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January 24, 2022

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**RE: Petition to List the Ghost Orchid (*Dendrophylax lindenii*), as Threatened or Endangered Under the Endangered Species Act, and to Designate Critical Habitat**

Dear Ms. Haaland, Ms. Estenoz, Ms. Williams, and Mr. Williams:

The Institute for Regional Conservation, Center for Biological Diversity, and National Parks Conservation Association (Petitioners) petition the U.S. Fish and Wildlife Service (FWS) to list the imperiled Florida-native ghost orchid, *Dendrophylax lindenii*, as threatened or endangered under the Endangered Species Act, and to designate critical habitat concurrent with listing.

Petitioners file this petition under the Endangered Species Act, 16 U.S.C. § 1531-1543. This petition is filed under 5 U.S.C. § 553(e), and 50 C.F.R. § 424.14, which grants interested parties the right to petition for issuance of a rule from the Secretary of the Interior. Petitioners request that FWS designate critical habitat as required by 16 U.S.C. § 1533(b)(6)(C) and 50 CFR § 424.12, and pursuant to the Administrative Procedure Act (5 U.S.C. § 553). Pursuant to 50 C.F.R. § 424.14(b) Petitioners sent the Florida Department of Agriculture and Consumer Services and the Florida Fish and Wildlife Conservation

Commission notice of the petition on Sept. 9, 2021. This petition sets in motion a specific process placing definite response requirements on the FWS and specific time constraints upon those requirements.

Petitioners submit substantial scientific information in this petition indicating that listing the ghost orchid is warranted; however, because one of the chief threats to the ghost orchid is overcollection, the petition does not include the exact locations of populations or of individual ghost orchid plants. Instead, the petition cites publicly available information regarding the location of ghost orchids and details the threats that put it at risk of extinction. For exact population location information, and for any other questions about the petition, please contact George Gann at (305) 247-6547 or [gann@regionalconservation.org](mailto:gann@regionalconservation.org). Petitioners understand and expect that location information about the ghost orchid will be protected from disclosure in the event of a Freedom of Information Act request and in any future rulemakings regarding the ghost orchid.

Sincerely,

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**PETITION TO LIST THE GHOST ORCHID (*DENDROPHYLAX LINDENII*) AS  
AN ENDANGERED OR THREATENED SPECIES UNDER THE U.S.  
ENDANGERED SPECIES ACT**



Photo Courtesy Tony Pernas

Written and submitted by The Institute for Regional Conservation, Center for Biological Diversity, and National Parks Conservation Association on January 24, 2022.

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## I. Executive Summary

This petition presents substantial scientific evidence indicating that the ghost orchid (*Dendrophylax lindenii*) faces threats to its continued existence and warrants listing as a threatened or endangered species under the Endangered Species Act. The ghost orchid is restricted to humid, swampy forests in southwestern Florida and restricted areas in Cuba. In Florida, this epiphytic orchid is dependent on deep sloughs in freshwater swamps, primarily growing on the central trunks of just two understory tree species, pop ash (*Fraxinus caroliniana*) and pond apple (*Annona glabra*). Ghost orchids have extremely low tolerance for saltwater and doubtful capacity to survive beyond environs with year-round extremely high humidity. A recent assessment by NatureServe estimates long-term and short-term declines of 30-50% in Florida and more than 90% globally. Because one of the chief threats to the ghost orchid is poaching, this petition does not include the exact locations of populations or of individual ghost orchids. Instead, this petition cites publicly available information regarding the location of ghost orchids and details the threats that put it at risk of extinction.<sup>1</sup> Already restricted by its narrow habitat requirements, the orchid is existentially threatened by habitat degradation and loss, hydrologic modifications and wildfire, invasive species, overcollection, sea level rise, hurricanes, and other climate crisis factors.

## II. Introduction

Florida is home to at least 120 varieties of orchids, of which 107 are native, including the ghost orchid.<sup>2</sup> The ghost orchid is one of the most rare and famous flowering plants in North America, having been made popular by Susan Orlean's book, *The Orchid Thief*, and the movie "Adaptation."<sup>3</sup> Meanwhile, the sides of U-Haul vans promote Florida tourism with the orchid.<sup>4</sup> In Florida, *Dendrophylax lindenii* almost always grows on just two host tree species, specifically on the central trunk of mature pond apple trees (*Annona glabra*) and pop ash trees (*Fraxinus caroliniana*); in Cuba, *D. lindenii* grows in tropical semi-deciduous forests on a wider variety of trees.<sup>5</sup> In both countries, *D. lindenii*

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<sup>1</sup> Please contact George Gann at (305) 247-6547 or [gann@regionalconservation.org](mailto:gann@regionalconservation.org) for more precise population or individual location information.

<sup>2</sup> Wunderlin, R.P., *et al.* 2021a. Atlas of Florida Plants (<http://florida.plantatlas.usf.edu/>); S.M. Landry and K.N. Campbell (application development), USF Water Institute. Institute for Systematic Botany, University of South Florida, Tampa. Accessed October 20 2021.

<sup>3</sup> Main, D. 2019. Florida's rare ghost orchids are getting cut off from water, National Geographic, <https://www.nationalgeographic.com/science/2019/10/florida-ghost-orchids-threatened-by-development/>

<sup>4</sup> Uhaul.com. 2021. <https://www.uhaul.com/supergraphics/52/venture-across-america-and-canada-modern/florida>. Accessed October 20, 2021.

<sup>5</sup> Mújica, E.B., *et al.* 2018. A comparison of ghost orchid (*Dendrophylax lindenii*) habitats in Florida and Cuba, with particular reference to seedling recruitment and mycorrhizal fungi. *Botanical Journal of the Linnean Society* 186: 572-586 at 572. ("In

grows in very restricted areas at low elevations, and is threatened by multiple factors including poaching, habitat degradation, sea level rise, hurricanes, hydrologic modifications and wildfire, and invasive species.<sup>6</sup> These threats are well-documented in this petition and are harming ghost orchids, putting the species at risk of extinction now or in the foreseeable future.

### III. Natural History and Ecology

#### A. Taxonomy & Synonymy

*Dendrophylax lindenii* (Lindl.) Benth. ex Rolfe. Family: Orchidaceae. Genus: *Dendrophylax*. Synonyms: *Aeranthus lindenii*, *Angraecum lindenii*, *Polyradicion lindenii*, *Polyrrhiza lindenii*. It was named by John Lindey in 1846 from plants discovered in Cuba. In Florida, the ghost orchid is one of a trio of leafless orchids, all members of the angraecoid group, which is part of the larger *Vanda-Phalaenopsis* alliance.<sup>7</sup> The other two Florida native members of this group are *Campylocentrum pachyrrhizum* and *Harrisella porrecta*, both of which have much different flowers than the ghost orchid.<sup>8</sup> A total of 14 species of *Dendrophylax* are native to Florida, the West Indies, Mexico, and Central America.<sup>9</sup> The ghost orchid is most closely related to *D. sallei* of Hispaniola, from which it differs in having smaller and less triangular lateral lobes on the labellum.<sup>10</sup> It has been suggested that plants in Florida may be taxonomically distinct from those in Cuba based on differences including flower size and blooming season, but genetic comparisons are needed.<sup>11</sup>

#### B. Species Description

The ghost orchid is characterized by a large, white, spindling bloom growing from gray-green roots, covered with tiny silver marks, which radiate out from one growing center.

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Florida, *D. lindenii* grew on just two host tree species, *Franxinus caroliana* and *Annona glabra*, most (69%) on the former, whereas in Cuba 18 tree species acted as hosts...”).

<sup>6</sup> *Id.*

<sup>7</sup> Stewart, S.L., and L.W. Richardson. 2008. Orchid flora of the Florida Panther National Wildlife Refuge. *North American Native Orchid Journal*. 14: 70-104, at 82.

<sup>8</sup> Brown, P.M. 2005. *Wild orchids of Florida*. Gainesville: University Press of Florida, at 28.

<sup>9</sup> World Flora Online. <http://www.worldfloraonline.org/> Accessed October 20, 2021.

<sup>10</sup> Ackerman, J.D. 2014. *Orchid Flora of the Greater Antilles*. The New York Botanical Garden Press, at 107

<sup>11</sup> Houlihan, P.R., *et al.* 2019. Pollination ecology of the ghost orchid (*Dendrophylax lindenii*): A first description with new hypotheses for Darwin’s orchids. *Sci Rep* 9, 12850 (2019); Mújica, *et al.* 2021. Projected status of the ghost orchid (*Dendrophylax lindenii*) in Florida during the next decade based on temporal dynamic studies spanning six years. *Plants* 2021, 10, 1579. <https://doi.org/10.3390/plants10081579>.

### C. Reproduction, Pollination

The ghost orchid is long-lived and may take 15 years or more to reach reproductive maturity; the oldest known plant in the wild was first observed as a reproductively mature individual in 1993.<sup>12</sup> In Florida, reproductive-age plants are typically found between 3.25-6.5 ft (1-2 m) above ground level, but always above the high water mark.<sup>13</sup> Mature plants may not flower at all within a season, and plants with more than one flower open at once are exceedingly rare. Flowering of plants in the wild is sporadic and almost nothing is known about the environmental and physiological factors required for floral development.<sup>14</sup> Ghost orchid studies related to reproduction have included mycorrhizal relationships,<sup>15</sup> host tree affinities,<sup>16</sup> seedling development,<sup>17</sup> and volatile compound composition.<sup>18</sup> Despite the relative fame and interest in the pollination story of this orchid, biologists are only recently coming to understand the ecological interactions between pollinators and ghost orchids. Two studies published in 2019 provide evidence that *D. lindenii* has multiple possible pollinators or flower visitors, but only a few moth species are likely to be *effective* pollinators. One study provides photographic evidence of flower visitation by both the giant sphinx moth (*Cocytius antaeus*) and the fig sphinx moth (*Pachylia ficus*), but pollinia were affixed only to the proboscis of the fig sphinx moth; furthermore, it was suggested that the giant sphinx moth may be robbing nectar to the orchid's detriment.<sup>19</sup> The second study provided photographic evidence that *D. lindenii* is pollinated by the fig sphinx moth and the pawpaw sphinx moth (*Dolba hyloeus*).<sup>20</sup> While having more than one potential pollinator could be beneficial, few seed capsules develop in Florida populations. In 25 years of monitoring ~450 ghost orchid plants in Fakahatchee Strand Preserve State Park, the largest number of capsules observed were seven in 2006 and six in 2017.<sup>21</sup> Little is known about seedling establishment and growth to maturity, but

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<sup>12</sup> Houlihan, *et al.* 2019; NatureServe. 2021a. *Dendrophylax lindenii*. NatureServe Explorer [web application]. NatureServe, Arlington, Virginia. Available <https://explorer.natureserve.org/>. (Accessed: December 5, 2021).

<sup>13</sup> Mújica, *et al.* 2018 at 581.

<sup>14</sup> Hoang, *et al.* 2017. Comparative seed germination and seedling development of the ghost orchid, *Dendrophylax lindenii* (Orchidaceae), and molecular identification of its mycorrhizal fungus from South Florida. *Annals of botany* 119(3), at 379.

<sup>15</sup> *Id.* (entire).

<sup>16</sup> Raventós, *et al.* 2015. Population viability analysis of the epiphytic ghost orchid (*Dendrophylax lindenii*) in Cuba. *Biotropica* 47(2), 179–189 (2015).

<sup>17</sup> Hoang, *et al.* 2017 (entire).

<sup>18</sup> Sadler, *et al.* 2011. Fragrance composition of *Dendrophylax lindenii* (Orchidaceae) using a novel technique applied *in situ*. *European Journal of Environmental Sciences*, 1(2).

<sup>19</sup> Houlihan, *et al.* 2019, at 7.

<sup>20</sup> Danaher, M.W. *et al.* 2019. Pollinia removal and suspected pollination of the endangered ghost orchid, *Dendrophylax lindenii* (Orchidaceae) by various hawk moths (Lepidoptera: Sphingidae): another mystery dispelled. *Florida Entomologist*, 102(4): 671-683.

<sup>21</sup> Houlihan, *et al.* 2019 at 7-8.

two plants that were tracked beginning in 1992 took 16 and 17 years to produce the first flowers.<sup>22</sup>

While ghost orchids' seed traits infer that they can be characterized as wind-dispersed, authoritative studies have shown that even wind-dispersed seeds travel very small distances and typically land nearby the source plant within moderately- to highly-dense forests, such as those that are typical of ghost orchid habitats.<sup>23</sup> Ghost orchids' seeds do not have appendages, such as "wings," on their seeds and thus do not have specifically-beneficial adaptations that are known to aid their aerodynamic properties, nor are the range of Floridian tree species that currently host the orchids of great height; aerodynamic properties of wind-dispersed seeds as well as the height from which a diaspore is dispersing are both factors that help determine how wind-dispersed seeds disperse.<sup>24</sup> The effects of relatively closed, dense canopies (that are characteristic of Florida ghost orchid microclimates) on ghost orchid seed movement could be inferred to highly limit seed movement and therefore dispersal, based on relevant mechanistic models and field-tested evaluations:

Even very sparse forests generated distance distributions that were much more shifted towards the source than those generated by isolated trees in open landscapes. Very dense forests produced very restricted seed shadows, with 99% of the seeds traveling less than 2.7m.<sup>25</sup>

Small, isolated subpopulations of orchids can have diminished genetic variability, which can lead to a reduced ability to adapt and respond to environmental stressors, which can decrease the probability of long-term persistence.<sup>26</sup> Species that are restricted to geographically limited areas are inherently more vulnerable to extinction than more widespread species because of the increased risk of genetic bottlenecks, random

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<sup>22</sup> Houlihan, *et al.* 2019 at 7.

