

Pinguicula ionantha
Godfrey's butterwort
5-Year Review:
Summary and Evaluation



Photo by Vivian Negrón-Ortiz

**U.S. Fish and Wildlife Service
Southeast Region
Panama City Field Office
Panama City, Florida**



5-YEAR REVIEW

***Pinguicula ionantha* (Godfrey's butterwort)**

I. GENERAL INFORMATION

A. Methodology used to complete the review

This review was accomplished using information obtained from the Recovery Plan of June 1994, 5-year review of June 2009, unpublished field survey results, reports of current research projects, peer reviewed scientific publications, unpublished field observations by Service, State and other experienced biologists, and personal communications. These documents are on file at the Panama City Field Office. A *Federal Register* notice announcing the review and requesting information was published on August 30, 2016 (81 FR 59650). No part of this review was contracted to an outside party. Comments and suggestions from peer reviewers were incorporated as appropriate (see Appendix A). The Service's lead recovery botanist in the Panama City Field Office, Florida, completed this review for this plant.

B. Reviewers

Lead Field Office: Dr. Vivian Negrón-Ortiz, Panama City Field Office, 850-769-0552 ext. 231, vivian_negronortiz@fws.gov

Lead Region: Southeast Regional Office: Kelly Bibb, 404-679-7132

Peer Reviewers:

Allix North, Environmental Specialist I, St. Joseph Bay State Buffer Preserve,
FDEP/Florida Coastal Office, 3915 State Road 30-A, Port St. Joe, FL 32456
Cathy Ricketts, Wildlife Biologist II, Florida Fish and Wildlife Conservation
Commission, Apalachicola River WEA
Jason Drake, Forest Ecologist, U.S. Forest Service, 325 John Knox Road, Suite F-100,
Tallahassee, FL 32303

C. Background

- 1. Federal Register Notice citation announcing initiation of this review:**
81 FR 59650 (August 30, 2016)
- 2. Species status:** General assessment: Stable. Short-term trends over the past several years indicate an increase of Element Occurrences¹ (EOs or occurrences) in public managed areas such as Apalachicola National Forest (J. Drake, USFS, 10/30/2017, pers. comm.) and Tate's Hell State

¹ Element Occurrence (EO): an area of land and/or water in which a species or natural community is, or was, present. For species, it corresponds with the local population (portion of a population or a group of nearby populations). It is also referred to as occurrence, location, or site.

Forest (M Jenkins, FDACS, 2/1/2017, pers. comm.). Population trends on private lands: unknown.

3. **Recovery achieved:** 2 (26-50% recovery objectives achieved); see section II.B.3 for details on recovery criterion and actions, and how each action has or has not been met.

4. **Listing history**
Original Listing

FR notice: 58 FR 37432: Endangered and threatened wildlife and plants:
Status for five Florida plants.

Date listed: July 12, 1993

Entity listed: species

Classification: Threatened

5. **Associated rulemakings**

Not applicable

6. **Review History**

Previous 5-year Review: July 8, 2009 (no status change was recommended)

Each year, the Service reviews and updates listed species information for inclusion in the required Recovery Report to Congress. Through 2013, we did a recovery data call that included status recommendations such as “Unknown” for this plant. We continue to show that species status as part of our 5-year reviews. The most recent evaluation for this plant was completed in 2017.

Recovery Plan was written and approved (June 22, 1994).

7. **Species’ Recovery Priority Number at start of review (48 FR 43098):**
The Godfrey’s butterwort is assigned a recovery priority of 8C because the degree of threat is moderate, it is a species in conflict with development and growth, and has a high recovery potential.

8. **Recovery Plan**

Name of plan: Recovery Plan for four plants of the lower Apalachicola Region, Florida: *Euphorbia telephoides* (telephus spurge), *Macbridea alba* (white birds-in-a-nest), *Pinguicula ionantha* (Godfrey’s butterwort), and *Scutellaria floridana* (Florida skullcap).

Date issued: June 22, 1994

Dates of previous plans: N/A

II. REVIEW ANALYSIS

A. Application of the 1996 Distinct Population Segment (DPS) policy

Pinguicula ionantha is a plant; therefore, the DPS policy is not applicable and it will not be addressed further in this review.

B. Recovery Criteria

1. Does the species have a final, approved recovery plan containing objective, measurable criteria?

The recovery plan includes a recovery objective for delisting the species as well as the criterion. The objectives are to guarantee that the populations in Apalachicola National Forest (ANF) are secure, and to conserve the species outside ANF by protecting habitat through land acquisition, and changes in management practices on government land, rights-of way (ROW), and private land. For delisting the species, the goal is to adequately protect and manage 15 populations distributed throughout the species' historical range for 10 years. The plan states that these goals are by necessity only preliminary, and they will be refined.

2. Adequacy of recovery criteria.

a. Do the recovery criteria reflect the best available and most up-to-date information on the biology of the species and its habitat?

No. The recovery criterion was based on available data at the time the plan was published 23 years ago.

b. Are all of the 5 listing factors* that are relevant to the species addressed in the recovery criteria (and is there no new information to consider regarding existing or new threats)?

No. The recovery plan only addressed factors A – habitat destruction and modification, which is still a threat, and B – overutilization for commercial, recreational, scientific, or educational purposes. See sections II.B.3 and II.C.2 for description of current information and threats.

3. List the recovery criteria as they appear in the recovery plan, and discuss how each criterion has or has not been met, citing information. For threats-related recovery criteria, please note which of the 5 listing factors* are

*A) 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) Inadequacy of existing regulatory mechanisms;
E) Other natural or manmade factors affecting its continued existence.

addressed by that criterion. If any of the 5-listing factors are not relevant to this species, please note that here.

