004, p. 504). Other models predict that hurricane and tropical storm frequencies in the Atlantic will decrease between 10–30 percent by 2100 (Knutson *et al.* 2008, pp. 1–21). For those models that predict fewer hurricanes, hurricane wind speeds are expected to increase by 5–10 percent due to an increase in available energy for intense storms. Increases in hurricane winds can elevate the chances of damage to existing canopy.

In south Florida, tropical hardwood hammock forests are known to experience frequent disturbances from hurricanes (Horvitz *et al.* 1998, p. 947). Hurricanes and tropical storms can damage existing canopy, which provides shade and cover from wind. Canopy loss of any kind is determined to be the threat with greatest impact to existing metapopulations of *Trichomanes punctatum* ssp. *floridanum* (Adimey 2013b, field notes; Possley 2013l, pers. comm.). For example, impacts from Hurricane Andrew in 1992 may have been responsible for the temporary loss of the subspecies from Hattie Bauer Hammock, where it had been observed for many years. Following this hurricane, the canopy was damaged, allowing increased exposure to sunlight for several years. *T.p.* ssp. *floridanum* was not seen again in Hattie Bauer Hammock until 2011 (Possley 2013l, pers. comm.). Through natural recovery, assisted by active management activities by the EEL Program and PROS–NAM, a large portion of the Hattie Bauer Hammock canopy has been restored to pre-hurricane Andrew conditions (Guerra 2014, pers. comm.). Destruction of habitat due to hurricanes has also been documented in Sumter County in the Indian Ledges Hammock located near the town of Wahoo. This hammock, known to host a variety of rare ferns, orchids, and large trees, sustained severe damage from several hurricanes in 2004; very few native plant species once found in Indian Ledges Hammock exist in this location today (Deangelis 2014a, pers. comm.).

Historically, *Trichomanes punctatum* ssp. *floridanum* may have benefitted from more abundant and contiguous habitat to buffer it from storm events. The destruction and modification of native habitat, combined with the subspecies' small population sizes, has likely contributed over time to the stress, decline, and, in some instances, extirpation of populations or local occurrences due to stochastic events.

A study conducted by Horvitz *et al.* (1998, p. 947) found that the regeneration of forest species after stochastic events depended on the amount of canopy disturbance, the time since disturbance, and the biological relationship between the individual species and its environment. Following Hurricane Andrew, the relative abundance and life stage changed for

many nonnative plant species within Miami-Dade County. These shifts continued to occur as a result of subsequent stochastic events, suggesting hurricanes can alter long-term hammock structure and the ongoing changes in species composition (Horvitz *et al.* 1998, pp. 961, 966).

Stochastic events resulting in changes in normal precipitation (amount, seasonal timing, and distribution) and extreme temperature fluctuations may also impact *Trichomanes punctatum* ssp. *floridanum.* During the winter dry season, *T.p.* ssp. *floridanum* can become desiccated without periodic rainfall and then recover during the wet season. Multiyear droughts may negatively impact populations. While droughts are natural events, they are a threat because there are so few populations of this subspecies. Specific parameters regarding humidity, temperature, and precipitation requirements are not known at this time for *T.p.* ssp. *floridanum,* making it difficult to accurately determine what impacts will occur from modifications in current environmental conditions where extant metapopulations occur. Extreme temperature changes such as cold events in south Florida or freezing temperatures in central Florida could have devastating impacts on this subspecies. The small size of each population makes this plant especially vulnerable, in which the loss of even a few individuals could reduce the viability of a single population.

Due to the small size of existing populations of *Trichomanes punctatum* ssp. *floridanum* and its limited genetic variability, the subspecies' overall ability to respond and adapt to threats is likely low. These factors, combined with additional stress from habitat modifications (*e.g.,* hydrological changes) may increase the inherent risk posed by stochastic events that impact this subspecies (Matthies *et al.* 2004, pp. 481–488). Additionally, stochastic events are expected to exacerbate the impacts of regional drainage and subsequent drops in humidity. For these reasons, *T.p.* ssp. *floridanum* is at risk of extirpation during extreme stochastic events. We have determined that these natural stochastic events coupled with existing small population sizes, as addressed above, are a threat to the subspecies (Adimey 2013b, field notes; Possley 2013l, pers. comm.).