<sup>23</sup> See Jones, F.A., and H.C. Muller-Landau. 2008. Measuring long-distance seed dispersal in complex natural environments: an evaluation and integration of classical and genetic methods. *Journal of Ecology*, 96(4), pp.642-652; Nathan *et al.* 2002. Mechanistic models for tree seed dispersal by wind in dense forests and open landscapes. In, Levey *et al.* 2002. *Seed Dispersal and Frugivory: Ecology, Evolution and Conservation*, 69-82. CAB International.

<sup>24</sup> *Id.*

<sup>25</sup> Nathan, *et al.* 2002 at 75.

<sup>26</sup> Barrett, S.C.H., and J. Kohn. 1991. The genetic and evolutionary consequences of small population size in plants: implications for conservation in: D. Falk and K.E. Holsinger, (Eds.). *Genetics and Conservation of Rare Plants*. Oxford University Press, Oxford, pp. 3–30; Newman, D. and D. Pilson. 1997. Increased probability of extinction due to decreased genetic effective population size: Experimental populations of *Clarkia pulchella*. *Evolution* 51(2):354–362.



demographic fluctuations, climate change, stochastic events, and localized catastrophes such as hurricanes and disease outbreaks.<sup>27</sup>

#### D. Habitat Requirements and Distribution

*Dendrophylax lindenii* is currently known only from southwestern peninsular Florida and Cuba. Though the two populations of the ghost orchid are separated by about 350 miles (560 km), they grow in two completely different habitats and colonize two different sets of host trees.<sup>28</sup>

In Florida, *D. lindenii* occurs in cypress domes, sloughs, mixed hardwood swamps, and strand swamps where it grows on the trunks, and rarely branches, of woody trees growing in standing water. These long-hydroperiod wetland forests have high levels of humidity, which have historically protected *D. lindenii* from winter freezes, drought, and wildfire.<sup>29</sup> However, these long-hydroperiod wetland forests are not immune to the effects of climate change and anthropogenic habitat modification as described below. Ghost orchids currently grow predominantly on two host trees, pond apple (*Annona glabra*) and pop ash (*Fraxinus caroliniana*), and to a lesser extent on bald cypress (*Taxodium distichum*),<sup>30</sup> and were reported more than 60 years ago as collected from live oak (*Quercus virginiana*) and royal palm (*Roystonea regia*).<sup>31</sup> A 2015 study at Florida Panther National Wildlife Refuge found roughly 70% of the plants growing on pop ash trunks.<sup>32</sup> These trees, characteristic of old-growth bald cypress habitat,<sup>33</sup> are rooted in stagnant pools of tannin-rich water which are present most of the year.<sup>34</sup> The orchid prefers deep swamps, high humidity, mild temperatures, dappled shade, and the presence of fungal endophytes.<sup>35</sup> The ghost orchid engages in a relationship with specific fungi that the orchid utilizes as a carbon source to potentially facilitate seed germination and development into maturity.<sup>36</sup> Research suggests that *D. lindenii* colonizes host trees with moist, corrugated or semi-corrugated bark harboring *Ceratobasidium* (a genus of fungi in the order of *Cantharellales*) for seed germination,<sup>37</sup> but other research indicates that in the Florida Panther National Wildlife

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<sup>27</sup> Mangel, M., and C. Tier. 1994. Four facts every conservation biologist should know about persistence. *Ecology* 75: 607-614, at 607; Pimm S.L., H.L. Jones, and J. Diamond. 1998. On the risk of extinction. *American Naturalist* 132: 757-785, at 757.

<sup>28</sup> Mújica, *et al.* 2018, at 573.

<sup>29</sup> Main, D. 2019 at 1.

<sup>30</sup> Houlihan, *et al.* 2019 (entire).

<sup>31</sup> Correll, D.S. 1950. Native Orchids of North America North of Mexico. *Chronica Botanica Company*. Waltham, MA. at 377.

<sup>32</sup> Mújica, *et al.* 2018, at 577.

<sup>33</sup> Clem, S.E., and M.J. Duever. 2019. Hydrologic changes over 60 Years (1959 – 2019) in an old-growth bald cypress swamp on a rapidly developing landscape. *Wetland Science and Practice*. October 2019, 362–372 at 363.

<sup>34</sup> Mújica, *et al.* 2018 at 575.

<sup>35</sup> *Id.* at 572.

<sup>36</sup> *Id.*

<sup>37</sup> Hoang, *et al.* 2017; Mújica, *et al.* 2018 at 572 (“Roots from mature [ghost orchids] in Florida yielded an endophyte identified as a strain of *Ceratobasidium*. We propose that

Refuge it may target a single clade of *Ceratobasidium* representing a rare Operational Taxonomic Unit (OTU).<sup>38</sup>

In western Cuba, where freezing temperatures do not occur, the ghost orchid makes use of a wider selection of host trees, growing on the bark of many species of tropical semi-deciduous hardwoods rooted in fractured limestone, with little or no standing water.<sup>39</sup> Approximately two-thirds (67%) of the ghost orchids located in Cuba between 2015 and 2018 were affixed to the bark of five host tree species, with 13 additional species hosting smaller proportions.<sup>40</sup> Just two of the 18 total known host tree species in Cuba hosted the great majority of seedlings (*Maba crassinervis* and *Erythroxylum areolatum*), whereas half (50%) of all mature plants were affixed to three different species (*Comocladia dentata*, *Mastichodendron foetidissimum*, *Tabebuia angustata*). Moreover, many (65.4%) of the ghost orchids in Cuba were solitary individuals, not in clusters or groups, unlike those in Florida which were mostly aggregated (79.5%). In Cuba, 15 of the 18 tree species that serve as hosts to the ghost orchid had corrugated or semi-corrugated bark (as both of the primary host tree species in Florida do).<sup>41</sup>

### E. Current and Historic Distribution

Recent NatureServe assessments estimate that the range of *D. lindenii* has retracted from an historical baseline by 7% or more in Florida,<sup>42</sup> and more than 90% globally,<sup>43</sup> with long-term and short-term trends showing 30-50% or more population declines in Florida<sup>44</sup> and more than 90% globally.<sup>45</sup>

The NatureServe Assessment estimates 603-744 known reproductively mature individuals remaining in the United States, all growing in extreme southwestern Florida, in Big Cypress National Preserve and nearby (e.g., Florida Panther National Wildlife Refuge, Fakahatchee Strand Preserve State Park, Audubon's Corkscrew Swamp Sanctuary).<sup>46</sup>

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*D. lindenii* colonizes host trees with moist, corrugated or semi-corrugated bark harboring *Ceratobasidium* for seed germination”).

<sup>38</sup> Johnson, J.A.N. 2019. Investigating specificity and diversity of orchid mycorrhizal fungi of *Vanilla planifolia* and *Dendrophylax lindenii*. Ph.D. Dissertation. Northwestern University, Evanston, IL, USA, at 48-49; OTUs are clusters of organisms grouped by DNA sequence similarity.

<sup>39</sup> Mújica, *et al.* 2018 at 573 (citing Acevedo, 1992).

<sup>40</sup> *Id.*

<sup>41</sup> *Id.* at 577.

<sup>42</sup> NatureServe. 2021b. Element National Ranking Form: *Dendrophylax lindenii* in Biotics 5 database. NatureServe, Arlington, Virginia. (Accessed: December 6, 2021).

<sup>43</sup> NatureServe. 2021a.

<sup>44</sup> NatureServe. 2021b.

<sup>45</sup> NatureServe. 2021a.

<sup>46</sup> NatureServe. 2021a; Gann, G.D., *et al.* 2021. The Floristic Inventory of South Florida Online. <https://regionalconservation.org/ircs/database/database.asp> Accessed October 20, 2021.

Florida's ghost orchids occur in the western Greater Everglades ecosystem in about 21 small subpopulations<sup>47</sup> from 10 conservation and tribal areas in Collier, Hendry, and possibly Lee counties,<sup>48</sup> in a small area just over 1,450 sq. miles (3,757 km).<sup>49</sup> The ghost orchid is presumed extirpated from a small, isolated conservation area in Lee County.<sup>50</sup> The Audubon's Corkscrew Swamp Sanctuary contains the United States' largest old-growth bald cypress forest<sup>51</sup> and is home to the "super ghost," the largest known ghost orchid mass, found 50 feet up a bald cypress tree and boasting up to 50 flowers in a summer,<sup>52</sup> which is notably an exceedingly uncharacteristic flowering pattern for this species.

In Cuba, fewer than 150 reproductively mature plants of *D. lindenii* are known in Guanahacabibes National Park in the extreme southwestern part of the country.<sup>53</sup> Two plants were reported from Ciénaga de Zapata National Park about 200 miles to the east of Guanahacabibes,<sup>54</sup> but are unconfirmed.<sup>55</sup> Plants have also been recorded or reported in eastern Cuba including the province of Granma (Rio Portillo),<sup>56</sup> and in Las Tunas, Santiago de Cuba, Guantanamo, and Holguin provinces,<sup>57</sup> but none of these populations are believed to be extant.<sup>58</sup> Luer (1972)<sup>59</sup> included the Bahamas in the range map for this species as does *Plants of the World Online*.<sup>60</sup> However, there are no museum specimens or other verifiable records known from the Bahamas and *D. lindenii* is only reliably documented for Florida and Cuba in the definitive Orchid Flora of the Greater Antilles.<sup>61</sup>

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<sup>47</sup> NatureServe, 2021b.

<sup>48</sup> Gann, *et al.* 2021.

<sup>49</sup> NatureServe, 2021b.

<sup>50</sup> Gann, *et al.* 2021.

<sup>51</sup> Main, D. 2019 at 1.

<sup>52</sup> *Id.* at 1.

<sup>53</sup> Mújica, E.B. 2021b. Email communication to G.D. Gann. October 7, 2021; see also Raventós, *et al.*, 2015 and Mújica, *et al.*, 2018 for documentation of *D. lindenii* at Guanahacabibes National Park.

<sup>54</sup> Zettler, L.W., *et al.* 2019. The ghost orchid demystified: biology, ecology, and conservation of *Dendrophylax lindenii* in Florida and Cuba. Proceedings of the 22th World Orchid Conference, at 140.

<sup>55</sup> NatureServe. 2021a.

<sup>56</sup> González-Oliva, L., *et al.* 2014. Categorización de taxones de la flora de Cuba - 2014. Bissea 8(1) at 228; Chomicki *et al.* 2014. Exodermis structure controls fungal invasion in the leafless epiphytic orchid *Dendrophylax lindenii* (Lindl.) Benth. ex Rolf. Flora 209 (2014) 88–94.

<sup>57</sup> NatureServe. 2021a.

<sup>58</sup> Mújica, E.B. 2021a. Email communication to G.D. Gann September 29, 2021.

<sup>59</sup> Luer, C.A. 1972 at 278. The Native Orchids of Florida. The New York Botanical Garden.

<sup>60</sup> Plants of the World Online. <http://plantsoftheworldonline.org/taxon/1034771-2>. Accessed March 11, 2021.

<sup>61</sup> Ackerman, J.D. 2014 at 107.

#### IV. Declining Population Status

The ghost orchid's total population in the United States is estimated at about 1,500 individuals, with 603-744 known reproductively mature plants, in approximately 21 known geographically-delineated subpopulations.<sup>62</sup> Of these ghost orchid subpopulations, only three were considered by NatureServe to be moderately resilient as characterized by at least 100 reproductively mature plants.<sup>63</sup> The ghost orchid is inherently vulnerable with slow growth rates, based on available life history and reproductive characteristics (e.g., low flowering rates; fewer than five known likely effective pollinators; and low seed capsule production).<sup>64</sup> FWS characterizes resiliency as “[being] positively related to population size and growth rate and may be influenced by connectivity among populations. Generally speaking, populations need abundant individuals within habitat patches of adequate area and quality to maintain survival and reproduction in spite of disturbance.”<sup>65</sup> Based on the FWS characterization of resiliency, given the low abundance of individuals (i.e., fewer than 100 mature plants), slow growth rates, and poor dispersal and connectivity between subpopulations, at least 18 and potentially all 21 of the subpopulations could be classified as having a low level of resiliency.

Although there are no published long-term studies of the ghost orchid population in southwest Florida, it has suffered from extensive logging operations, large scale land conversion, and wetlands drainage since the 1940s,<sup>66</sup> and overcollection since at least the 1970s.<sup>67</sup> At the subpopulation level, individual ghost orchids have been monitored in Fakahatchee Strand Preserve State Park for more than 25 years.<sup>68</sup> Ten out of 125 individual orchids tracked in the Fakahatchee since 2005 were poached, and 35 of the remaining 115 plants have died, representing a 36% reduction in those plants.<sup>69</sup> An intensive study of 652 plants at Florida Panther National Wildlife Refuge occurred 2015-2020.<sup>70</sup> Results of this study suggest that ghost orchid numbers will decline by 20% in the Refuge over the next decade in the absence of external adverse factors (e.g. hurricanes), which would be expected to accelerate decline if present.<sup>71</sup> From a demographic perspective, seedling recruitment is not expected to keep pace with the projected decline.<sup>72</sup> From 2017 to 2018, researchers documented a loss of 48 individual mature plants from Florida Panther

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<sup>62</sup> NatureServe. 2021b.

<sup>63</sup> *Id.* Defined as populations with “good viability”.

<sup>64</sup> *Id.*

<sup>65</sup> U.S. Fish and Wildlife Service. 2016. USFWS Species Status Assessment Framework: an integrated analytical framework for conservation. Version 3.4 dated August 2016.