The recovery plan includes a delisting criterion to adequately protect and manage 15 populations distributed throughout the species' historical range for 10 years. This plant, based on best available information, is known from six counties with the populations primarily found on ANF and Tate's Hell State Forest (THSF) (Table 1, Fig. 1). In section IV, we recommend that the plan's recovery criteria be revised and better defined; in section II.C. 1 and 2, we present current information on status and threats to the species. This recovery criterion addresses factors A and B. Factor C is not relevant to *P. ionantha*. Factors D and E, although relevant to this species, were not addressed by the Recovery Plan. We summarize our progress below under existing recovery actions. Recovery actions 1-5 address factor A. Recovery action 6 addresses factor B.

Recovery Action 1: Protect population in ANF and on other public lands
This action has been partially met.

1.1. Management/general monitoring in ANF

Management is an ongoing action conducted by the U.S. Forest Service (USFS). ANF has a yearly goal of completing 100,000 acres of prescribed burning (J. Dunlap, USFS, 10/30/2017, pers. comm.). From 2012-2016, the USFS burned annually on average 68,441 acres, with an average of 28,562 of those acres burned in the growing season (J. Dunlap, USFS, 10/30/2017, pers. comm.).

Monitoring. The USFS established six plots, three in 1997 and three additional plots over the past five years, to monitor the numbers of *P. ionantha* plants (J. Drake, USFS, 10/30/2017, pers. comm.). These monitoring plots are georeferenced and found in compartments² 27, 70, 77 (two plots), 79 and 80 of ANF. They all have had at least one revisit over the past five years, and the numbers of *P. ionantha* are stable or increasing (J. Drake, USFS, 02/21/2018, pers. comm.).

1.2. Conduct population biology studies

This action is complete, and comprises studies of reproduction (Molano-Flores et al. 2018), demography and fire (Kesler et al. 2008), and population genetics (Zaya et al. 2017; see section I.C.1b for a summary of the study).

Reproductive ecology – Molano-Flores et al. (2018) studied the breeding system, flower phenology and longevity, pollinator visitation, and fruit and seed set differences among populations of *P. ionantha*, *P. lutea*, and *P.*

² Compartments are small subdivisions of forest land for purposes of orientation, administration and/or silvicultural operations.

planifolia. All three species were determined to be xenogamous (outcrossing) and self-compatible with high levels of fruit and seed set. The primary flower visitors were Hymenoptera, but visitation was low. However, the three species flower longevity ranges from two to three weeks, possibly to guarantee pollinator visitation in a habitat where pollinator availability seems to be low and uncertain. The rare status of the three *Pinguicula* species is likely due to their specific ecological requirements (e.g., prey capture; habitat structure), patterns of genetic diversity, and/or habitat management, rather than limited reproduction.

Demographic responses to prescribed fire – Kesler et al. (2008) studied the effects of prescribed fire on demography of 12 populations of *P. ionantha* over a period of two years in ANF and THSF, and used these data to project the effect of fire frequency and seasonality on population growth. The study showed that *P. ionantha* responds strongly and positively to prescribed fire. The results indicated that 57% of the yearly variation in population growth was related to time since last burn. Applying prescribed fire more frequently (i.e., < 4-year fire return interval) at the sites will have a positive impact on population growth due to increases in fecundity and individual plant growth. According to their model, population growth is expected to be maximized by annual growing season (June-July) or bi-annual dormant season (Dec-Feb) fires, which results in a positive, but delayed response of 430 days. According to Kesler and Trusty (2008), this delayed response could be explained by the lack of a seed bank. The growth response to days since last fire was nearly equal for individuals in the small and medium size classes. However, post-fire growth of the medium size class made a larger contribution to increased population growth following a fire event. This was because the small and medium plants are the only size classes that can grow. The large size class could either stay in the large size class (stasis), shrink (regression), or die. Burning during the flowering period (mid-Feb to April) was not part of their study, but is likely to negatively affect population growth rates by preventing seed production and seedling establishment.

Kesler and Trusty's (2008) model indicates that the timing of the fire event had an influence on fecundity contributions of *P. ionantha*. The authors found that the post-fire increase in fecundity was almost three times more important to population growth than was the increase in individual plant growth. Increased fecundity is associated with increased seedling establishment, which last up to 430 days following a fire event; shading and competition from surrounding vegetation appear to reduce this positive effect.

Based on Kesler and Trusty's (2008), the fire return interval could be reduced to about 2 years. The authors' observations in the field led them to conclude that the rarity of this species is a result of the rarity of its herbaceous bog habitat. Their conclusion is supported by the estimated loss of 85 to 98% of this habitat (Folkerts 1982).

1.3. Conduct botanical inventories on public land, possible purchase areas, and selected private land.

This action has been partially met. Botanical inventories on selected private lands have been primarily conducted by FNAI (see section C1a). No land acquisition has been completed.

1.31. *Pinguicula* surveys in ANF

This recovery action is ongoing and conducted primarily by the USFS and Florida Natural Areas Inventory (FNAI). To date, ANF has a total of 257 sites for *P. ionantha* over 22 compartments (J. Drake, USFS, 10/30/2017, pers. comm.).

Recovery action 2: Manage rights-of-way

This is an ongoing action. *Pinguicula ionantha* is found scattered along the ANF right-of-way (ROW) on State Route (SR) 65. The Florida Department of Transportation (FDOT) routinely consults with the Service under section 7 of the Act on all major road construction activities and protective measures are normally established on ANF right of way.