Fires

Although fires are not a current concern for existing populations of *Trichomanes punctatum* ssp. *floridanum,* they have been known to impact populations in the past. Craighead (1963, p. 39) noted that extensive fires in hammocks eliminated ferns in much of their former range. Drainage efforts in the early 1900s also increased the occurrence of fire, as lands became drier. Phillips (1940, p. 166) noted that the frequent occurrence of fires in the late 1930s in southern Florida resulted in widespread destruction of flora. Fires may have been a factor in the disappearance of this taxon in Royal Palm Hammock, which suffered multiple fires in the first half of the 1900s according to photographs from J.K. Small (1917; Florida Memory, State Library and Archives of Florida; Tallahassee, Florida). In recent decades, wildfires have been controlled in most rockland hammocks due to the extensive urbanization in Miami-Dade County. However, fires do have the potential to impact *T.p.* ssp. *floridanum* during periods of prolonged drought. While fires are a natural component of some ecosystems in south Florida, fires in hammocks can set back succession to pine rockland or other communities and will directly kill many plant species that are not adapted to fires, such as *T.p.* ssp. *floridanum.*

Generally, hammock environments are considered less susceptible to wildfires because their shaded, humid microclimate is not conducive to fire spread (Snyder *et al.* 1990, p. 258). Additionally, rockland hammocks occupy elevated, rarely inundated, and fire-free sites in all three of the major rockland areas in south Florida (Snyder *et al.* 1990, p. 239). Mesic hammocks are also considered fire resistant in that many occur as ''islands'' on high ground within basin or floodplain wetlands, as patches of oak/palm forest in dry prairie or flatwoods communities, on river levees, or in ecotones between wetlands and upland communities, and possess high-moisture soils due to heavy shading of the ground layer and accumulation of litter (FNAI 2010, p. 20). Additionally, wildfires are now considered a minor stressor in mesic hammocks because of the use of prescribed burns within the last 15 years (Werner 2013d, pers. comm.).

Snyder (*et al.* 1990, p. 238) points out that the high organic content of hammock soils in south Florida can enable the soil to burn; however, soil fires typically only burn in hammocks in times of drought or when fires are intentionally set (Snyder *et al.* 1990, pp. 258–260). This stressor is considered minimal in that fires typically will go out when they reach hammock margins, whether entering from pineland or some other community due to the presence of hardwood leaf litter lying directly on moist organic soil with minimal herbaceous fuel.

Although wildfires are known to occur in Miami-Dade and Sumter Counties, they are not currently considered a threat at this time due to regional prescribed burn efforts that help minimize the occurrence of wildfires, the natural fire-resistant features of these two habitats, and, in Sumter County, hydric hammock (less likely to burn) surrounding *Trichomanes punctatum* ssp. *floridanum* populations.

Public Use/Encroachment

In Miami-Dade County, two of the four hammocks containing *Trichomanes punctatum* ssp. *floridanum* (Castellow and Hattie Bauer) are accessible to the public. However, in both cases, *T.p.* ssp. *floridanum* is not accessible from the nature trail (Possley 2013g, pers. comm.). If public use were to increase significantly at any of the Miami-Dade hammocks, populations of *T.p.* ssp. *floridanum* could become at risk. For example, because the taxon grows along the rim and walls of solution holes, people climbing into these holes could damage existing populations; increased use could also introduce additional nonnative seed sources into the habitat. Similarly, climbing on boulders where the fern occurs in Sumter County could also cause damage. However, due to the low amount of visitation at the Withlacoochee State Forest (Werner 2013b–c, pers. comm.), public use and encroachment do not appear to be occurring at this time, and we have determined they do not pose a threat to *T.p.* ssp. *floridanum.*

Small Population Size Effects and Isolation

Small, isolated populations are more susceptible to impacts overall, and relatively more vulnerable to extinction due to genetic problems, demographic and environmental fluctuations, and natural catastrophes (Primack 1993, p. 255). That is, the smaller a population becomes, the more likely it is that one or more stressors could impact a population, potentially reducing its size such that it is at increased risk of extinction. Although robust population viability analyses (including minimum viable population calculations) have not been conducted for this subspecies, indications are that most existing populations are minimal in terms of abundance and size. Lack of dispersal between occurrences also contributes to the low resilience for this subspecies (see ''Habitat Fragmentation'' under *Factor A*).