<sup>66</sup> NatureServe. 2021a.

<sup>67</sup> Langdon, K.R. 1979. The ghost orchid, *Polyrrhiza lindenii*, and endangered species in Florida. Circular 56. Gainesville: Florida Department of Agriculture and Consumer Services, Division of Plant Industry.

<sup>68</sup> Houlihan, *et al.* 2019 at 7.

<sup>69</sup> Owen, M. 2021. Personal communication between M. Owen, Florida Department of Environmental Protection, and G.D. Gann on September 9, 2021.

<sup>70</sup> Mújica, *et al.* 2021 (entire).

<sup>71</sup> *Id.* at 5.

<sup>72</sup> *Id.*

National Wildlife Refuge, in addition to fallen host trees and downed branches, likely caused by Hurricane Irma's high winds during September of 2017.<sup>73</sup> Recent monitoring of a subpopulation in Big Cypress National Preserve indicated that 30% of ghost orchid host trees had died along with approximately 30% of the ghost orchids as a result of Hurricane Irma (2017), and an additional 6% of ghost orchids in that same subpopulation had died since 2017.<sup>74</sup> Poaching of many individual ghost orchids in at least one subpopulation of the plants was perpetrated in Big Cypress National Preserve during the summer of 2020.<sup>75</sup> A study in Guanahacabibes, Cuba from 2006-2010 found that annual growth rates were below 1 (or declining) for three of the four study years.<sup>76</sup> Reproductive values would need to be approximately 4.8 times their measured values to reach an approximately stochastic stable population.<sup>77</sup> As such, the ghost orchid is clearly at risk of extinction and in need of Endangered Species Act protections.

## V. Threats to the Ghost Orchid

Under the ESA, 16 U.S.C. § 1533(a)(1), FWS is required to list a species as endangered if it is in danger of extinction in all or a significant portion of its range or threatened if it is at risk of becoming endangered in the foreseeable future in all or a significant portion of its range based on any of the five statutory listing 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;
- (E) other natural or manmade factors affecting its continued existence.

16 U.S.C. § 1533(a)(1)(A)-(E); 50 C.F.R. § 424.11(c)(1)-(5).

The substantial scientific information presented in this petition, representing the best available scientific data on the ghost orchid, its habitat, and threats, indicates that listing the orchid under the ESA is warranted. Specifically, the ghost orchid is threatened by multiple factors including habitat loss and degradation, changes in hydrology, poaching, invasive species, sea level rise, hurricanes, and other climate-crisis impacts.

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<sup>73</sup> Mújica, *et al.* 2021 at 3.

<sup>74</sup> Angelo, C. 2021a. Letter to George Gann, September 13, 2021.

<sup>75</sup> Forsyth, T. 2021. Public verbal communication by Big Cypress National Preserve Superintendent T. Forsyth during a public webinar meeting on Nov. 10, 2020. Meetings dates and times listed on NPS PEPC website at <https://parkplanning.nps.gov/MeetingNotices.cfm?projectID=49334>.

<sup>76</sup> Raventós, *et al.* 2015 at 182.

<sup>77</sup> *Id.*

## A. Present or Threatened Destruction, Modification, or Curtailment of Habitat

Almost all remaining ghost orchid habitats are threatened by the same problems: habitat degradation due to development and overuse, and climate change affecting the critical habitats where they are found.<sup>78</sup> The ghost orchid grows in extremely specialized habitats and is threatened by habitat modification and loss, especially modifications to hydrology, including water quantity and seasonality, motorized and non-motorized access trails, and invasive species.

### *i. Hydrologic changes and drought harm ghost orchid habitat and impact ghost orchid persistence and reproduction.*

Nearly all the places where ghost orchids are found are experiencing significant habitat modification due to changes in hydrology.<sup>79</sup> While greenhouse experiments suggest that reproductively mature ghost orchids tolerate prolonged desiccation,<sup>80</sup> field studies show that continuous seedling recruitment and growth occurs only in the wettest locations.<sup>81</sup> Preliminary findings resulting from a six year study in the Florida Panther National Wildlife Refuge indicate that six of seven subpopulations studied appeared to be possibly senile, or lacking the conditions suitable for reproduction, primarily due to inadequate hydrologic conditions.<sup>82</sup> Only one subpopulation “harbored spontaneous seedlings during all six years when data were collected, and this site was also the wettest, i.e. it maintains relatively high water levels throughout the year.”<sup>83</sup>

Hydrologic modifications within ghost orchid habitat in Florida have been extensive. As an example, in Audubon’s Corkscrew Swamp Sanctuary, from 1960 to 2000 water levels receded below ground in the cypress forest for no more than two months of the year, while standing water remained in nearby pond habitats throughout most years.<sup>84</sup> In recent years (and despite no change in rainfall), the Sanctuary has experienced more than three dry months each year, with nearby pond habitats also drying completely and “a markedly shortened hydroperiod in all wetland habitats.”<sup>85</sup> Recent hydrologic modeling suggests the Sanctuary’s over-drying is due to downstream diversion by canals (which keep water off

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<sup>78</sup> Main, D. 2019 at 2.

<sup>79</sup> *Id.*

<sup>80</sup> Coopman, J., and Kane, M.E. 2018. Greenhouse acclimatization methods for field establishment of in vitro–derived ghost orchid (*Dendrophylax lindenii*) plants. *Native Plants Journal* Summer 2018 vol. 19 no. 2; Coopman, J.C., and Kane, M.E. 2019. In vitro desiccation tolerance of the epiphytic Ghost Orchid, *Dendrophylax lindenii* (Lindl.) Benth x. Rolfe. *In Vitro Cell.Dev.Biol.-Plant* 55, 60–70 (2019). <https://doi.org/10.1007/s11627-018-9948-4>.

<sup>81</sup> Mújica, *et al.* 2021 at 8.

<sup>82</sup> *Id.*

<sup>83</sup> *Id.*

<sup>84</sup> *Id.* at 2; Clem and Duever. 2019 at 363.

<sup>85</sup> Main, D. 2019 at 2; Clem and Duever 2019 at 370.

of roads and out of neighborhoods),<sup>86</sup> although in parts of this region increased water extraction by well fields and agriculture could also be possible drivers.<sup>87</sup> Large areas downstream of the Corkscrew Swamp have been converted to low density residential development, only made possible by a grid of canals that rapidly drain wet season surface water and groundwater from the adjacent landscape and carry it to coastal estuaries.<sup>88</sup>

Big Cypress National Preserve, too, is significantly drier in the last 15 years than it has been historically,<sup>89</sup> and hydrological changes directly harmed ghost orchid habitat; some of these impacts, as articulated by the National Park Service when describing the April 2020 Silver King wildfire, which burned within 1.85 m (6 feet) of a known ghost orchid plant and within 5 m (20 feet) of numerous other ghost orchids,<sup>90</sup> include:

The Preserve is currently way too dry to let fires burn. Wildfires at this time will burn too hot, too fast, and for too long. Instead of recycling nutrients back to grow new plants, the high intensity burns would kill mature trees and land recovery. The drought condition in the Preserve was never part of the "natural" sequence of Big Cypress. For at least the past 100 years, humans have done things to intentionally dry out parts of the Preserve. Whether it was for logging, farming, or real estate development, water was removed from the landscape. When you add a drought on top of the human-caused changes making it this dry, even the peat catches fire as well as exposing the root structure of the trees to too much heat, causing them to die.<sup>91</sup>

Severe droughts have affected Big Cypress National Preserve and these events can directly lead to desiccation and death of individual ghost orchids. In 2020, Big Cypress experienced one of its driest periods and most significant rainfall deficits in nearly a century:

One of the meteorologists at the [South Florida Water Management] district characterized the month of March as showing ‘exceptional, long-lived, unprecedented dryness’,” said John Mitnik, chief engineer at the South Florida Water Management District... The region is heading into dangerous weather territory as the first three months of the year were the hottest on record, creating conditions for soil collapse in the Everglades and sea grass die-offs in Florida Bay. March [2020] was the hottest month on record for Florida, with an average of just 0.24 inches of rain — the driest in 89 years,

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<sup>86</sup> Clem, S.E., and B. Cornell. 2021. Investigations of observed drier conditions in long-term data at Lettuce Lake by National Audubon Society’s Corkscrew Swamp Sanctuary. Final Report to South Florida Water Management District at 4-5, 42.

<sup>87</sup> Clem and Duever. 2019 at 366.

<sup>88</sup> See SFWMD. 2018. Lower West Coast Water Supply Plan Update Planning Document/Appendices. West Palm Beach, FL. Accessible from: [https://www.sfwmd.gov/sites/default/files/documents/2017\\_est\\_water\\_use\\_report.pdf](https://www.sfwmd.gov/sites/default/files/documents/2017_est_water_use_report.pdf).

<sup>89</sup> Main, D. 2019 at 3.

<sup>90</sup> Angelo, C. 2021. Letter to George Gann, September 13, 2021.

<sup>91</sup> Big Cypress National Preserve News Release, Release Date: April 14, 2020, 8:09 pm.

according to the Water Management District... Big Cypress National Preserve was among the areas with the biggest rainfall deficit, Mitnik said.<sup>92</sup>

*ii. Recreational impacts and trail expansion threatens to destroy or alter orchid habitat.*

Recreational use of key western Everglades habitats, including motorized access (e.g., off-road vehicle or ORV use) and non-motorized access (e.g., hiking, camping, eco-touring, backcountry recreation, on-foot hunting) both on and off informal trails or in the vicinity of established trails, directly and indirectly impact ghost orchid habitats.

Direct impacts include increased accessibility to ghost orchid populations and the accompanying threat of poaching<sup>93</sup> (i.e., overcollection and illegal collection of ghost orchid plants, such as has occurred in protected areas as specified in section B) which results in directly reducing subpopulation size, overall subpopulation growth rate, and in turn can reduce resiliency. For example, in Big Cypress National Preserve, while no formal trails to ghost orchid habitat have been established by the Preserve's management, orchid subpopulation sites are nonetheless accessible and informal trails to access ghost orchids have been established by Preserve visitors.<sup>94</sup> These specific informal trails to access ghost orchid habitat have even been established to the degree that visitors have utilized flagging tape to mark trails<sup>95</sup> and made clear pathways across the habitat. Not only do informal trail networks have the potential to directly contribute to increased poaching events<sup>96</sup> but additionally contribute to habitat degradation in the Preserve<sup>97</sup> and are broadly known to have additional indirect effects to habitat, as discussed in detail below.

If informal and formal trail networks continue to expand within ghost orchid habitat, this could directly result in destruction of suitable habitat for ghost orchids, in addition to the habitat degradation that is already occurring.<sup>98</sup> This degradation typically includes habitat modification by way of alteration of microclimates, localized hydrologic patterns, and edge effects;<sup>99</sup> and possible alteration of community and functional composition.<sup>100</sup> Habitat

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<sup>92</sup> Miami Herald. 2020. "March was the driest on record. Can the Everglades cope?" Miami Herald, April 14, 2020. Online at: [Everglades may suffer after record dry March in South Florida | Miami Herald](#).

<sup>93</sup> See Section IV for further discussion of the poaching threat; see also Wraith, J., and C. Pickering. 2017. Tourism and recreation a global threat to orchids. *Biodiversity and Conservation*, 26(14), 3407-3420.

<sup>94</sup> Angelo, C. 2021b. Email communication to G.D. Gann, October 12, 2021.

<sup>95</sup> *Id.*

<sup>96</sup> Wraith and Pickering. 2017 at 3413-15.

<sup>97</sup> Personal communication via email, C. Angelo to G. Gann, October 12, 2021.

<sup>98</sup> *Id.*

<sup>99</sup> Ballantyne M., and C.M. Pickering. 2015. Recreational trails as a source of negative impacts on the persistence of keystone species and facilitation. *J Environ Manage*. 2015 Aug 15; 159:48-57. doi: 10.1016/j.jenvman.2015.05.026; Yan, X., W. Bao, and X. Pang. 2014. Indirect effects of hiking trails on the community structure and diversity of trunk-epiphytic bryophytes in an old-growth fir forest. *Journal of Bryology*, 36(1), 44-55.

<sup>100</sup> Ballantyne 2015 (entire).



degradation caused by non-motorized trail usage in protected areas is well-documented, and includes impacts associated both with formal and informal trail networks.<sup>101</sup> Numerous observation- and experiment- based studies<sup>102</sup> have demonstrated that vegetation is trampled, damaged, and sometimes killed or uprooted as a result of trail use, and this can be especially impactful at the landscape scale in habitats where unregulated use of “informal” trails or backcountry access is common,<sup>103</sup> as it is in ghost orchid habitats such as Big Cypress National Preserve and Fakahatchee Strand Preserve State Park. Ghost orchids are indirectly impacted when host tree seedlings are trampled, or not able to recruit into trampled and compacted soils. Furthermore, given the importance of specific microclimatic conditions - including long-hydroperiod, canopied, forest wetland habitats containing a small set of host tree species - to the persistence and reproduction of ghost orchids, additional habitat modification caused by trail use such as edge effects, fragmentation, and localized hydrologic alterations have high likelihood of impacting ghost orchid subpopulations. Edge effects generally include alterations to abundance, behavior, or reproduction of species adjacent to the edges (typically up to about 50 meters away from edges)<sup>104</sup> and there is evidence that pollinators may decline in abundance and alter their flower visitation behavior.<sup>105</sup> One study that examined the effects of proximity to pathway edges on the reproductive success of two orchid species within a protected area found that plants closer to pathways had significantly lower reproductive success.<sup>106</sup>

Ghost orchids are also directly and imminently threatened by the potential expansion of new and re-opened off-road vehicle (ORV) trails and backcountry access trails in Big Cypress National Preserve.<sup>107</sup> In October 2020, the National Park Service (NPS) released a Draft Environmental Impact Statement (DEIS) for the Big Cypress National Preserve’s Backcountry Access Plan (BAP) wherein its preferred alternative would cause damage to wetlands and habitat by allowing for newly developed and re-opened trails to occur in 2,654 acres of the Preserve, including at least 12 miles of newly developed motorized-use

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<sup>101</sup>See, e.g., Cole, D.N. 2004. Impacts of hiking and camping on soils and vegetation: a review. In: Buckley, R. (Ed.), *Environmental Impacts of Ecotourism*. CABI Publishing, New York, pp. 41–60; Barros, A., and C.M. Pickering. How networks of informal trails cause landscape level damage to vegetation. *Environmental Management* 60, 57–68 (2017). <https://doi.org/10.1007/s00267-017-0865-9>.