Management for other *P. ionantha* elements of occurrences found in ROW outside SR 65 has not been initiated.

Recovery action 3: Protect and manage these plants outside ANF

3.1. Secure protection

This is an ongoing action. To date, about 27 extant protected populations have been secured.

Table 1. Locations and protected populations outside ANF

County	Location	EOs
Bay	Lathrop Bayou	1
	Tyndall AFB	4
Franklin	Apalachicola River WEA	6
	Box-R WMA	1 (potentially extirpated)
	THSF	14
Gulf	Apalachicola River WEA	1
	St. Joseph Bay State Buffer Preserve	2

Wildlife and Environmental Area (WEA), Wildlife Management Area (WMA), Air Force Base (AFB)

No land acquisition has been accomplished for specific protection of *P. ionantha*.

3.2. Develop and implement management and monitoring plans for protected sites

Management plans have been developed and implemented for the six locations outside ANF (Table 1), but long-term monitoring for *P. ionantha* (except Tyndall AFB) has not been initiated. This recovery action will be completed when the sites are revisited, and the status of the populations/plants provided.

1. Florida Fish and Wildlife Conservation Commission (FWCC) for the Apalachicola River Wildlife and Environmental Area (ARWEA; FWCC 2014-2024) and Box-R WMA (FWCC 2006-2016):

The ARWEA, located in Franklin and Gulf counties, consists of 86,140 acres (FWCC 2014-2024). It protects the floodplain of the lower Apalachicola River for the purposes of (1) perpetuating its function as a buffer, and a source of nutrients and detritus for the river/bay complex; (2) maintaining natural wildlife habitat; and (3) protecting rare, threatened, endangered, and unique animals and plants. FNAI and ARWEA staff have recorded 7 EOs of *P. ionantha* within the ARWEA

Box-R WMA consists of 8,397 acres in Franklin County (FWCC 2006-2016). Management for this species includes application of prescribed fire every 2-3 years during the growing season, and avoidance of: 1) rutting and soil compaction in wetlands; 2) placing of firebreaks in wetlands ecotones; and 3) using herbicides on roadsides. FNAI has recorded one element of occurrence of *P. ionantha* within Box-R WMA.

2. Florida Department of Agriculture and Consumer Services for the THSF (FDACS 2007-2017):

The 2007 management plan for 202,436.58 acres of THSF, located in Franklin and Liberty counties, provides general guidance for management of the THSF until 2017; presently a new plan is being drafted and will be finalized during 2018 (M Jenkins, FDACS, 12/13/2017, pers. comm.). Two of the five main objectives are to restore, maintain, and protect all native ecosystems, and to ensure the long-term viability of populations and species considered rare, endangered, threatened, or of special concern. Plant and wildlife surveys (including *P. ionantha*) are presently conducted throughout the forest with the purpose to help prioritize areas for prescribed burning and other management activities.

3. Florida Department of Environmental Protection for St. Joseph Bay State Buffer Preserve (SJBSBP, FDEP 2016-2026):

The SJBSBP consists of 5,019 acres located in Gulf County. The 10-year management plan (FDEP 2016-2026) includes: 1) resource mapping, modeling, biological monitoring, research and scientific oversight to help prioritize restoration and resource protection, 2) application of fire and the preservation and/or restoration of hydrological patterns to sustain wetland ecosystems, and 3) increase public awareness of the regions natural resources via public workshops and trainings.

4. Bureau of Land Management (BLM) and the St. Joe Timberland Company (Timberland Company) for the Lathrop Bayou (BLM 2008):

The 2008 management plan for 539 acres of Lathrop Bayou, located at the eastern end of East Bay (Bay County), focuses on habitat improvements to benefit endemic plants and animals (e.g., prescribed fire, management of red-cockaded woodpecker, and monitoring of several plants and animals). In 2008, the island was owned by the BLM (189 acres), the Timberland Company (206 acres), and the Genecov Group (144 acres; BLM 2008). In 2013, the Timberland Company sold its land to AgReserves Inc. (ARI), who **may** maintain timber and agricultural uses of the land. About 482 individuals of *P. ionantha* were reported in a 1/2 acre on BLM property (BLM, Service, and Illinois staff, 2015 field work).

5. Tyndall AFB Integrated Natural Resources Management Plan (INRMP 2015):

The INRMP provides guidelines for the protection, conservation, and use of natural resources at Tyndall AFB. Tyndall currently conducts annual surveys for the four *P. ionantha* populations. In addition, Tyndall conducts prescribed fire to manage the areas; and efforts are in progress to minimize impacts from mowing, road and ditch maintenance (INRMP 2015). Wetland restoration will begin in 2018 to remove (i.e. hand and mechanical removal) unnaturally dense midstory shrubs in Tyndall's wetlands to improve habitat conditions for *P. ionantha*.

Recovery action 4: Conduct systematic and other studies

This recovery action has been completed.

Chromosome studies among species of *Pinguicula* including the six species in the southeastern United States indicated that *P. ionantha* has the same ploidy level, i.e., $2n = 22$, as *P. pumila* and *P. primuliflora*; the number for the other three species (*P. caerulea*, *P. lutea*, and *P. planifolia*) is $2n=32$ (Casper and Stimper 2009, Godfrey and Stripling 1961).