Limited genetic variability will also impact *Trichomanes punctatum* ssp. *floridanum* populations. The ability of a species to adapt to environmental change is dependent upon genetic variation, a property of populations that derives from its members possessing different forms (*i.e.,* alleles) of the same gene (Primack 1998, p. 283). High genetic diversity can enhance a species' persistence in a changing environment (Lynch and Lande 1993, pp. 246–247). Although *Trichomanes punctatum* ssp. *floridanum* can grow in clusters, separate clusters are not necessarily different individuals, as they may have been connected by one or more stems in the past (Possley 2014b, pers. comm.). Thus, a population of *T.p.* ssp. *floridanum* containing many clusters may not have greater genetic diversity than a population with few clusters. Because there are only six extant populations of *T.p.* ssp. *floridanum,* each with few plants, the genetic variability is considered low, and the subspecies is inherently at greater risk from stochastic events and changes in environmental conditions (Matthies *et al.* 2004, pp. 481–488).

In summary, *Trichomanes punctatum* ssp. *floridanum* is impacted by factors such as small population size, vulnerability to random demographic fluctuations or natural catastrophes, and low genetic diversity, which is further magnified by synergistic (interaction of two or more components) effects with other threats, such as those discussed above. In evaluating the stressor of small population size effects on *Trichomanes punctatum* ssp. *floridanum,* we reviewed the limited data available concerning abundance at each of the occurrences across the subspecies' range. This represents a conservative classification of small population size, as available data do not discriminate among individual plants and life-history stages. These small populations are at risk of adverse effects from reduced genetic variation, an increased risk of inbreeding depression, and reduced reproductive output. Many of these populations are small and isolated from each other, decreasing the likelihood that they could be naturally reestablished in the event that extirpation from one location occurs.

Conservation Efforts To Reduce Other Natural or Manmade Factors Affecting Its Continued Existence

Miami-Dade County and the State of Florida have ongoing nonnative plant management programs to reduce threats on public lands, as funding and resources allow. In Miami-Dade County, nonnative, invasive plant management is very active, with a goal to treat all publically owned properties at least once a year and more often in many cases. Annual monitoring of *Trichomanes punctatum* ssp. *floridanum* is conducted by Fairchild, which records health and size of individual clusters of the subspecies along with potential new stressors, including nonnative, invasive species or habitat destruction; reports are forwarded to the County preserve managers for further attention (Possley 2013l, pers. comm.). IRC also conducts research and monitoring in multiple hammocks within Miami-Dade County for various rare and endangered plant species. Nonnative, invasive species are documented, along with any occurrence of human disturbance (van der Heiden 2013i, pers. comm.). In Sumter County, the Florida Park Service surveys each State-owned property at least once a year to manage for nonnative plants (Werner 2013a–b, pers. comm.). Furthermore, Withlacoochee State Forest conducts prescribed burning on an annual basis, controlling regional wildfires in dry swamps and mesic hammocks.

Continuing efforts to propagate *Trichomanes punctatum* ssp. *floridanum* in-vitro may eventually lead to the establishment of healthy populations that can be reintroduced in locations where the taxon once occurred or introduced to new areas deemed appropriate. These efforts can assist with combating potential or realized impacts from natural stochastic events that may harm or destroy existing populations.

Summary of Factor E

Stochastic events resulting in changes in canopy structure and environmental conditions within the taxon's current habitat are considered threats to existing and future populations of *T.p.* ssp. *floridanum.* Droughts, tropical storms, and hurricanes are common occurrences in Florida, and changes associated with these events have the potential to limit reproduction and compromise overall health in the long term, making plants more vulnerable to other stressors (*e.g.,* periodic, long-term droughts, hurricanes) or causing extirpations. As few populations remain, the entire taxon is at risk of extinction during these events. Climatic changes, including SLR, are longer term concerns expected to exacerbate existing impacts and ultimately reduce the extent of available habitat for *T.p.* ssp. *floridanum.*

The presence of nonnative species, including other plants and feral hogs, is also a threat, but may be reduced on public lands due to active programs by Miami-Dade County and the State. The majority of the remaining populations of this plant are small and geographically isolated, and genetic variability is likely low, increasing the inherent risk due to overall low resilience of this subspecies. Furthermore, the isolated existence of *Trichomanes punctatum* ssp. *floridanum* makes natural recolonization of extirpated populations virtually impossible without human intervention. Although considered stressors, wildfires and public use at extant sites are minimal and do not rise to the level of a threat.