<sup>102</sup> *Id.*

<sup>103</sup> Barros 2017 at 63–65.

<sup>104</sup> Murcia, C. 1995. Edge effects in fragmented forests: implications for conservation. *Trends in Ecology and Evolution* 10 at 58–63.

<sup>105</sup> Liu, H. and S. Koptur. 2003. Breeding system and pollination of a narrowly endemic herb of the lower Florida Keys: impacts of the urban–wildland interface. *American Journal of Botany* 90, 1180–87; Aguilar, R., *et al.* 2006. Plant reproductive susceptibility to habitat fragmentation: review and synthesis through a meta-analysis. *Ecology Letters* 9, 968–80.

<sup>106</sup> Huang, B., *et al.* 2009. Impact of proximity to a pathway on orchid pollination success in Huanglong National Park, South-West China. *Biological Conservation* 142.4 (2009): 701–708.

<sup>107</sup> See *Nat’l Parks Conservation Ass’n v. U.S. Dep’t of the Interior*, 835 F.3d 1377 (11th Cir. 2016).

trails cut into one area of the Preserve that overlaps directly with at least one subpopulation of ghost orchids.<sup>108</sup> The NPS preferred alternative seeks to:

...expand the hiking trail system by 51 miles. It would also open 66 additional miles of primary ORV trails and 154 miles of secondary ORV trails... However, more miles of trail would traverse least resilient to unsuitable substrates under this alternative than under alternative 4. A total of 203 additional backcountry destinations would be opened. Dispersed camping would be allowed in all of the preserve's management zones, and as in alternatives 2, 3, and 4, the camping stay limit would be 14 consecutive days. No reservation system would be implemented for camping, and the annual 60-day ORV closure would be lifted.<sup>109</sup>

Opening up new motorized and non-motorized trails will exacerbate well-known damaging impacts to habitat and specifically to ghost orchid habitat and microclimate in particular: Duever et al. (1981) found that established ORV trails through swamps (and sloughs) had some of the deepest ruts of all vegetation types, and that typically trails were worn down to bedrock and filled with standing water. ORV use has been shown to alter plant community structure, likely by altering the period of time and depth of inundation along rutted or trampled areas, in addition to potentially increasing the amount of sunlight caused by tree or shrub canopy removal within ORV use areas.<sup>110</sup>

In its DEIS, NPS acknowledges that ORVs demonstrably impact Big Cypress National Preserve habitats. Increased sunlight, and tree, shrub, or canopy removal can all directly degrade ghost orchid habitat. Impacts of ORVs outside of the southwestern Everglades, such as in other national park units and protected areas, are well-documented.<sup>111</sup> Prior to the release of the DEIS, a well-documented history of ORV use impacting habitat occupied by rare species was already established.<sup>112</sup> The network of tire-caused soil ruts and ridges

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<sup>108</sup> National Park Service. 2020. Big Cypress National Preserve Backcountry access plan / draft Environmental Impact Statement, October 2020, at xiii.; Abdo, M. 2021. Personal communication.

<sup>109</sup> *Id.* at xiii., emphasis added.

<sup>110</sup> *Id.* at 86-87.

<sup>111</sup> Ingle, C., *et al.* 2003. Monitoring visitor impacts in coastal national parks: A review of techniques. In Proceedings of the George Wright Society and National Park Service Joint Conference (pp. 228-233); Schlacher, T.A., D. Richardson, and I. McLean. 2008. Impacts of off-road vehicles (ORVs) on macrobenthic assemblages on sandy beaches. *Environmental Management*, 41(6), 878-892; Arp, C.D., and T. Simmons. 2012. Analyzing the impacts of off-road vehicle (ORV) trails on watershed processes in Wrangell-St. Elias National Park and Preserve, Alaska. *Environmental management*, 49(3), 751-766.

<sup>112</sup> See NPCA et al. comments on the Backcountry Access Plan Draft Environmental Impact Statement for Big Cypress National Preserve, Submitted to NPS on Dec. 15, 2020. See also Duever M.J., *et al.* 1981. Off-road vehicles and their impacts in the Big Cypress National Preserve. National Park Service, South Florida Research Center,

that ORVs create can influence the volume, timing, and distribution of surface water flows in the vast wetlands that comprise Big Cypress,<sup>113</sup> and have elsewhere been shown to harm ecological processes at the watershed scale.<sup>114</sup> Specifically, soil ruts caused by ORV use, which can be two or more feet deep, can channel water and alter natural water flow patterns and timing. Duever, *et al.* found that over wet and dry seasons, water flows accelerated from two to four times in trails oriented parallel to the direction of water flows.<sup>115</sup> Flows in some trails continued after water had ceased flowing in surrounding areas, possibly leading to a shortened natural hydroperiod in a localized area.<sup>116</sup>

Based upon the well-documented hyper-specific microclimatic habitat of ghost orchids in Florida,<sup>117</sup> if NPS' plan to expand ORV trails proceeds, it is likely that even indirect effects of ORV trail expansion will affect local hydrology, hydroperiods, and microclimates, which could lead to desiccation and increased mortality of ghost orchid plants in Big Cypress National Preserve. Furthermore, this could in turn lead to loss of redundancy for the Florida subpopulations overall, through compounding factors arising from decrease in resilience of the species in its ecological settings in Big Cypress, loss of numbers within each subpopulation, and decreased connectivity caused by increased habitat fragmentation and reduction of closed-canopy swamp habitat that could be caused by expansion of ORV trails.<sup>118</sup>

Protected areas are seeing massive increases in visitation, with Big Cypress National Preserve's visitor numbers doubling over the last decade: the National Park Service estimates that 1.2 million visitors experienced the Preserve in 2020 alone.<sup>119</sup> Despite the massive increases in visitation, over the last decade the National Park Service has

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Everglades National Park; Duever, M.J., *et al.* 1986. Long term recovery of experimental off-road vehicle impacts and abandoned old trails in the Big Cypress National Preserve. Report SFRC-86/09, Everglades National Park. Homestead; Sobczak, R.V., and A.J. Pernas. 2002. Re-evaluation of off-road vehicle management in Big Cypress National Preserve, Florida, after twenty-six years of management. *Florida Scientist* (2002): 100-114.

<sup>113</sup> See National Park Service. 2000. Final recreational off-road vehicle management plan, supplemental environmental impact statement, Big Cypress National Preserve, Florida, at 86 and including references therein starting at 585, especially Duever *et al.* 1981.

<sup>114</sup> See Arp and Simmons. 2012 at 764-65.

<sup>115</sup> Duever, *et al.* 1981 at 190.

<sup>116</sup> *Id.*

<sup>117</sup> See *supra* III.d.

<sup>118</sup> Definition of redundancy evaluated herein follows U.S. Fish and Wildlife Service. 2016.

<sup>119</sup> See 2010 NPS visitation data in: Styne, D.J. 2011. Economic benefits to local communities from national park visitation and payroll, 2010. Natural Resource Report NPS/NRSS/EQD/NRR—2011/481. National Park Service, Fort Collins, Colorado; See 2020 NPS visitation data in: National Park Service. 2021. 2020 National Park visitor spending effects - economic contributions to local communities, states, and the nation. Natural Resource Report NPS/NRSS/EQD/NRR—2021/2259.

experienced roughly a 14% reduction in staffing overall.<sup>120</sup> Fakahatchee Strand Preserve State Park is Florida's largest state park yet in 2019 only had 5 staff members while receiving over 95,000 visitors.<sup>121</sup> These figures are indicative that trail use pressures and the expansion of backcountry access and informal trails are only likely to increase in key ghost orchid habitats and far outpace staff capacity to regulate, monitor, or mitigate associated impacts.

*iii. Invasive plant species modify and degrade ghost orchid habitat, and can overtop and kill individual plants.*

Ninety species of nonnative, invasive plants in Florida listed by the Florida Invasive Species Council have been documented in Collier County alone.<sup>122</sup> Threats of invasive plants to ghost orchid habitat have been found to be pervasive, affecting all or most (71-100%) of the total population or occurrences, and potentially degrading or reducing affected occurrences or habitats, or reducing populations by up to 10%.<sup>123</sup>

Highly competitive invasive plant species, like *Lygodium microphyllum*, can overtop and kill canopy trees, including host trees, and potentially kill ghost orchid plants by smothering them. Invasive species can take advantage of disturbances including those created by hurricanes, storms, and off season fire, or can exacerbate fire intensity.<sup>124</sup>

The nonnative emerald ash borer (*Agrilus planipennis*) could potentially pose a threat to the ghost orchid by killing one of its two principal host trees, pop ash (*Fraxinus carolinianus*), but it has not yet been recorded in Florida.<sup>125</sup>

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<sup>120</sup> National Parks Conservation Association. 2020. Press Release February 20, 2020. Parks experience record visitation while dealing with staff cuts and growing maintenance backlog. <https://www.npca.org/articles/2469>.

<sup>121</sup> Florida State Parks Foundation. 2019. Fakahatchee Strand Preserve State Park fact sheet. <https://www.floridastateparksfoundation.org/resources/Documents/2019%20Park%20Impact%20Sheets/Fakahatchee%20Strand%20Preserve%20State%20Park.pdf>.

<sup>122</sup> Wunderlin, R.P., *et al.* 2020b. Atlas of Florida Plants (<http://florida.plantatlas.usf.edu/>); S.M. Landry and K.N. Campbell (application development), USF Water Institute. Institute for Systematic Botany, University of South Florida, Tampa. Accessed December 8, 2021; Florida Invasive Species Council. 2022. <https://floridainvasivespecies.org/index.cfm>. Accessed January 20, 2022. Florida Invasive Species Council was previously known as the Florida Exotic Pest Plant Council.

<sup>123</sup> NatureServe. 2021b.

<sup>124</sup> *Id.*

<sup>125</sup> Ray, H., and J.L. Gillette-Kaufman. 2019. Featured creatures: emerald ash borer. University of Florida. [https://entnemdept.ufl.edu/creatures/TREES/BEETLES/emerald\\_ash\\_borer.htm](https://entnemdept.ufl.edu/creatures/TREES/BEETLES/emerald_ash_borer.htm). Accessed August 5, 2021.

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

### *i. Poaching pressure has been ongoing for decades.*

Over collecting, including illegal poaching, is a major cause for the decline of orchid species worldwide,<sup>126</sup> and in the southeastern United States particularly.<sup>127</sup> Due to its beauty and rarity, the ghost orchid has long been prized by collectors in Florida, and instructions for how to collect them from the wild were published as part of Donovan Correll's 1950 book *Native Orchids of North America North of Mexico*.<sup>128</sup> Population declines due to over collecting, coupled with habitat degradation and loss, have long been documented by the State of Florida.<sup>129</sup> Difficulty in growing the plant historically increased collecting pressure.<sup>130</sup> A popular non-fictional book, published in 1998 by Susan Orlean ("The Orchid Thief") and the subsequent 2002 fictional film ("Adaptation" starring Nicolas Cage and Meryl Streep) brought popular attention to the species and its habitat in the Fakahatchee Strand and the threat poaching poses to it.<sup>131</sup> Ten out of the 125 individual orchids (8%) monitored in the Fakahatchee since 2005 have been poached.<sup>132</sup> While recent efforts to grow *D. lindenii* in cultivation have been successful,<sup>133</sup> and it is now offered commercially in the United States,<sup>134</sup> illegal collecting continues. Poaching of many individuals in at least one documented subpopulation of ghost orchids was perpetrated in Big Cypress National Preserve during the summer of 2020.<sup>135</sup> This poaching event resulted in a significant reduction in the number of individuals within the subpopulation.<sup>136</sup> The

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<sup>126</sup> Fay, M.F. 2018. Orchid conservation: how can we meet the challenges in the twenty-first century? *Bot. Stud.* 59, 16.

<sup>127</sup> Swarts, N.D., and K.W. Dixon. 2009a. Terrestrial orchid conservation in the age of extinction. *Ann. Bot.* 104, 543–56.

<sup>128</sup> Correll, D.S. 1950 at 377.

<sup>129</sup> Langdon, K.R. 1979 (entire).

<sup>130</sup> *Id* at 2. ("The spectacular flowers of this plant have made it a prize of collectors. Unfortunately it is difficult to grow in cultivation, resulting in death of a very high percentage of collected plants. This loss often results in the collector obtaining more plants from the woods to replace the dead ones. Such collecting, losses, and recollecting plus development and other land clearing operations resulting in habitat destruction are seriously depleting the numbers of this very attractive species.").

<sup>131</sup> Regan, K.E. 2004. The need for a comprehensive approach to protecting rare plants: Florida as a case study. 44 *Nat. Resources J.* 125 (2004) at 133; Zettler et al. 2019 at 136-37.