Chloroplast DNA sequences studies strongly support a sister group relationship between *P. ionantha* and *P. primuliflora* (Casper and Stimper 2009, Cieslak et al. 2005). Although Godfrey and Stripling (1961) separated *P. ionantha* from *P. primuliflora* based on chromosome number, this was based on an incorrect count ($2n=32$) for *P. primuliflora*, according to Casper and Stimper (2009). Although these two species have the same chromosome number and are morphologically similar, the current taxonomic status of these two species is accepted.

Recovery action 5: Garden propagation and reintroduction

This recovery action will be completed when the soil seed bank study is revisited, to demonstrate if there is seed survival in the soil that contributes to *P. ionantha* population persistence.

Propagation: Molano-Flores et al. (2014) investigated seed germination

requirements for *ex situ* conservation, and the presence or absence of a persistent seed bank for *P. ionantha*. Out of 7 treatments tested (stratification, liquid smoke solutions, plant growth regulators, Murashige and Skoog media, gibberellic acid soak, bleach soak, and water soak), seeds presoaked with gibberellic acid produced the highest germination (63%); the least successful was stratification (<5%). The authors developed a protocol to germinate *P. ionantha* seeds using a 500 mg/L presoak of gibberellic acid for *ex-situ* seed program. Only two *Pinguicula* sp. seedlings emerged from the seed bank, but identification to species was not possible because seedlings did not reach the flowering stage during the study.

In 2011, Bok Tower Gardens (Bok Sanctuary) collected 3,598 seeds from three sites at Tyndall AFB for cryogenic preservation (C. Peterson, Bok Sanctuary, 11/1/2017, pers. comm.). None of the seeds were used for viability trials, but were all sent to the National Laboratory for Genetic Resources Preservation, Fort Collins, CO.

Additionally, in 2007 Bok Sanctuary collected 26 capsules containing a total of 2,024 seeds from SJBSBP: 465 were kept at ambient storage; 1,103 seeds were refrigerated; and 200 were sent to Peter D'Amato (California carnivores, <https://www.californiacarnivores.com/pages/butterworts-pinguicula>) for propagation work (Peterson and Campbell 2007). Six months after the collecting was done, 456 seeds were used in the seed experiments, but germination was unsuccessful as of December 2007. D'Amato, however, successfully germinated about half a dozen plants; seeds tend to take a long time to germinate and winter stratification helps with this process (Campbell, 11/1/2017, pers. comm.). Kesler (<http://foliusconsulting.com/services.html>) successfully germinated *P. ionantha* seeds in vitro using a media with vitamins after seeds were sterilized.

Reintroduction. In February 2016, 238 plants were removed from the F-22 Munitions Storage Complex on Tyndall AFB prior to new bunker construction (site north of highway 98 and north of the main runway). Plants were relocated to a wet prairie at Tyndall AFB and a post-transplanting monitoring plan initiated. As of November 2017, 101 of the original transplanted plants have survived and 36 new seedlings have survived (M. Kaeser, Tyndall AFB, 1/25/2018, pers. comm.). Numbers continue to fluctuate with changing environmental conditions and seasonality. A bi-monthly survey conducted in January 2018 showed an increase in survival from November 2017 likely due to rainfall (M. Kaeser, Tyndall AFB, 1/25/2018, pers. comm.)

Plant transplantation experiments were conducted at Bok Gardens, Lake Wales, Florida during 2006 and 2007. Twenty-three plants including soil and nine leaf-cuttings were collected from SJBSBP, Gulf County and THSF, Franklin County (Peterson and Campbell 2007). Although some plants flowered eight to ten months after the 2006 collecting trip, all individuals have subsequently died. According to Peterson and Campbell (2007), mortality was likely due to the type of containers (i.e., plastic non-draining pots with terra-cotta clay) used in the experiments. Leaf-cuttings, a successful technique for a few species in the genus,

were not an optimal propagation method for *P. ionantha* because all the collected leaves died after two weeks. However, J. Clemens (2009, pers. comm.) of CarnivorousPlant.com has observed plantlets forming on the proximal end of severed leaves. Therefore, leaf-cuttings could be a good propagation technique

Recovery action 6: Protect *P. ionantha* from depredations due to collecting.

This recovery action has been partially addressed. See section C.2.b.

C. Updated Information and Current Species Status

1. Biology and Habitat

a. Abundance, population trends, demographic features, or demographic trends:

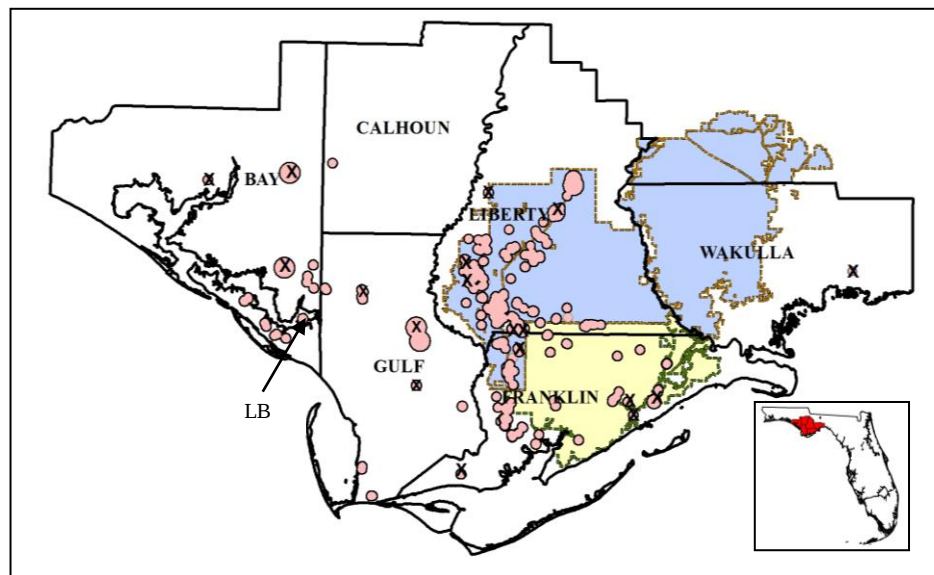


Fig. 1. Map of Florida (inset) showing the counties and locations of *P. ionantha*. LB= Lathrop Bayou; X = EOs with populations or plants not found during surveys. Public lands: THSF (yellow), ANF (blue).