Cumulative Effects of Threats

When two or more threats affect *Trichomanes punctatum* ssp. *floridanum* occurrences, the effects of those threats could interact or become compounded, producing a cumulative adverse effect that is greater than the impact of either threat alone. The most obvious cases in which cumulative adverse effects would be significant are those in which small populations (Factor E) are affected by threats that result in destruction or modification of habitat (Factor A). The limited distributions and small population sizes of *T.p.* ssp. *floridanum* make it extremely susceptible to the detrimental effects of further habitat modification, degradation, and loss, as well as other anthropogenic threats. Mechanisms leading to the decline of this taxon, as discussed above, range from local (*e.g.,* hydrology changes, agriculture) to regional (*e.g.,* development, fragmentation, nonnative species) to global influences (*e.g.,* climate change, SLR). The synergistic effects of threats, such as impacts from hurricanes on a species with a limited distribution and small populations, make it difficult to predict population viability. While these stressors may act in isolation, it is more probable that many stressors are acting simultaneously (or in combination) on populations of *T.p.* ssp. *floridanum,* making this subspecies more vulnerable.

Determination

We have carefully assessed the best scientific and commercial data available regarding the past, present, and future threats to *Trichomanes punctatum* ssp. *floridanum. T.p.* ssp. *floridanum* has been extirpated from the majority of its historical range, and the primary threats of habitat destruction and modification resulting from human population growth and development, agricultural conversion, regional drainage, and resulting changes in canopy and hydrology (Factor A); competition from

nonnative, invasive species (Factor E); changes in climatic conditions, including sea level rise (Factor E); and natural stochastic events (Factor E) remain threats for existing populations. Existing regulatory mechanisms have not led to a reduction or removal of threats posed to the subspecies from these factors (see Factor D discussion). These threats are ongoing, rangewide, and expected to continue in the future. Populations of *T.p.* ssp. *floridanum* are relatively small and isolated from one another, and their ability to recolonize suitable habitat is unlikely without human intervention. Because of the current condition of the extant populations and life-history traits of the subspecies, it is vulnerable to natural or human-caused changes in its currently occupied habitats. The threats have had and will continue to have substantial adverse effects on *T.p.* ssp. *floridanum* and its habitat. Although attempts are ongoing to alleviate or minimize some of these threats at certain locations, all populations appear to be impacted by one or more threats.

The Act defines an endangered species as ''any species which is in danger of extinction throughout all or a significant portion of its range'' and a threatened species as ''any species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.'' As described in detail above, this plant is currently at risk throughout all of its range due to the immediacy, severity, significance, timing, and scope of those threats. Impacts from these threats are ongoing and increasing; singly or in combination, these threats place the subspecies in danger of extinction. The risk of extinction is high because the populations are small, isolated, and have limited to no capacity for recolonization. Numerous threats are currently ongoing and are likely to continue in the foreseeable future, at a high intensity and across the entire range of this subspecies. Furthermore, natural stochastic events and changes in climatic conditions pose a threat to the persistence of the subspecies, especially because mitigation measures have yet to be developed. Individually and collectively, all of these threats can contribute to the local extirpation and potential extinction of this subspecies. Because these threats are placing this subspecies in danger of extinction throughout its range, we have determined this plant meets the definition of an endangered species. Therefore, on the basis of the best available scientific and commercial information, we are listing *Trichomanes punctatum* ssp. *floridanum* as an endangered species in accordance with sections 3(6) and 4(a)(1) of the Act. We find that a threatened species status is not appropriate for *T.p.* ssp. *floridanum* because of the contracted range of the subspecies and because the threats are occurring rangewide, are currently acting on the subspecies at a high intensity, and are expected to continue into the future.

Significant Portion of the Range

Under the Act and our implementing regulations, a species may warrant listing if it is endangered or threatened throughout all or a significant portion of its range. Because we have determined that *Trichomanes punctatum* ssp. *floridanum* is an endangered species throughout all of its range, no portion of its range can be ''significant'' for purposes of the definitions of ''endangered species'' and ''threatened species.'' See the Final Policy on Interpretation of the Phrase ''Significant Portion of Its Range'' in the Endangered Species Act's Definitions of ''Endangered Species'' and ''Threatened Species'' (79 FR 37578, July 1, 2014).