<sup>132</sup> Owen, M. 2021 personal communication; Levy, A. 2016. Ghost orchid: protecting the rare ghost orchid. *Florida Trend*, 11/28/2016.

<sup>133</sup> Hoang, *et al.* 2017 (entire).

<sup>134</sup> See for example, Orchidweb.com. 2021. <https://www.orchidweb.com/orchids/other-orchids/species/dendrophylax-lindenii-the-ghost-orchid>. Accessed December 8, 2021.

<sup>135</sup> Forsyth, T. 2021.

<sup>136</sup> *Id.*

poaching event is also believed to have damaged host tree species and had been accompanied by the removal of other state-listed epiphytes.<sup>137</sup>

*ii. Overutilization of recreational areas in ghost orchid habitat, and unregulated visitor access to orchids, can lead to numerous harmful effects likely to damage or degrade habitat and individual plants.*

An increasingly significant threat is caused by unregulated visitor activity, including professional commercial photography ventures, during the bloom period.<sup>138</sup> Social media pages and posts celebrate and draw attention to the ghost orchid.<sup>139</sup> Although cautions are sometimes stated, such as not spraying mosquito repellent on your hands and then touching the flowers or making sure to remove coordinates in photo metadata,<sup>140</sup> there is no formal enforcement of these precautionary measures and the overall message is that visiting flowering ghost orchids is acceptable and will not cause harm. This is, however, contrary to best-available data that demonstrates that visiting rare orchid habitat sites can lead to the degradation of those habitats, and celebrating such activity can further amplify the market-side demand for the orchids which in turn increases orchid poaching.<sup>141</sup> While the effects of high levels of visitation to ghost orchid habitat in southwestern Florida have not yet been studied in detail, documentation of high levels of visitor activity<sup>142</sup> and damaging activities, such as touching flowers,<sup>143</sup> are readily posted on social media. In Big Cypress National Preserve, park staff have observed people placing ladders and climbing trees to get better photographs, resulting in damage to tree bark and epiphytes including ghost orchid seedlings.<sup>144</sup> Scientific understanding of the impacts of visitation to intact habitats indicate that numerous potential harmful effects could be introduced or exacerbated. Such potential harmful effects include physically damaging flowers or plants, killing or discouraging potential pollinators, transferring diseases, acting as dispersal agents for invasive organisms (which are known to be a major problem throughout the range of the orchid, and known to displace rare species in their habitats), and changing local hydrology through soil compaction and channeling along informal pathways.

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<sup>137</sup> *Id.*

<sup>138</sup> NatureServe. 2021b.

<sup>139</sup> See for example Ghost Orchid Facebook Group (2021a)

<https://www.facebook.com/groups/1794395230806054>. Accessed December 8, 2021.

<sup>140</sup> See for example Ghost Orchid Facebook Group (2021b).

<https://www.facebook.com/groups/1794395230806054/permalink/1797916927120551/>. Accessed December 8, 2021.

<sup>141</sup> Mackenzie, S., and D. Yates. 2016. Collectors on illicit collecting: Higher loyalties and other techniques of neutralization in the unlawful collecting of rare and precious orchids and antiquities. *Theoretical Criminology*, 20(3), 340-357.

<sup>142</sup> See for example Ghost Orchid Facebook Group. 2021a.

<sup>143</sup> Mayorca, A. 2010. <https://www.flickr.com/photos/atahuay/4932995748/in/album-72157624695339379/> Accessed December 9, 2021.

<sup>144</sup> Email communication from A. Pernas to George Gann, January 6, 2022.

### C. Disease or predation

Ghost orchids are vulnerable to introduced pest insects, including soft scales (*Pulvinaria* spp.) and mealy bugs (*Ferrisia* spp.), which were documented on the inflorescences of a wild population in Naples, Florida in 2009.<sup>145</sup> High winds (e.g., hurricanes) may play a role in the dispersal of these insects from contaminated material in nearby urban areas and cultivated fields.<sup>146</sup>

### D. Inadequacy of existing regulatory mechanisms

Existing federal, state, and local regulatory mechanisms are inadequate to protect against threats to the ghost orchid, which include habitat destruction and degradation, poaching, disease and predation, and climate change. Existing mechanisms have not stemmed the decline of ghost orchid populations in Florida due to poaching, habitat loss, and habitat degradation.

Florida's ghost orchids are mostly found in national wildlife refuges, a national preserve, state preserves and state forest, and private conservation lands like Audubon's Corkscrew Swamp Sanctuary,<sup>147</sup> and are therefore largely protected from the *direct* impacts of *most* development. However, they are not adequately protected from *direct* impacts of habitat destruction, *indirect* impacts of development, or threats that persist in conservation lands, including sea level rise and other impacts of climate change. Moreover, poaching on public land remains a threat to the species,<sup>148</sup> and protection from the collection, transport, and sale does not appear to be effectively mitigated by existing laws regulating<sup>149</sup> the collection of plants from federal, state, local, and private lands where orchids occur, including the state-level Preservation of Native Flora of Florida statute<sup>150</sup> nor by federal laws aimed at enhancing the protection status of conservation lands, such as the Wilderness Act.<sup>151</sup>

#### *State Regulatory Mechanisms*

The Preservation of Native Flora of Florida statute (PNFFS)<sup>152</sup> and the related Endangered Plant Advisory Committee statute (EPACS)<sup>153</sup> are the primary state legal protections for

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<sup>145</sup> Zettler, J.A., *et al.* 2012. Pestiferous scale insects on native epiphytic orchids in South Florida: A new threat posed by introduced species. *Southeastern Naturalist* 11(1):127-34.

<sup>146</sup> *Id.*

<sup>147</sup> Gann, *et al.* 2021.

<sup>148</sup> *Supra* V.B.i.

<sup>149</sup> See, for example, the National Park Service Organic Act (16 U.S.C. § 1-4) and the General Authorities Act of 1970 (16 U.S.C. § 1a-1, *et seq.*) for National Parks and Preserves, 50 CFR § 27.51 and 27.52 for National Wildlife Refuges, F.A.C. 62D-2.013 for State Parks, and F.A.C. 5I-4 for State Forests.

<sup>150</sup> *Supra* V.B.i.

<sup>151</sup> *Supra* poaching section (V.B.i).

<sup>152</sup> F.S. §581.185.2021.

<sup>153</sup> *Id.*

rare plants in Florida.<sup>154</sup> These statutes regulate the “harvesting”<sup>155</sup> and commercial exploitation of listed, protected plant species, including *D. lindenii*.<sup>156</sup>

The PNFFS was intended to “provide recognition of those plant species native to the state that are endangered, threatened, or commercially exploited.”<sup>157</sup> The statute provides for the goal of protecting native flora from unlawful harvesting on both public and privately-owned lands. It also establishes a permitting system in an effort to “provide an orderly and controlled procedure for restricted harvesting of native flora from the wild, thus preventing wanton exploitation of native species of flora.”<sup>158</sup> The Florida Department of Agriculture and Consumer Services administers the PNFFS. The department is authorized to adopt rules relating to the “listing, delisting, and changing from one category to another category any plant on the regulated plant index.”<sup>159</sup> The regulated plant index is the list of plant species that are designated as “endangered,”<sup>160</sup> “threatened,”<sup>161</sup> or “commercially exploited”<sup>162</sup> by the department.<sup>163</sup> The ghost orchid is listed as endangered.<sup>164</sup> The Endangered Plant Advisory Council, a committee created by the EPACS, consists of seven members and has specified duties.<sup>165</sup> These duties include advising the department about proposals for revising the two statutes, reviewing the species on the regulated plant index, and considering native plants proposed for inclusion.<sup>166</sup>

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<sup>154</sup> Regan, K.E. 2003. Protecting Florida's rare plants from extinction, 77 Fla. B.J. 70, 72–73 (July/August 2003); Regan. 2004 at 143.

<sup>155</sup> Under the PNFFS, “harvest” means “to dig up, remove, or cut and remove from the place where grown.” F.S. § 581.185(2)(c).

<sup>156</sup> Regan. 2004 at 143.

<sup>157</sup> F.S. §581.185(1).

<sup>158</sup> *Id.*

<sup>159</sup> F.S. §581.185(4).

<sup>160</sup> Endangered plants are defined as “species of plants native to the state that are in imminent danger of extinction within the state, the survival of which is unlikely if the causes of a decline in the number of plants continue.” F.S. § 581.185(2)(b). This definition also includes “all species determined to be endangered or threatened pursuant to the federal Endangered Species Act of 1973, as amended.”

<sup>161</sup> Threatened plants are defined as “species native to the state that are in rapid decline in the number of plants within the state, but which have not so decreased in such number as to cause them to be endangered.” *Id.* at § 581.185(2)(h).

<sup>162</sup> Commercially exploited plants are defined as “species native to the state which are subject to being removed in significant numbers from native habitats in the state and sold or transported for sale.” *Id.* at § 581.185(2)(a). This category represents a broader level of protection than that of the ESA, regulating plants that are not yet designated as threatened or endangered.

<sup>163</sup> F.S. §581.185(2)(f). This list of protected plants can be accessed at Fla. Admin. Codes 5B-40.0055 (2020).

<sup>164</sup> 5B-40.0055 (2020) Regulated Plant Index.

<sup>165</sup> F.S. §581.186.

<sup>166</sup> F.S. §581.186(3).



Under the PNFFS, it is unlawful for any person to willfully destroy or harvest any plant listed as endangered on the regulated plant index that is growing on private or public land without first obtaining the written permission of the landowner or legal representative of the landowner<sup>167</sup> and a permit from the department.<sup>168</sup> However, PNFFS does not prohibit landowners from destroying protected plants on their own property.<sup>169</sup> Threatened species under the PNFFS are afforded less protection than endangered species because no permit is required.<sup>170</sup> In the case of plants designated as commercially exploited, permission from the landowner is required to harvest any plants, but a permit is only required if three or more plants are harvested.<sup>171</sup> Thus, the protections available for commercially exploited plants are stronger than those for threatened plants.<sup>172</sup>

The PNFFS limits the transport and sale of protected plants, and these limitations even apply to private landowners, but threatened species are not subject to this requirement.<sup>173</sup> Moreover, the PNFFS states that the regulated plant index is “not to be used to regulate construction or other land alteration activities on any property,”<sup>174</sup> which are the most pressing threats to the ghost orchid and its habitat.<sup>175</sup> The clearing or other disturbances of land for agricultural, silvicultural, mining assessment, or fire control purposes are exempt from the statute,<sup>176</sup> making it altogether ineffectual in the face of the challenges faced by the ghost orchid; the statute provides no protection from the activities that destroy habitat and individual orchids.<sup>177</sup> A significant limitation of Florida’s rare plant protection statutes is that they only attempt to regulate the harvesting and commercial exploitation of rare plants as opposed to providing comprehensive protection for rare plant species and their habitats.<sup>178</sup> The protected status afforded to plants listed on the regulated plant index, including the ghost orchid, can only be used for regulating the harvesting of plants. The EPACS states in F.S. §581.186(3):

The regulated plant index must be used solely for the purposes specified in §581.185 and may not be used for regulatory purposes by other agencies.

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<sup>167</sup> Florida requires permission when the landowner is the state and is the only state that specifically requires such permission. See Rachlinski, J.J. 1998. Protecting endangered species without regulating private landowners: The case of endangered plants, 8 Cornell J.L. & Pub. Pol’y 1, 11 (1998) at 13.

<sup>168</sup> F.S. § 581.185(3)(a). However, permits issued for federally listed species must be consistent with federal standards. *Id.*

<sup>169</sup> It does, however, prohibit the landowner from selling protected plants harvested from his or her property without the appropriate permit. *Id.* § 581.185(3)(d).

<sup>170</sup> F.S. § 581.186(3)(b).

<sup>171</sup> F.S. § 581.186(3)(c).

<sup>172</sup> Regan. 2004 at 146.

<sup>173</sup> F.S. § 581.185(3)(d).

<sup>174</sup> F.S. § 581.185(12).

<sup>175</sup> Main, D. 2019 at 2.

<sup>176</sup> F.S. § 581.185(8).

<sup>177</sup> Regan. 2004 at 146.

<sup>178</sup> *Id.*

However, this section does not preclude another agency *authorized to protect endangered plants* from including one or more species listed on the regulated plant index on a list developed by that agency under its own regulatory authority (emphasis added).

This language severely limits the use of the regulated plant index for conservation purposes by other agencies. Florida agencies typically involved with conservation programs, such as the Department of Environmental Protection or the Fish and Wildlife Conservation Commission, do not have authority to list plant species. Thus, these agencies cannot use the regulated plant index as a basis for decision-making or conservation programs, including in reviewing permits to impact wetlands. Although the statute provides for cooperation between relevant state agencies with the Endangered Plant Advisory Council,<sup>179</sup> the extent of this cooperation has been limited.<sup>180</sup>

#### *Federal Regulatory Mechanisms*

The Clean Water Act, National Environmental Policy Act, National Park Service Organic Act, Wilderness Act, and federal regulatory mechanisms are inadequate to protect the ghost orchid from extinction.

Congress enacted the Clean Water Act to restore and maintain the “chemical, physical and biological integrity” of waters of the United States.<sup>181</sup> To attain that goal, it prohibits the discharge of pollutants into U.S. waters without a permit.<sup>182</sup> The United States Army Corps of Engineers (“the Corps”) may issue permits for projects that will require the dredging or filling of material into “waters of the United States,” under Section 404 of the Clean Water Act. In reviewing a Section 404 permit, the Corps applies Clean Water Act Section 404(b)(1) Guidelines, which specify where and under what conditions dredged or fill material can be discharged lawfully.<sup>183</sup>

The state of Florida submitted its application to assume 404 permitting from the federal government to the U.S. Environmental Protection Agency (EPA) on August 20, 2020 calling for the Florida Department of Environmental Protection to assume dredge and fill permitting for “waters of the United States” in Florida not retained by the Corps, which would retain permitting authority projects in tidal waters and adjacent wetlands within a 300-foot administrative boundary.<sup>184</sup> On December 17, 2020, EPA announced it was

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<sup>179</sup> *Id.* at § 581.186(4).