P. ionantha Godfrey (Godfrey's butterwort) is a carnivorous plant located in Bay, Calhoun, Franklin, Gulf, Liberty, and Wakulla counties (Fig. 1). At present, we have 92 data points (hereafter called 'sites'), according to FNAI and FWCC records (FNAI 2017, FWCC 2018, <http://florida.plantatlas.usf.edu/Plant.aspx?id=1139>). Since many data points could be counted in more than one EO, and points within 1 km could all be associated with one EO (http://www.natureserve.org/library/delimiting_plant_eos_Oct_2004.pdf; Fig. 1); therefore, these locations technically comprise 66 EOs, the majority located on public managed lands (Table 2, Fig. 1). We use the term EO to indicate data points separated by at least 1 km to document unique populations for this status review following NatureServe (2004) guidance.

Several EOs appear to be extirpated due to loss of habitat and/or habitat modification (e.g., Wakulla County site). We have poor information regarding trends because surveys were conducted irregularly and based on either presence/absence and/or qualitative visual estimates of the density (Jenkins et al. 2007); most sites were visited only once; and actual counts of plants were not provided. The information below is organized by county.

Bay County

Surveys conducted in Bay County between 1960 and 2015 indicated the presence of 11 sites (FNAI 2017), representing 10 EOs. Five of these occurrences were re-surveyed in 2008 and 2009, but plants were not found by the FWS lead botanist for four of these sites. The occurrences were found disturbed, near railroads, in ditches, or destroyed (V. Negrón-Ortiz, 2008 and 2009 surveys).

The BLM property at the Lathrop Bayou has about 482 individual plants (BLM, Service, and 2015 field work), representing 1 EO. This population was first reported in 1997 by a Service biologist (BLM 2008), but was not seen again until the inception of management and surveys in 2002; the population was located again in 2008 and was regularly surveyed until 2015.

Surveys at Tyndall AFB revealed the presence of 10 sites containing *P. ionantha* (M. Kaeser, FWS, 1/24/2018, pers. comm.), representing four EOs (FNAI 2017). The total number of plants for all sites is about 2,191 plants with an additional ~137 plants that were transplanted.

Calhoun County

One site in a disturbed bog containing 20 plants was documented in 2004 by FNAI (2017), and represents 1 EO. This small population has not been re-surveyed.

Gulf County

Surveys conducted in Gulf County between 1960 and 2018 indicated the presence of seven EOs (FNAI 2016, 2017; Molano-Flores et al. 2014); three located on public lands (2 SJSBP and 1 Apalachicola River WEA EOs). Plants counted in six of these EOs ranged from 108 to 1,022 plants (Molano-Flores et al. 2014). A 2015 count at SJSBP (two sites) estimated 7,324 plants (Molano-Flores et al. 2014).

Most sites without counts were referred to as ‘plants flowering’ or ‘present’. Three occurrences surveyed in 2006 and 2008 were found without plants; the sites were found drastically altered (e.g., clearcut, residential development; Fig. 1).

Franklin & Liberty counties

About 72 sites have been documented for Franklin and Liberty counties (FNAI 2017, FWCC 2018), representing 47 EOs. About 3,137 plants were estimated for

27 EOs during 2015 - 2018 surveys (Molano-Flores et al. 2014, FWCC 2018). Plants for seven EOs documented between 1961 and the 1980s were not found during 2006 and 2008 surveys (Kesler and Trusty 2008; Negrón-Ortiz, 2008 surveys): four of these EOs were found in fire suppressed areas; one in a dense lightly bedded pine plantation; and two were clearcut.

Apalachicola National Forest: To date, the ANF has a total of 257 sites for *P. ionantha* over 22 compartments (J. Drake, USFS, 10/30/2017, pers. comm.), representing 24 EOs. These populations are considered protected.

The total estimated number of plants reported between 1956 and 2001 for 35 (90 %) of the occurrences ranged from 6,618+ to 22,314+. However, surveys indicated a decline of about 39% in the maximum number of estimated plants (8,718 plants are currently present or reported; FNAI 2008, Kesler and Trusty 2008). Six EOs were not found during 2006, 2008, and 2009 surveys (Kesler and Trusty 2008; Negrón-Ortiz, 2008 & 2009 surveys). However, the numbers of *P. ionantha* for the established six plots for long-term monitoring in compartments 27, 70, 77, 79 and 80 are stable or increasing (J. Drake, USFS, 02/21/2018, pers. comm.).

Apalachicola River WEA: Surveys conducted between 1991 and 2018 indicated the presence of 11 sites (FNAI 2017, 2016; FWCC 2018), representing seven EOs (Fig. 1). The total number of plants for all sites is 392 (FWCC 2018).

Box-R WMA: One EO with 30 plants was documented in 1988 (FNAI 2017). However, plants were not observed during a 2007 survey (FNAI 2017).