Available Conservation Measures

Conservation measures provided to species listed as endangered or threatened species under the Act include recognition, recovery actions, requirements for Federal protection, and prohibitions against certain practices. Recognition through listing results in public awareness and conservation by Federal, State, Tribal, and local agencies, private organizations, and individuals. The Act encourages cooperation with the States and requires that recovery actions be carried out for all listed species. The protection required by Federal agencies and the prohibitions against certain activities are discussed, in part, below.

The primary purpose of the Act is the conservation of endangered and threatened species and the ecosystems upon which they depend. The ultimate goal of such conservation efforts is the recovery of these listed species, so that they no longer need the protective measures of the Act. Subsection 4(f) of the Act requires the Service to develop and implement recovery plans for the conservation of endangered and threatened species. The recovery planning process involves the identification of actions that are necessary to halt or reverse the species' decline by addressing the threats to its survival and recovery. The goal of this process is to restore listed species to a point where they are secure, self-sustaining, and functioning components of their ecosystems.

Recovery planning includes the development of a recovery outline shortly after a species is listed and preparation of a draft and final recovery plan. The recovery outline guides the immediate implementation of urgent recovery actions and describes the process to develop a recovery plan. The plan may be revised to address continuing or new threats to the species, as new substantive information becomes available. The recovery plan identifies recovery criteria for review of when a species may be ready for downlisting (from endangered species to threatened species) or delisting and methods for monitoring recovery progress. Recovery plans also establish a framework for agencies to coordinate their recovery efforts and provide estimates of the cost of implementing recovery tasks. Recovery teams (composed of species experts, Federal and State agencies, nongovernmental organizations, and stakeholders) are often established to develop recovery plans. When completed, the draft and final recovery plans will be available on our Web site (*http://www.fws.gov/endangered*) or from our South Florida Ecological Services Field Office (see **FOR FURTHER INFORMATION CONTACT**).

Implementation of recovery actions generally requires the participation of a broad range of partners, including other Federal agencies, States, Tribes, nongovernmental organizations, businesses, and private landowners. Examples of recovery actions include habitat restoration (*e.g.,* restoration of native vegetation), research, captive propagation and reintroduction, and outreach and education. The recovery of many listed species cannot be accomplished solely on Federal lands because their range may occur primarily or solely on non-Federal lands. To achieve recovery of these species requires cooperative conservation efforts on private, State, and Tribal lands.

Following publication of this final listing rule, funding for recovery actions will be available from a variety of sources, including Federal budgets, State programs, and cost share grants for non-Federal landowners, the academic community, and nongovernmental organizations. In addition, pursuant to section 6 of the Act, the State of Florida will be eligible for Federal funds to implement management actions that promote the protection or recovery of *Trichomanes punctatum* ssp. *floridanum.* Information on our grant programs that are available to aid species recovery can be found at: *http://www.fws.gov/grants.*

Please let us know if you are interested in participating in recovery efforts for *Trichomanes punctatum* ssp. *floridanum.* Additionally, we invite you to submit any new information on this subspecies whenever it becomes available and any information you may have for recovery planning purposes (see **FOR FURTHER INFORMATION CONTACT**).

Section 7(a) of the Act requires Federal agencies to evaluate their actions with respect to any species that is listed as an endangered or threatened species and with respect to its critical habitat, if any is designated. Regulations implementing this interagency cooperation provision of the Act are codified at 50 CFR part 402. Section 7(a)(2) of the Act requires Federal agencies to ensure that activities they authorize, fund, or carry out are not likely to jeopardize the continued existence of any endangered or threatened species or destroy or adversely modify its critical habitat. If a Federal action may affect a listed species or its critical habitat, the responsible Federal agency must enter into consultation with the Service.

Federal agency actions within the species' habitat that may require conference or consultation, or both, as described in the preceding paragraph, include, but are not limited to, federally funded or authorized actions such as habitat restoration and control of nonnatives management and any other landscape-altering activities on Federal lands administered by the U.S. Fish and Wildlife Service; issuance of section 404 Clean Water Act permits by the Army Corps of Engineers; and construction and maintenance of roads or highways by the Federal Highway Administration.