<sup>180</sup> F.S. § 581.186(3).

<sup>181</sup> 33 U.S.C. § 1251.

<sup>182</sup> *Id.* § 1311(a).

<sup>183</sup> 40 C.F.R. § 230.10(b).

<sup>184</sup> The Florida legislature passed HB 7043 “State Assumption of Federal Section 404 Dredge and Fill Permitting Authority” giving the Florida Department of Environmental Protection the authority to adopt rules and assume Section 404 permitting. Fla. Stat. 373.4146.

approving Florida’s application at a press conference,<sup>185</sup> and on December 22, 2020 published a notice of its approval of Florida’s application.<sup>186</sup>

Following EPA’s approval of Florida’s application, the Corps immediately transferred 591 applications to the Florida Department of Environmental Protection, 211 of which were transferred back to the Corps because they were requests for Approved Jurisdictional Determinations, which the Department is not performing.<sup>187</sup> In the past, the Florida Department of Environmental Protection reported that it was not resourced to handle the additional workload of Section 404 permitting,<sup>188</sup> and that “the boundaries between navigable and non-navigable waters are not clearly defined in many waters” in Florida, and therefore it would “not [be] able to assume the federal program in large portions of the state.”<sup>189</sup>

This transfer in authority will impact wetlands, and by extension, ghost orchid habitat in several ways. First, EPA regulations specify that the state’s *mens rea* not be greater than the “burden of proof and degree of knowledge or intent” that EPA uses to bring actions under the Clean Water Act,<sup>190</sup> i.e., “negligence.”<sup>191</sup> But Florida’s standard instead requires gross or culpable negligence,<sup>192</sup> which could weaken the deterrent effect of the Clean Water Act’s enforcement mechanisms and potentially shield those who violate Section 404 in Florida from liability. Also, on August 31, 2021, the U.S. District Court for the District of Arizona vacated “The Navigable Waters Protection Rule: Definition of ‘Waters of the United States’” (NWPR), a rule by the Trump administration that effectively severely curtailed the reach of the Clean Water Act.<sup>193</sup> By September 16,

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<sup>185</sup> EPA. Dec. 17, 2020. *EPA Approves Florida’s Request to Administer the Clean Water Act Section 404 Program*. <https://youtu.be/QLUr-sMRRmo>.

<sup>186</sup> 85 Fed. Reg. 83,553.

<sup>187</sup> Gillis, C. Aug. 15, 2021. *Wetland permits seem to rise since state took over Clean Water Action section*. Fort Myers News-Press.

<sup>188</sup> Florida Department of Environmental Protection. Sept. 30, 2005. *Consolidation of State and Federal Wetland Permitting Programs Implementation of House Bill 759* (Chapter 2005-273, Laws of Florida).

<sup>189</sup> *Id.* at 8.

<sup>190</sup> 40 C.F.R. § 233.41(b)(2).

<sup>191</sup> 33 U.S.C. § 1319(c)(1) (“[a]ny person who ... negligently violates” a permit issued by the Corps or a state under Section 404 “shall be punished.”) *See United States v. Maury*, 695 F.3d 227, 259 (3d Cir. 2012); *United States v. Pruett*, 681 F.3d 232, 243 (5th Cir. 2012); *United States v. Ortiz*, 427 F.3d 1278, 1283 (10th Cir. 2005); *United States v. Hanousek*, 176 F.3d 1116, 1120 (9th Cir. 1999).

<sup>192</sup> *See* Fla. Stat. §§ 373.430(1)(a), 373.430(3)–(4) (requiring willfulness, reckless indifference, or gross careless disregard to establish criminal liability for a pollution offense); *id.* §§ 373.430(1)(b)–(c), 373.430(5) (requiring willfulness to establish criminal liability for permit violations and false statements).

<sup>193</sup> *Pasqua Yaqui Tribe, et al. v. United States Env’t Prot. Agency, et al.*, No. CV-20-00266-TUC-RM, 2021 WL 3855977, at \*5 (D. Ariz. Aug. 30, 2021) (finding the NWPR had substantially reduced the number of waterways, including wetlands, protected under Section 404 of the Clean Water Act as compared to prior rules and practices.).

2021, EPA and the Corps announced that they had “halted implementation” of the NWPR in light of the court’s ruling on a nationwide basis,<sup>194</sup> yet Florida continues to apply the now-vacated-as-unlawful NWPR as to the assumable waters in its jurisdiction, meaning that it is unlawfully excluding from Section 404 regulation waterways covered again by the Clean Water Act.<sup>195</sup> On October 21, 2021, FDEP acknowledged this position at a hearing before the Florida House of Representatives’ Environment, Agriculture & Flooding Subcommittee.<sup>196</sup>

With authority to permit development of wetlands transferred to the state, there will no longer be any National Environmental Policy Act (NEPA) analysis for individual 404 permits. Furthermore, serious questions remain as to how the state will fulfill Section 7 Endangered Species Act consultation requirements to ensure that activities authorized under 404 permits do not jeopardize species or adversely modify their critical habitat. On January 14, 2021, conservation groups filed a lawsuit against EPA, U.S. Fish and Wildlife Service, and the Corps challenging EPA’s approval of Florida’s application to administer the Clean Water Act Section 404 permitting program.<sup>197</sup> The judge has yet to rule, the state continues to process Section 404 permits, as Section 404 applications appear to be on the rise.<sup>198</sup> Therefore, the protections provided under the Clean Water Act and National Environmental Policy Act are insufficient.

The Wilderness Act established a National Wilderness Preservation System to designate lands and preserve their wilderness character. The Act recognized the value of preserving “an area where the earth and its community of life are untrammelled by man, where man himself is a visitor who does not remain.”<sup>199</sup> However, the National Park Service (NPS) has not completed a Wilderness Study that encompasses the entirety of Big Cypress National Preserve, although a Wilderness Study for a portion of the Preserve known as the Addition Lands was completed in 2010. While the Wilderness Act and NPS policy<sup>200</sup> are designed specifically to “provide accountability, consistency, and continuity to the National Park Service’s Wilderness Stewardship Program, and guide the National Park Service efforts to meet the letter and spirit of the 1964 Wilderness Act”<sup>201</sup> ghost orchids have suffered from

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<sup>194</sup> <https://www.epa.gov/wotus/current-implementation-waters-united-states>.

<sup>195</sup> <https://floridaphoenix.com/blog/federal-court-ruling-could-compel-fl-to-pause-on-permitting-dredge-and-fill-of-wetlands/>;

<https://www.myfloridahouse.gov/VideoPlayer.aspx?eventID=7473>.

<sup>196</sup> <https://www.myfloridahouse.gov/VideoPlayer.aspx?eventID=7473>.

<sup>197</sup> *Center et al. v. EPA et al.*, Case 1:21-cv-00119 (D.D.C. Jan. 14, 2021); 33 U.S.C. § 1344(g)–(h).

<sup>198</sup> Gillis, C. Aug. 15, 2021. *Wetland permits seem to rise since state took over Clean Water Act section*. Fort-Myers News-Press.

<https://www.naplesnews.com/story/tech/science/environment/2021/08/15/former-dep-deputy-secretary-wetland-permits-applications-rise/5333437001/>.

<sup>199</sup> 11 U.S.C. § 1131(c).

<sup>200</sup> See Director’s Order #41: Wilderness Stewardship, National Park Service. (2013). Available online at: [https://www.nps.gov/policy/DOrders/DO\\_41.pdf](https://www.nps.gov/policy/DOrders/DO_41.pdf)

<sup>201</sup> See “Wilderness in the National Park System,” online at:

<https://home.nps.gov/yell/learn/nature/wilderness.htm>

illegal poaching within areas of Big Cypress National Preserve<sup>202</sup> and ghost orchid habitat has suffered degradation caused by unregulated recreational impacts.<sup>203</sup> These impacts have negatively affected several ghost orchid subpopulations within areas of Big Cypress, despite the spirit of the Wilderness Act which seeks to preserve wilderness character and the letter of the Act that recognizes the value of preserving “an area where the earth and its community of life are untrammled by man, where man himself is a visitor who does not remain.”<sup>204</sup>

The importance of wilderness character maintenance and restoration was highlighted in Big Cypress National Preserve’s 2000 ORV Management Plan,<sup>205</sup> which restates Congressional report findings of the preserve’s legislative history (U.S. House of Representatives 1973; U.S. Senate 1974) that “[t]he area included in the preserve is largely undeveloped at the present time and ... it will be managed in a manner which will assure its return to the true wilderness character which once prevailed.” These Congressional reports indicate an intent to limit and control uses authorized at the time the preserve was created to allow the wilderness character of the area to be restored.

Wilderness policy within NPS clearly indicates that wilderness eligible areas – such as those that encompass at least one subpopulation of ghost orchids within Big Cypress National Preserve - are to be managed in a manner that fully upholds their wilderness characteristics, regardless of not having formal wilderness designation in place: “[f]or those lands that possess wilderness characteristics, no action that would diminish their wilderness eligibility will be taken until after Congress and the President have taken final action. The superintendent of each park containing wilderness will develop and maintain a wilderness management plan or equivalent document.”<sup>206</sup> NPS further clarifies in its 2013 policy on wilderness stewardship that “[t]he NPS will apply the guidance contained in this Order [on wilderness stewardship] to all of its wilderness stewardship activities. For the purpose of applying this guidance, unless specifically noted, the term ‘wilderness’ includes the categories of eligible, proposed, recommended, and designated.”<sup>207</sup> Ghost orchid habitats such as long-hydroperiod wetland forests are found in eligible wilderness, and the fact is that several subpopulations of ghost orchids within close proximity to eligible wilderness of Big Cypress have experienced poaching or habitat degradation and face increasing threats of both motorized and non-motorized recreational access and trail

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<sup>202</sup> Supra poaching section (V.B.i).

<sup>203</sup> Supra overutilization and unregulated recreational access section (V.B.ii.)

<sup>204</sup> 11 U.S.C. § 1131(c).

<sup>205</sup> National Park Service. (2000). Final Recreational Off-Road Vehicle Management Plan Supplemental Environmental Impact Statement, United States Department of the Interior, Big Cypress National Preserve, Ochopee, FL. Online at <https://www.nps.gov/bicy/learn/management/upload/BICY-ORV-Manangement-Plan-2012-Scan.pdf> (internal citations omitted).

<sup>206</sup> Wilderness Preservation and Management, National Park Service Management Policies, National Park Service, at 77. (2006). Available online at: <https://www.nps.gov/orgs/1548/upload/ManagementPolicies2006.pdf#page=87>

<sup>207</sup> Director’s Order #41: Wilderness Stewardship (2013) at 2.

expansion;<sup>208</sup> these facts are indicative of the inadequacy of any additional protections from wilderness status that may be afforded these subpopulations of the orchids within the one national park unit where they occur.

U.S. climate policy is inadequate to meet the international Paris Agreement 1.5°C climate limit and avoid the worst damages of the climate crisis. The U.S. is the world’s biggest cumulative emitter of greenhouse gas pollution, responsible for 25% of cumulative global CO<sub>2</sub> emissions since 1870,<sup>209</sup> and is currently the world’s second highest emitter on an annual basis and highest emitter on a per capita basis.<sup>210</sup> Estimates of an equitable U.S. “fair share” of emissions reductions needed to meet a 1.5°C climate limit equate to cutting U.S. domestic emissions by at least 70% below 2005 levels by 2030 and reaching near zero emissions by 2040, paired with financial and technological support for large-scale emissions reductions internationally.<sup>211</sup> However, the United Nations *Emissions Gap Report* and the Climate Action Tracker consortium warned that U.S. policy is significantly off-track to limit warming to 1.5°C or even 2°C and must greatly accelerate greenhouse gas emissions reductions.<sup>212</sup>

As summarized by the Fourth National Climate Assessment, U.S. efforts to mitigate greenhouse gas emissions do not approach the scale needed to avoid “substantial damages to the U.S. economy, environment, and human health and well-being over the coming decades”:

Climate-related risks will continue to grow without additional action. Decisions made today determine risk exposure for current and future generations and will either broaden or limit options to reduce the negative consequences of climate change. While Americans are responding in ways that can bolster resilience and improve livelihoods, neither global efforts to mitigate the causes of climate change nor regional efforts to adapt to the impacts currently approach the scales needed to avoid substantial damages

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<sup>208</sup> Supra recreational impacts and trail expansion threats section (V.A.ii)

<sup>209</sup> Global Carbon Project, *Global Carbon Budget 2021* (2021), at 85, [https://www.globalcarbonproject.org/carbonbudget/21/files/GCP\\_CarbonBudget\\_2021.pdf](https://www.globalcarbonproject.org/carbonbudget/21/files/GCP_CarbonBudget_2021.pdf).

<sup>210</sup> *Id.* at 19-20.

<sup>211</sup> Muttitt, Greg and Sivan Kartha, *Equity, climate justice and fossil fuel extraction: principles for a managed phase out*, 20 *Climate Policy* 1024 (2020) (entire); U.S. Climate Action Network, *The U.S. Climate Fair Share* (2020), <https://usfairshare.org/background/> (entire); ActionAid USA et al., *United States of America: Fair Shares Nationally Determined Contribution* (April 2021), (entire) <https://foe.org/usa-fair-shares-ndc>.