Tate's Hell State Forest: Surveys conducted in Franklin County indicated the presence of 19 sites (M Jenkins, FDACS, 2/1/2017, pers. comm.) with *P. ionantha* plants, representing 14 EOs. Four new EOs were found between 2011-2014 (M Jenkins, FDACS, 2/1/2017, pers. comm.). These populations are protected (Fig. 1) but monitoring has not been initiated. According to M Jenkins (FDACS, 2/1/2017, pers. comm.), < 1% of THSF has been surveyed.

Wakulla County

A herbarium collection from 1986 of *P. ionantha* in this County was made from a plant in a ditch, a disturbed site containing very few plants north of the town of St. Marks, representing 1 EO. The site was visited by L.C. Anderson (Florida State University) a few years later but plants were not found. The number of plants in the collecting location was neither counted nor estimated; it was stated as 'frequent.' In 2009, a FWS botanist surveyed several sites and ditches near the collection area described by L.C. Anderson, but sites were found disturbed with residential development.

Table 2. Number of sites with *P. ionantha* plants. An EO is defined as a set of points within 1 km (i.e., a population). Potential extirpated sites/EOs are included.

County	# of sites and EOs		EOs Managed Land	
	# sites	EOs	Public	Private
Bay	17	10	5	5
Calhoun	1	1		1
Franklin	30	23	22	1
Gulf	7	7	3	4
Liberty & Franklin (ANF)	259	24	24	
Wakulla	1	1		1
Total	315	66	54	12

b. Genetics, genetic variation, or trends in genetic variation (e.g., loss of genetic variation, genetic drift, inbreeding, etc.):

Genetic diversity and structure was assessed in 17 populations from four of the six counties from which *P. ionantha* is known to occur (Zaya et al. 2017). Using AFLP markers, the authors found varying levels of genetic diversity among populations, but with the proportion of polymorphic loci and Nei's gene diversity low. They also found low levels of population genetic structure; no clear relationship of genetic isolation by distance, and a significant proportion of genetic variation partitioned amongst regions (2.4 %, $P = 0.02$) or populations (20.8 %, $P < 0.001$). The results suggested some gene flow occurred among populations or that isolation has been too recent to leave a genetic signature.

c. Taxonomic classification or changes in nomenclature:

Kingdom: Plantae
Division: Magnoliophyta
Class: Magnoliopsida
Order: Scrophulariales
Family: Lentibulariaceae
Genus: *Pinguicula* L.
Species: *ionantha* Godfrey
Common name: Godfrey's butterwort, violet butterwort

Pinguicula L., the second most diverse genus of the carnivorous Lentibulariaceae, is monophyletic and composed of about 85 to 100 species native to Europe, North America, Asia, and South and Central Americas (Cieslax et al. 2005, Degtjareva et al. 2006). Members of this genus use sticky, glandular leaves to trap and digest insects. Six species can be found in Florida, of which *P. ionantha* Godfrey is endemic (Gluch 2005). All Florida species belong to the section or subgenus *Isoloba* (Cieslax et al. 2005, Gluch 2005), characterized by uniform corolla lobes, a cylindrical corolla tube with a palate and a short spur.

Pinguicula ionantha has a rosette of fleshy, bright green-yellow leaves of up to 15 cm across that can be characterized by upward rolled leaf edges. The plants stay in rosette form all year. The flowers rise from late February to April depending

on temperature. The flowers, borne on stalks of about 10 to 15 cm in height, are about two centimeters across and possess five pale violet to white petals all of the same shape corolla. The throat of the corolla and the corolla tube are deeper violet with dark violet veins. A yellow to olive spur 4 to 5 mm long is present on the corolla and the palate is yellow with a purple base and covered with yellow hairs (Godfrey and Stripling 1961, Godfrey and Wooten 1981).

d. Spatial distribution, trends in spatial distribution, or historic range:

Pinguicula ionantha is endemic to the Florida panhandle ranging from Tallahassee to Panama City (Godfrey and Wooten 1981, FNAI 2008). Originally, the Recovery Plan (1994) only reported the species in Bay, Franklin, Gulf, and Liberty counties, however, herbarium specimens no. 70198 and 9117 collected in 1971 and 1986, respectively, and located at Robert K. Godfrey Herbarium (Florida State Univ.) confirmed the species is also found in Wakulla County. In addition, the geographical distribution has been extended to Calhoun County based on an observation by A. Johnson (FNAI) in 2004 of 20 plants.

Previously, 83 historical sites were documented between 1956 and 2009 (FNAI 2008). Based on information provided by FNAI (2017) and FWCC (2018) and recent surveys, the number of sites has increased to 92; technically representing 66 EOs. About 10,558 plants were present at 21 of the 23 EOs revisited in 2015 (Molano-Flores et al. 2014).

A total of 52 sites were visited in 2006, 2008, and 2009 surveys: 33 sites were revisited by Kesler and Trusty (2008) during April 2006, and 19 sites were visited by Negrón-Ortiz during 2008 and 2009 surveys. Plants were present at 24 (46%) of these sites. Searches did not locate plants at 22 (42%) of the previously recorded sites. Additionally, high water or a dense woody midstory prevented access to six previously recorded sites in Gulf and Franklin counties (Kesler and Trusty 2008, Negrón-Ortiz, 2008 surveys).