With respect to endangered plants, 50 CFR 17.61 makes it illegal for any person subject to the jurisdiction of the United States to import or export, transport in interstate or foreign commerce in the course of a commercial activity, sell or offer for sale in interstate or foreign commerce, or to remove and reduce to possession any such plant species from areas under Federal jurisdiction. In addition, for endangered plants, the Act prohibits malicious damage or destruction of any such species on any area under Federal jurisdiction, and the removal, cutting, digging up, or damaging or destroying of any such species on any other area in knowing violation of any State law or regulation, or in the course of any violation of a State criminal trespass law. Exceptions to these prohibitions are contained in 50 CFR 17.62.

We may issue permits to carry out otherwise prohibited activities involving endangered plants under certain circumstances. Regulations governing permits are codified at 50 CFR 17.62. With regard to endangered plants, the Service may issue a permit authorizing any activity otherwise prohibited by 50 CFR 17.61 for scientific purposes or for enhancing the propagation or survival of endangered plants.

It is our policy, as published in the **Federal Register** on July 1, 1994 (59 FR 34272), to identify to the maximum extent practicable at the time a species is listed, those activities that would or would not constitute a violation of section 9 of the Act. The intent of this policy is to increase public awareness of the effect of a listing on proposed and ongoing activities within the range of a listed species. The following activities could potentially result in a violation of section 9 of the Act. This list is not comprehensive:

(1) Import the subspecies into, or export the subspecies from, the United States without authorization;

(2) Remove and reduce to possession the subspecies from areas under Federal jurisdiction; maliciously damage or destroy the subspecies on any such area; or remove, cut, dig up, or damage or destroy the subspecies on any other area in knowing violation of any law or regulation of any State or in the course of any violation of a State criminal trespass law;

(3) Sell or offer for sale in interstate or foreign commerce the subspecies; except for properly documented antique specimens of the taxon at least 100 years old, as defined by section 10(h)(1) of the Act;

(4) Unauthorized delivering, carrying, or transporting of the subspecies, including import or export across State lines and international boundaries;

(5) Introduction of nonnative species that compete with or prey upon *Trichomanes punctatum* ssp. *floridanum;*

(6) Unauthorized release of biological control agents that attack any life stage of this subspecies; and

(7) Unauthorized manipulation or modification of the habitat where *Trichomanes punctatum* ssp. *floridanum* is present on Federal lands including, but not limited to, unauthorized water withdrawal from solution holes and unauthorized removal of canopy.

Questions regarding whether specific activities would constitute a violation of section 9 of the Act should be directed to the South Florida Ecological Services Field Office (see **FOR FURTHER INFORMATION CONTACT**).

Critical Habitat

Section 3(5)(A) of the Act defines critical habitat as ''(i) the specific areas within the geographical area occupied by the species, at the time it is listed . . . on which are found those physical or biological features (I) Essential to the conservation of the species and (II) which may require special management considerations or protection; and (ii) specific areas outside the geographical area occupied by the species at the time it is listed . . . upon a determination by the Secretary that such areas are essential for the conservation of the species.'' Section 3(3) of the Act (16 U.S.C. 1532(3)) also defines the terms ''conserve,'' ''conserving,'' and ''conservation'' to mean ''to use and the use of all methods and procedures which are necessary to bring any endangered species or threatened species to the point at which the measures provided pursuant to this chapter are no longer necessary.''

Prudency Determination

Section 4(a)(3) of the Act, as amended, and implementing regulations (50 CFR 424.12), require that, to the maximum extent prudent and determinable, the Secretary shall designate critical habitat at the time the species is determined to be an endangered or threatened species. Our regulations (50 CFR 424.12(a)(1)) state that the designation of critical habitat is not prudent when one or both of the following situations exist:

(1) The species is threatened by taking or other human activity, and identification of critical habitat can be expected to increase the degree of threat to the species, or

(2) such designation of critical habitat would not be beneficial to the species.