<sup>212</sup> Climate Action Tracker, *USA Assessment* (November 4, 2021), (entire) <https://climateactiontracker.org/countries/usa/>; United Nations Environment Programme (UNEP), *Emissions Gap Report 2021: The Heat Is On – A World of Climate Promises Not Yet Delivered*, Nairobi (2021), at 15, <https://www.unep.org/resources/emissions-gap-report-2021>.

to the U.S. economy, environment, and human health and well-being over the coming decades.<sup>213</sup>

Importantly, to meet a 1.5°C limit, most U.S. and global fossil fuels must remain undeveloped including an immediate halt to new fossil fuel production and infrastructure, paired with a phase-out of existing production and infrastructure within the next several decades.<sup>214</sup>

U.S. policies that promote fossil fuel production and infrastructure include enabling fracking by exempting it from the Safe Drinking Water Act, lifting the crude oil export ban, and providing billions in government subsidies to the fossil fuel industry.<sup>215</sup> For example, after Congress lifted the 40-year-old crude oil export ban in December 2015, U.S. crude oil exports increased by 750% so that by 2019, one quarter of all U.S. oil production was exported.<sup>216</sup> Exports today continue to average more than three million barrels per day.<sup>217</sup>

In January 2021, President Biden issued a “whole of government” directive ordering every federal agency to “deploy [their] full capacity” to combat the climate crisis in their decision-making as a matter of both foreign policy and national security,” noting the “narrow moment” to take action on the “profound climate crisis”.<sup>218</sup> The President

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<sup>213</sup> U.S. Global Change Research Program, *Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume II* (2018), at 34, <https://nca2018.globalchange.gov/>.

<sup>214</sup> Intergovernmental Panel on Climate Change (IPCC), *Global warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty* (2018), (entire) <https://www.ipcc.ch/sr15/>; Oil Change International, *Drilling Toward Disaster: Why U.S. Oil and Gas Expansion Is Incompatible with Climate Limits* (2019), (entire) <http://priceofoil.org/2019/01/16/report-drilling-towards-disaster/>.

<sup>215</sup> Erickson, Peter et al., *Effect of subsidies to fossil fuel companies on united states crude oil production*, 2 *Nature Energy* 891 (2017) (entire); Oil Change International and Greenpeace, *Policy Briefing: Carbon Impacts of Reinstatement the U.S. Crude Export Ban* (January 2020), (entire) <http://priceofoil.org/2020/01/28/crude-export-ban-carbon>; SEI, IISD, ODI, E3G, and UNEP, *The Production Gap Report 2021* (2021), at 39, <http://productiongap.org/2021report>.

<sup>216</sup> Oil Change International and Greenpeace, *Policy Briefing: Carbon Impacts of Reinstatement the U.S. Crude Export Ban* (January 2020), (entire) <http://priceofoil.org/2020/01/28/crude-export-ban-carbon>.

<sup>217</sup> U.S. Energy Information Administration, *Data: Petroleum & Other Liquids*, (entire) <https://www.eia.gov/dnav/pet/hist/LeafHandler.ashx?n=p&s=mcexus2&f=m>.

<sup>218</sup> White House, *Tackling the Climate Crisis at Home and Abroad*, Exec. Order No. 14,008, 86 Fed. Reg. 7619 (Jan. 27, 2021), (entire) <https://www.whitehouse.gov/briefing->

immediately paused oil and gas leasing on federal lands and launched a review of the fossil fuel leasing and permitting program.<sup>219</sup> The administration also announced the goal of reaching net-zero emissions in the electricity sector by 2035 and recognized the need to “secur[e] environmental justice”.<sup>220</sup>

However, in practice, President Biden is failing to take the necessarily ambitious actions needed to combat the climate crisis and his administration is instead promoting fossil fuel production that undercuts his plans to deploy renewable energy and secure environmental justice. In his first year in office, President Biden approved more oil and gas drilling permits on public lands than President Trump, approving about 3,700 drilling permits through November 2021, 35% more than the Trump administration approved in its first year in office.<sup>221</sup> The Biden administration is supporting additional coal mining on public lands and drilling projects in the vulnerable Arctic, including offshore drilling in Cook Inlet and onshore drilling in the Western Arctic Reserve. Additionally, while President Biden canceled the Keystone XL oil pipeline from Canada, he continues to support the buildout of fossil fuel infrastructure, including the controversial Line 3, Dakota Access, and Mountain Valley Pipelines, and multiple liquefied gas export terminals.<sup>222</sup>

In November 2021 President Biden scheduled an oil and gas lease sale across 80 million acres of the Gulf of Mexico and auctioned the right to drill offshore on 1.7 million acres, locking in more dangerous drilling – and carbon emissions – for decades.<sup>223</sup> The Biden administration also plans to offer 734,000 acres of public lands for oil and gas leasing, with the fossil fuels in these leases containing up to 246 million tons of climate pollution — as much as 62 coal-fired power plants emit in one year.<sup>224</sup> Further, the administration’s delayed final report on the federal oil and gas leasing program was a meager 12 pages long, failed to address the possibility of ceasing new leasing, and

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[room/presidential-actions/2021/01/27/executive-order-on-tackling-the-climate-crisis-at-home-and-abroad](https://www.whitehouse.gov/briefing-room/presidential-actions/2021/01/27/executive-order-on-tackling-the-climate-crisis-at-home-and-abroad).

<sup>219</sup> *Id.*

<sup>220</sup> *Id.*

<sup>221</sup> Public Citizen, Biden’s Oil Letdown (December 6, 2021), (entire)

<https://www.citizen.org/wp-content/uploads/bidenoil-final.pdf>.

<sup>222</sup> Civil Society Equity Review, A Fair Shares Phase Out: A Civil Society Equity Review on an Equitable Global Phase Out of Fossil Fuels (2021), at 54-55,

<http://civilsocietyreview.org/report2021/>; Global Witness, President Biden is Set to Choke the World’s Climate in Fossil Gas (October 2021), (entire)

<https://www.globalwitness.org/en/campaigns/fossil-gas/president-biden-is-set-to-choke-the-worlds-climate-in-fossil-gas/>.

<sup>223</sup> Bureau of Ocean Energy Management (BOEM), Gulf of Mexico Lease Sale Results Announced (November 17, 2021), (entire) <https://www.boem.gov/newsroom/press-releases/gulf-mexico-lease-sale-results-announced>.

<sup>224</sup> Center for Biological Diversity et al., Objections Target Biden’s Oil Leasing Plan Amidst Climate ‘Code Red’ (October 1, 2021), (entire)

<https://biologicaldiversity.org/w/news/press-releases/objections-target-bidens-oil-leasing-plan-amidst-climate-code-red-2021-10-01/>.



instead offered recommendations to raise royalty rates for onshore and offshore leasing – actions that will have no impact on fossil fuel production whatsoever.<sup>225</sup>

#### *International Regulatory Mechanisms*

Similarly ineffective, the Convention on International Trade in Endangered Species (CITES) has not curbed a chief direct threat of poaching. CITES “represents a major step towards conserving biodiversity as long as one is willing to overlook the fact that it does not work.”<sup>226</sup> The expansion of CITES during the 1980s to “all aspects of trade and research” in orchids “immediately increased the desire for the plants, raised their market value dramatically, and led to even more collection of rare orchid species from the wild.”<sup>227</sup> Nothing in CITES stops activities that would “flood [critical] habitat with a hydroelectric dam, log it, level the hillsides of a road, build a golf course on the site, or burn the jungle to the ground for agricultural purposes.”<sup>228</sup> Not surprisingly, “no reliable data [shows] that CITES and similar efforts ha[ve] reduced smuggling, saved any orchid species from extinction, helped protect orchid habitats, or even salvaged orchid plants facing ... certain destruction.”<sup>229</sup>

### **E. Other Natural or Manmade Factors Affecting the Continued Existence of the Species**

The ghost orchid faces the concurrent dangers of the climate crisis, including sea level rise, hurricane wind effects and storm surges, and changing temperatures.

#### *i. Sea level rise will negatively impact ghost orchid habitat.*

Global average sea level rose by seven to eight inches over the past century as the oceans have warmed and land-based ice has melted. Sea level rise is accelerating in pace with almost half of recorded sea level rise occurring since 1993. The Fourth National Climate Assessment estimated that global sea level is very likely to rise by 0.3-0.6 feet by 2030, 0.5-1.2 feet by 2050, and 1.0-4.0 feet by the end of the century relative to the year 2000,

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<sup>225</sup> U.S. Department of Interior, Report on the Federal Oil and Gas Leasing Program (November 2021), (entire) <https://www.doi.gov/sites/doi.gov/files/report-on-the-federal-oil-and-gas-leasing-program-doi-eo-14008.pdf>.

<sup>226</sup> Chen, J. 2005. Across the Apocalypse on horseback: imperfect legal responses to biodiversity loss, 17 Wash. U. J.L. & Policy 12, 18 (2005); see also, Rachlinski, J.J. 1998 (entire).

<sup>227</sup> Hansen, E. 2000. Orchid Fever. Pantheon, at 67.

<sup>228</sup> *Id.* at 17; Chen, J. 2005 at 18.

<sup>229</sup> *Id.* at 262-63.

with sea level rise in excess of 8 feet possible.<sup>230</sup> The impacts of sea level rise will be long-lived: under all emissions scenarios, sea levels will continue to rise for many centuries.<sup>231</sup>

Unfortunately, the sea level rise projected for southwest Florida reflects the global outlook, with sea level rise projections averaging 4.2 feet, and ranging between 1.9 and 6.4 feet, within this century for Collier County<sup>232</sup> in the range of the ghost orchid (Fig. 1). At least two populations would be impacted by 3-6 feet of sea-level rise and one additional population impacted by 6 feet of sea level rise.

On this backdrop of rising sea levels, coastal regions are threatened by increased flooding and intensifying storm surge, which in combination further threaten ghost orchid habitat.<sup>233</sup> Coastal flooding is becoming more damaging as Atlantic hurricanes and hurricane-generated storm surges grow more severe due to climate change.<sup>234</sup> Projections anticipate an increase in the acceleration of sea level rise in Florida,<sup>235</sup> which when combined with intensifying hurricanes and storm surge, is greatly increasing the flooding risk.<sup>236</sup> Under a lower emissions RCP 4.5 scenario, storm surge is projected to increase by 25-47 percent along the U.S. Gulf and Florida coasts due to the combined effects of sea level rise and growing hurricane intensity.<sup>237</sup> The increasing frequency of extreme precipitation events is

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<sup>230</sup> Hayhoe, K., *et al.* 2018. Our changing climate. In *Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume II* [Reidmiller, D.R., *et al.* (eds.)]. U.S. Global Change Research Program, Washington, DC, USA, pp. 72–144. Doi: 10.7930/NCA4.2018.CH2.

<sup>231</sup> Walsh, *et al.* 2014. Ch. 2: Our changing climate. *Climate change impacts in the United States: The Third National Climate Assessment*, U.S. Global Change Research Program, Washington, DC. 19-67. Doi:10.7930/JOKW5CXT; U.S. Global Climate Research Program. 2017. *Climate Science Special Report: Fourth National Climate Assessment, Vol. I*.

<sup>232</sup> Climate Central. 2016. Sea level rise and coastal flood exposure: Summary for Collier County, FL. Surging Seas Risk Finder file created July 21, 2016. Accessed from [http://ssrf.climatecentral.org.s3-website-us-east-1.amazonaws.com/Buffer2/states/FL/downloads/pdf\\_reports/County/FL\\_Collier\\_County-report.pdf](http://ssrf.climatecentral.org.s3-website-us-east-1.amazonaws.com/Buffer2/states/FL/downloads/pdf_reports/County/FL_Collier_County-report.pdf); Climate Central. 2021a. Coastal Risks for Collier County, FL, <https://riskfinder.climatecentral.org/county/collier-county.fl.us>.

<sup>233</sup> Climate Central. 2019. Surging Seas Risk Zone Map. Available at: <http://sealevel.climatecentral.org/>.

<sup>234</sup> Hayhoe, *et al.* 2018 at 92.

<sup>235</sup> Southeast Florida Regional Climate Change Compact Sea Level Rise Work Group. 2020. Unified sea level rise projection Southeast Florida, 2019 Update. Accessible at [https://southeastfloridaclimatecompact.org/wp-content/uploads/2020/04/Sea-Level-Rise-Projection-Guidance-Report\\_FINAL\\_02212020.pdf](https://southeastfloridaclimatecompact.org/wp-content/uploads/2020/04/Sea-Level-Rise-Projection-Guidance-Report_FINAL_02212020.pdf).

<sup>236</sup> Little, *et al.* 2015. Joint projections of U.S. East Coast sea level and storm surge. *Nature Climate Change* 5:1114-1121.

<sup>237</sup> Balaguru, *et al.* 2016. Future hurricane storm surge risk for the U.S. gulf and Florida coasts based on projections of thermodynamic potential intensity. *Climatic Change* 138:99-110.

also compounding coastal flooding risk when storm surge and heavy rainfall occur together.<sup>238</sup> Impacts of storm surges on coastal populations and severe flooding on individual ghost plants on host trees have been identified as significant threats.<sup>239</sup> Furthermore, increased flooding may cause water managers to mitigate flooding and potentially over-drain conservation lands, particularly those adjacent to or upstream from flood-prone development.