This species appears to be increasing in number of populations on public lands. However, overall trends in both abundance of individuals within each population and the total number of populations through the species range remain unknown.

e. Habitat or ecosystem conditions (e.g., amount, distribution, and suitability of the habitat or ecosystem):

Pinguicula ionantha inhabits herbaceous bogs embedded in longleaf pine savannas and pine flatwoods. Specifically, it is found between a lower elevation habitat dominated by pond cypress (*Taxodium ascendens*) overstory and a slightly higher elevation pine flatwoods dominated by an overstory of longleaf pine (*Pinus palustris*). This species inhabits seepage bogs, deep swampy bogs, ditches, wet prairies, and depressions in grassy pine flatwoods and savannas. It survives in open peat or sandy peat in very wet areas, in shallow standing water or

sometimes even submerged for several days after a heavy rain (Godfrey and Stripling 1961; Negrón-Ortiz, 2008, pers. observ.; J. Drake, USFS, 02/21/2018, pers. comm).

The longleaf pine savanna habitat where this species occurs is defined as a fire-dependent community and is dominated by wiregrass (*Aristida stricta*), spurned panic grass (*Panicum spretum*), flattened pipewort (*Eriocaulon compressum*) and Chapman's beakrush (*Rhynchospora chapmanii*) (Kindell 1997). In Franklin and Liberty counties, it can sometimes co-occur with other imperiled plants, including *Macbridea alba* (white birds-in-a-nest) and *Scutellaria floridana* (Florida skullcap), both Federally listed as threatened species. It is locally abundant in ANF, where fire management is maintained.

2. Five-Factor Analysis (threats, conservation measures, and regulatory mechanisms)

a. Present or threatened destruction, modification or curtailment of its habitat or range:

Habitat modification is the primary threat identified in the Recovery Plan for *P. ionantha* and remains the primary threat to this plant. Commercial timber production, urban development, and fire management and suppression in this region have resulted in ecosystem degradation. The threats are discussed in more detail below:

1. Pulpwood production in the outer Coastal Plain in the Apalachicola Basin

Privately owned forests managed (clearcutting, mechanical site preparation, and bedding) for commercial timber production, is a primary threat to *P. ionantha* habitat. An active paper mill located in Panama City (Bay County) receives timber from thousands of acres of pine plantation.

The commercial timber industry in North Florida became well established in the 1850's (FNAI 2005). It started in Franklin County in the 1870's and continued to be a prominent industry until the mid-1990's (Howell and Hartsell 1995). The Timberland Company had close to a million acres in timber production in the eastern region of the Panhandle and they plan to continue to commercially harvest and replant off-site pine species. The Company also owned a paper mill in Port St. Joe until it was sold and shut down in 1999. In 2013, the Timberland Company sold more than 380,000 acres of its land to AgReserves, Inc.. The land sold included timberlands in Bay, Calhoun, Franklin, Gadsden, Gulf, Jefferson, Leon, Liberty and Wakulla counties. Within Gulf County, AgReserves, Inc. has repurposed timberlands into pasture lands for cattle (A. North, FDEP, 2/6/2018, pers. comm.).

2. Coastal real estate and road development

Urban development continues to threaten Godfrey's butterwort. The Timberland

Company is one of the largest private landowners in Florida, and one of the largest real estate operating companies in the Southeast. The Company develops both residential and commercial properties along roadways and near or within business districts in the region. More than a third of Florida's land is projected to be developed by 2070 along with a grow of about 33.7 million residents—almost 15 million more people than in 2010 (University of Florida GeoPlan Center 2017).

Many *P. ionantha* locations are found along U.S. and state roads. Construction activity may directly kill individual plants or convert habitat to unsuitable habitat; widening may convert native habitat to managed road side; and culvert modification may change drainage patterns, which may change seasonal hydrology. Evidence suggests past road improvements have resulted in localized extirpation of Godfrey's butterwort in ANF (Kesler and Trusty 2008). Therefore, because they contribute to habitat loss, road widening and new roads continue to pose a threat to the species.

3. Fire suppression

Suppression of fire during the growing season continues to threaten the pineland and savanna's flora, as fire is an important factor in the maintenance of flatwoods (Abrahamson and Hartnett 1990). Fire influences community structure and composition (Abrahamson and Hartnett 1990), and with insufficient frequency in longleaf pine communities, a woody midstory quickly develops (Glitzenstein et al. 1995), negatively affecting the understory diversity.

Several studies have shown that frequent, low intensity prescribed fire regimes are important for maintenance of flatwoods diversity (Hiers et al. 2007). Therefore, frequent prescribed burnings, i.e., < 3 yr interval, are needed to maintain optimal habitat for *P. ionantha* populations (Kesler et al. 2008). At present, the ANF utilizes a 3- to 5-yr interval burn rotation (2-4 yr burn rotation at the burn units with *P. ionantha*, J. Drake, USFS, 02/21/2018, pers. comm.); Box-R WMA and SJBSBP utilize 2- to 3-yr interval; and Lathrop Bayou applies prescribed fire on a 2- to 7-yr interval.

Thus, fire suppression continues to threaten to *P. ionantha* habitat and population numbers. Lack of fire, and subsequent growth of shrubs (particularly encroachment of *Cyrilla racemiflora* L., commonly known as swamp titi) and saplings in the understory, in addition to shading by planted pines, inhibits this species emergence (Negrón-Ortiz, 2008, pers. observ.; FNAI 2008, Kesler et al. 2008). Declining fire frequency reduces *P. ionantha* abundance in areas where it was previously observed in large quantities (FNAI 2008). Emergence of this species is prolific within one year of the fire event (Kesler and Trusty 2008).

b. Overutilization for commercial, recreational, scientific, or educational purposes:

This factor is a threat, but the magnitude has been reduced. Butterworts are widely cultivated, grown and sold by plant enthusiasts and nurseries. *Pinguicula ionantha*

was overcollected in the 1970s (58 FR 37440). Many thousands of plants propagated by tissue culture were sold without permits, but the plant is no longer commercially available in large quantities (D'Amato, California carnivores).