In our proposed listing rule, because we determined that the designation of critical habitat will not likely increase the degree of threat to the species and may provide some measure of benefit, we determined that designation of critical habitat is prudent for *Trichomanes punctatum* ssp. *floridanum.*

Critical Habitat Determinability

Having determined that designation is prudent under section 4(a)(3) of the Act, we must find whether critical habitat for *Trichomanes punctatum* ssp. *floridanum* is determinable. Our regulations (50 CFR 424.12(a)(2)) further state that critical habitat is not determinable when one or both of the following situations exists: (1) Information sufficient to perform required analysis of the impacts of the

designation is lacking; or (2) the biological needs of the species are not sufficiently well known to permit identification of an area as critical habitat.

In our proposed listing rule, we found that critical habitat was not determinable because a careful assessment of the economic impacts that may occur due to a critical habitat designation was still ongoing, and we were still in the process of acquiring the information needed to perform that assessment. We have recently received new data on suitable habitat for *T. p.* ssp. *floridanum* in Sumter County, which has caused us to begin reassessing which specific features and areas are essential for the conservation of the species and, therefore, meet the definition of critical habitat. Consequently, a careful assessment of the new biological information is still ongoing, and we are still in the process of acquiring the information needed to perform that assessment. The information sufficient to perform a required analysis of the impacts of the designation is lacking, and therefore, we find designation of critical habitat to be not determinable at this time. Accordingly, we will publish a proposed critical habitat rule when we finish our assessment of the new biological information.

Required Determinations

National Environmental Policy Act

We have determined that environmental assessments and environmental impact statements, as defined under the authority of the National Environmental Policy Act (42 U.S.C. 4321 *et seq.*), need not be prepared in connection with listing a species as an endangered or threatened species under the Endangered Species Act. We published a notice outlining our reasons for this determination in the **Federal Register** on October 25, 1983 (48 FR 49244).

Government-to-Government Relationship With Tribes

In accordance with the President's memorandum of April 29, 1994 (Government-to-Government Relations with Native American Tribal Governments; 59 FR 22951), Executive Order 13175 (Consultation and Coordination with Indian Tribal Governments), and the Department of the Interior's manual at 512 DM 2, we readily acknowledge our responsibility to communicate meaningfully with recognized Federal Tribes on a government-to-government basis. In accordance with Secretarial Order 3206 of June 5, 1997 (American Indian Tribal Rights, Federal-Tribal Trust Responsibilities, and the Endangered Species Act), we readily acknowledge our responsibilities to work directly with tribes in developing programs for healthy ecosystems, to acknowledge that tribal lands are not subject to the same controls as Federal public lands, to remain sensitive to Indian culture, and to make information available to tribes. We are not aware of any *Trichomanes punctatum* ssp. *floridanum* populations on tribal lands.

References Cited

A complete list of references cited in this rulemaking is available on the Internet at *http://www.regulations.gov* and upon request from the South Florida Ecological Services Field Office (see **FOR FURTHER INFORMATION CONTACT**).

Authors

The primary authors of this final rule are the staff members of the South Florida Ecological Services Field Office.

List of Subjects in 50 CFR Part 17

Endangered and threatened species, Exports, Imports, Reporting and recordkeeping requirements, Transportation.

Regulation Promulgation

Accordingly, we amend part 17, subchapter B of chapter I, title 50 of the Code of Federal Regulations, as follows:

PART 17—[AMENDED]

■ 1. The authority citation for part 17 continues to read as follows:

Authority: 16 U.S.C. 1361–1407; 1531–1544; 4201–4245; unless otherwise noted.

■ 2. Amend § 17.12(h) by adding an entry for ''*Trichomanes punctatum* ssp. *floridanum*'' to the List of Endangered and Threatened Plants in alphabetical order under Ferns and Allies to read as follows:

§ 17.12 Endangered and threatened plants.

* * * * *

(h) * * *

Species		Historic range	Family	Status	When listed	Critical habitat	Special rules
Scientific name	Common name						
*	*	*	*	*	*		*
FERNS AND ALLIES							
*	*	*	*	*	*		*
Trichomanes punctatum ssp. *floridanum*.	Florida bristle fern	U.S.A. (FL)	Hymenophyllaceae	E	859	NA	NA
*	*	*	*	*	*		*

* * * * *

Dated: September 28, 2015.

Stephen Guertin,

Acting Director, U.S. Fish and Wildlife Service.

[FR Doc. 2015–25299 Filed 10–5–15; 8:45 am]

BILLING CODE 4333–15–P