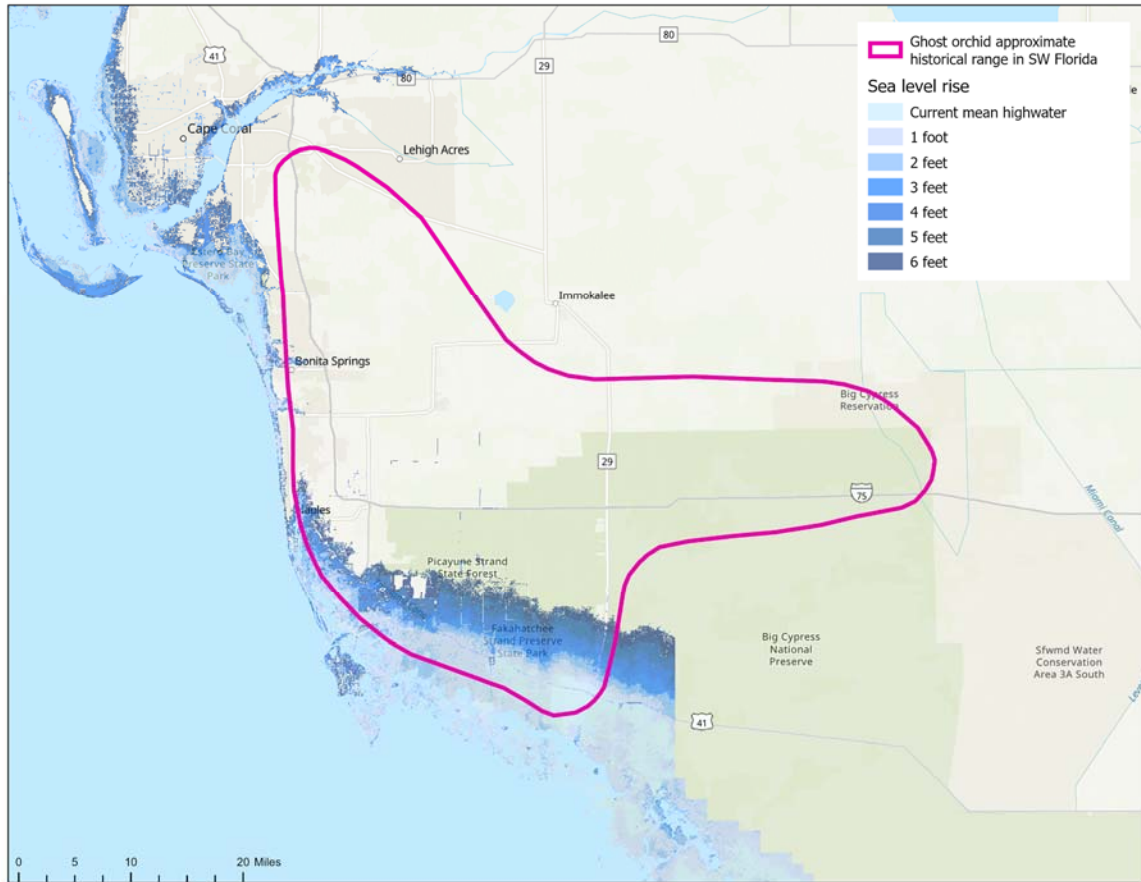


Figure 1. Potential direct sea level rise impacts on ghost orchid habitat.<sup>240</sup>

Flooding concerns extend to those associated with high tide. Since the 1960s, sea level rise has increased the frequency of high tide flooding by a factor of 5-10 for several U.S. coastal communities, and flooding rates are accelerating in many Atlantic and Gulf Coast cities.<sup>241</sup> For much of the U.S. Atlantic coastline, a local sea level rise of 1.0-2.3 feet would be sufficient to turn nuisance high tide events into major destructive floods.<sup>242</sup> In Florida specifically, which could have over 6 feet of sea level rise by the end of the century,

<sup>238</sup> Wahl *et al.* 2015. Increasing risk of compound flooding from storm surge and rainfall for major US cities. *Nature Climate Change* 5:1093-1098.

<sup>239</sup> NatureServe. 2021b.

<sup>240</sup> Figure 1 sea-level rise data from <https://coast.noaa.gov/slrdata/>.

<sup>241</sup> Hayhoe, *et al.* 2018 (entire).

<sup>242</sup> *Id.*

nuisance flooding due to sea level rise has already resulted in severe property damage and social disruption.<sup>243</sup> The frequency, depth, and extent of tidal flooding are expected to continue to increase in the future.<sup>244</sup> As the sea level rises, storm surge and tidal flooding will occur on an increasingly higher sea surface which will push water further inland and create more flooding of coastal habitats.<sup>245</sup>

With water pushed further inland, not just during storm surge events but also due to a general state of elevated seal level, habitat currently suitable for the ghost orchid will be lost. One way this could occur is through the seawater-intrusion-induced retreat of freshwater swamp forests relied upon by the ghost orchid. A study on freshwater-dependent species in coastal forests at the Withlacoochee Gulf Preserve in Yankeetown, Florida found that the coastal forest is retreating as saltwater intrudes freshwater at an estimated rate of seven meters per year; effects accelerated during a period of drought.<sup>246</sup> Another study in south Florida found that even before the onset of seawater inundation, sea level rise influences the species composition of coastal forests in the Everglades National Park and threatens rare species.<sup>247</sup> Any reduction in freshwater inflows into the region will accelerate the loss of salinity-intolerant low elevation plant communities such as freshwater swamp forests, and lead to their replacement by salt-tolerant plant species. The ghost orchid's reliance on this habitat is well-noted, so in the event of such forests' decline, the orchid may have its best chance at survival if migration could occur north or inland in response to warming winter temperatures. Therefore, in preparation for this eventuality, some currently unoccupied contiguous habitat should also be part of the critical habitat designation.

*ii. Hurricanes and other climate change effects will negatively impact the ghost orchid.*

As was observed with Hurricane Irma in 2017, hurricanes can damage or destroy ghost orchid host trees, opening up the canopy, and creating more open exposed conditions and lowering humidity.<sup>248</sup> Higher mortality of ghost orchids following Hurricane Irma at Florida Panther National Wildlife Refuge was published,<sup>249</sup> and recent monitoring of a subpopulation in Big Cypress National Preserve indicated that 30% of ghost orchid host trees had died as a result of Hurricane Irma (2017).<sup>250</sup> One ghost orchid at Audubon's

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<sup>243</sup> Wdowinski, *et al.* 2016. Increasing flood hazard in coastal communities due to rising sea level: Case study of Miami Beach, Florida. *Ocean & Coastal Management* 126:1-8.

<sup>244</sup> Hayhoe, *et al.* 2018 (entire).

<sup>245</sup> Tebaldi, *et al.* 2012. Modelling sea level rise impacts on storm surges along US coasts. *Environmental Research Letters* 7:014032. Doi: 10.1088/1748-9326/7/1/014032.

<sup>246</sup> Williams, *et al.* 2003. Interactions of Storm, drought, and sea-level rise on coastal forest: A case study. *Journal of Coastal Research* 19:1116-1121; Desantis *et al.* 2007. Sea-level rise and drought interactions accelerate forest decline on the Gulf Coast of Florida, USA. *Global Change Biology* 12:2349-2360.

<sup>247</sup> Saha, *et al.* 2011. Sea level rise and South Florida coastal forests. *Climatic Change*. 107. 81-108. 10.1007/s10584-011-0082-0.

<sup>248</sup> NatureServe. 2021b.

<sup>249</sup> Mújica, *et al.* 2021 at 3-4.

<sup>250</sup> Angelo, C. 2021a.

Corkscrew Sanctuary also died as a result of Hurricane Irma.<sup>251</sup> The intensity, frequency, and duration of North Atlantic hurricanes, as well as the frequency of Category 4 and 5 hurricanes, have increased since the early 1980s.<sup>252</sup> Hurricane-associated storm intensity and rainfall rates are projected to increase as the climate continues to warm,<sup>253</sup> and, according to the National Oceanic and Atmospheric Administration, 2020 was a record-breaking season with 14 hurricanes and 7 major hurricanes, with 11 named storms hitting the U.S. coastline.<sup>254</sup> Because of the limited area of occupancy of ghost orchid in southern Florida, most subpopulations could be affected by a single hurricane event. Collier County has averaged a direct hit by three hurricanes per decade since 1991.<sup>255</sup>

With climate change, summer temperatures in Florida have increased by about 1°F since 1950, averaging 81.4°F (27.4°C) from 1991 to 2010. In the next 20 years, average summer temperatures are expected to rise above 83°F (28.3°C) under moderate and high emissions scenarios. Meanwhile, winter temperatures in Florida have increased by about 2°F, averaging 57.4°F (14.1°C) between 1950 and 1970 and averaging 59.5°F (15.3°C) between 1991 and 2010. In the next 20 years, average winter temperatures are expected to rise above 60°F (15.6°C) under moderate and high emissions scenarios.<sup>256</sup> Furthermore, Florida is projected to experience some of the highest frequencies of extreme heat in the U.S. by mid-century with 105 days with a heat index over 100°F (in an average year and averaged across the state) in comparison to just 25 days historically. This included 63 days with a heat index over 105°F.<sup>257</sup>

While the direct effects of changing temperatures on ghost orchids are unknown, increases in maximum temperatures coupled with changes in precipitation, such as a hotter, drier, prolonged dry season, would have severe consequences for the ghost orchid. Higher temperatures alone would lead to increased rates of evaporation, including more loss of moisture through plant leaves.<sup>258</sup>

Regarding the Cuban population of orchids, Raventós, *et al.* (2015) found that *D. lindenii* could become extinct in Guanahacabibes within 25 years if the annual probability of

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<sup>251</sup> Clem, S. 2021. Personal communication with G.D. Gann on July 6, 2021.

<sup>252</sup> Walsh *et al.* 2014 at 20.

<sup>253</sup> *Id.*

<sup>254</sup> National Oceanic and Atmospheric Administration. 2021a.

<https://www.noaa.gov/media-release/record-breaking-atlantic-hurricane-season-draws-to-end>. Accessed December 9, 2021.

<sup>255</sup> National Oceanic and Atmospheric Administration 2021b.

<https://oceanservice.noaa.gov/news/historical-hurricanes/>. Accessed December 9, 2021.

<sup>256</sup> Raimi, *et al.* 2020. Florida climate outlook: Assessing physical and economic impacts through 2040. Resources for the Future Report 20-01. Available at:

<https://www.rff.org/publication/reports/florida-climate-outlook/>.

<sup>257</sup> Dahl, *et al.* 2019. Killer heat in the United States: Climate choices and the future of dangerously hot days. Union of Concerned Scientists.

<https://www.ucsusa.org/resources/killer-heat-united-states-0>.

<sup>258</sup> Walsh *et al.* 2014 at 40.

disturbances, including hurricanes, exceeds 14%.<sup>259</sup> Current models and analyses on what affects climate change will have on altering how disturbances caused by intense hurricanes will impact Florida and Cuba indicate that “[a]lthough results can differ greatly from model to model... there is a general tendency...[for climate change] to increase the incidence of the most intense storms, and to increase tropical cyclone rainfall rates... potential intensity generally increases with warming, so that some increase in the frequency of the most intense events is to be expected.”<sup>260</sup>

## VI. Request for Critical Habitat Designation

We request that all known locations where the ghost orchid remains be designated as critical habitat concurrent with the species’ listing.

As required by the Endangered Species Act, the Secretary shall designate critical habitat concurrent with determination that a species is endangered or threatened.<sup>261</sup> Congress recognized that the protection of habitat is essential to the recovery and/or survival of listed species, stating that “classifying a species as endangered or threatened is only the first step in ensuring its survival. Of equal or more importance is the determination of the habitat necessary for that species’ continued existence...If the protection of endangered and threatened species depends in large measure on the preservation of the species’ habitat, then the ultimate effectiveness of the Endangered Species Act will depend on the designation of critical habitat.”<sup>262</sup>

Critical habitat includes specific areas occupied by the threatened or endangered species with “physical or biological features . . . essential to the conservation of the species and . . . which may require special management considerations or protection,” as well as specific suitable habitat that is currently unoccupied by the species but is “essential for the conservation of the species.”<sup>263</sup> The unoccupied habitat is essential for the recovery of this species. The “conservation” of a species means “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 [the Endangered Species Act] are no longer necessary.”<sup>264</sup> Accordingly, critical habitat includes areas that require proper management to ensure a listed species cannot only survive but also recover.

The U.S. Fish and Wildlife Service has discretion with the scale at which it publishes critical habitat information. Published critical habitat designation should be publicly presented range-wide or at the county or federal management unit level. All site-specific data should be kept confidential. Because one of the chief threats to the ghost orchid is

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<sup>259</sup> Raventós, *et al.*, 2015 at 187.

<sup>260</sup> Emanuel, K. 2008. The Hurricane—climate connection. *Bulletin of the American Meteorological Society*, 89(5), pp.ES10-ES20.

<sup>261</sup> 16 U.S.C. § 1533(a)(3A).

<sup>262</sup> H. Rep. No. 94-887 at 3 (1976).

<sup>263</sup> 16 U.S.C. § 1532(5)(A).

<sup>264</sup> 16 U.S.C. § 1532(3).

poaching, the petition does not include the exact locations of populations or individuals. Instead, the petition cites publicly available information regarding the general locations of populations and provides contact information for communicating with petitioners directly for additional confidential site-specific information. Petitioners understand and expect that location information about the ghost orchid will be protected from disclosure in the event of a Freedom of Information Act request and in any future rulemakings regarding the species.

## **VII. Conclusion**

The ghost orchid warrants protection under the Endangered Species Act. Habitat loss and degradation, overcollection, and the climate crisis threaten the survival of the ghost orchid, which has experienced significant population declines. This orchid urgently needs Endangered Species Act protection and critical habitat designation to safeguard its habitat in perpetuity.

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