In order to implement conservation measures and regulations, the Service granted a permit (TE061005-1) to the International Carnivorous Plant Society (ICPS) in 2003, which allows the society to sell seeds of endangered and threatened carnivorous plants only within the USA. Some restrictions apply to this permit (see <http://www.carnivorousplants.org/conservation/policies>); in addition, an annual report is required stipulating their selling activities. Collecting guidelines for live plants and seeds were developed by the ICPS: 1) they do not recommend collecting live plants unless it is for scientific purposes such as herbaria, the species has never been introduced to cultivation, or because a variant (a taxon exhibiting slight differences in form); 2) they will not accept field collected seed of listed plants, only seeds from cultivated plants will be accepted if they are donated in accordance with all relevant laws. The Nurseries Stock Restrictions manual summarizes the entry status of regulated plant material capable of or intended for propagation (USDA 2010).

c. Disease or predation:

There is no evidence to suggest that this factor is a threat.

d. Inadequacy of existing regulatory mechanisms:

Section 7(b)(4) and 7(b)(2) of the Endangered Species Act (Act) generally do not apply to listed plant species. However, limited protection of listed plants from take is provided to the extent that the Act prohibits the removal and reduction to possession of Federally listed threatened and endangered plants or the malicious damage of such plants on areas under Federal jurisdiction, or the destruction of endangered plants on non-Federal areas in violation of State law or regulations or in the course of any violation of a State criminal trespass law. Seeds of both threatened and endangered species found on Federal land are regulated under the Act. However, the seeds of threatened species are not regulated if they come from cultivated plants (7 CFR 319.37.2, USDA 2008). Since *P. ionantha* is a threatened species, growers can obtain and sell seeds from other growers.

Several populations of *P. ionantha* occur on private timberland and ROWs. While the Act requires Federal agencies to carry out programs for the conservation of endangered and threatened species, no such programs are stipulated for private landowners. The Act does not provide for protection of plants on private lands as long as the activity is permissible under state/local laws. The State requires permission of private landowners for collecting of State-listed plants from their property.

Pinguicula ionantha is protected under Florida State Law, chapter 581.185: Preservation of native flora of Florida (<https://www.flsenate.gov/Laws/Statutes/2013/581.185>), which includes

preventions of take, transport, and the sale of the plants listed under the State Law. The rule Chap. 5B-40, Florida Administrative Code, contains the "Regulated Plant Index" (5B-40.0055) and lists endangered, threatened, and commercially exploited plant species for Florida; defines the categories; lists instances where permits may be issued; and describes penalties for violations (Coile and Garland 2003).

Bay County Comprehensive plan, under chapter 6, provides restrictions, constraints and requirements to protect and preserve designated habitat conservation areas for rare, threatened, or endangered species, and wetlands (<http://baycountyfl.gov/276/Planning-Zoning>). Calhoun, Gulf, Franklin, and Liberty Counties do not have such regulations.

Highway ROW maintenance activities are not always reviewed for threatened and endangered species impact. However, if there is an activity (e.g., construction, mowing, or maintenance projects) affecting protected species, then the Service can recommend consultation to the FDOT under section 7 of the Act. The FDOT routinely consults with the Service on all major road construction activities.

e. Other natural or manmade factors affecting its continued existence:

1. Herbicide. While the Recovery Plan mentioned that the use of herbicide or the wrong type of herbicide is a threat when it is used to control vegetation on power line ROWs, we no longer consider this a threat because mowing is now the common practice to maintain ROWs in Florida. Franklin and Liberty counties allow only "selective application or spot treatment" due to impacts concerning the ANF and waters within Apalachicola Bay and River basin.

2. Saltwater inundation caused by hurricanes. Saltwater inundation from storm surges caused by hurricanes represents a threat. Kesler and Trusty (2008) monitored one population in Franklin County, which was flooded during Hurricane Francis in 2004. In 2005, they observed that the plant number declined from about 100 to two individuals.

3. Sea Level Rise. Sea level rise (SLR) as a result of climate change is a growing concern for much of Florida's coastline and the endemic species that occur there because about 10% of Florida is less than 1 meter above current sea level. Being endemic to Florida, Godfrey's butterwort is threatened by climate change. Using the NOAA Sea Level Rise and Coastal Flooding Impacts Viewer (<https://coast.noaa.gov/slr/>), the projections indicated potential impacts to six known *P. ionantha* EOs (Bay Co.: 1 EO; Franklin Co.: 5 EOs) by intrusion of saltwater beginning at one foot SLR.

D. Synthesis

Godfrey's butterwort is a carnivorous plant presently located in six Florida panhandle counties (Fig. 1). It is extremely vulnerable because of its limited range, its specific habitat preference, rarity of habitat, and low genetic variation. The main threat to this species is habitat loss. Conversion of much of the historical forest land to commercial

pine plantations has possibly extirpated many populations. Development pressures in the Florida panhandle are extreme; more than a third of Florida's land is projected to be developed by 2070 along with a grow of almost 15 million more people than in 2010. Informal and formal consultations have resulted in minimizing impacts from road projects, specifically for SR 65 in the ANF. Overcollection was a threat of high importance in the past, but the present magnitude has been reduced. No problems have been detected with disease and predation. However, populations are threatened by flooding and habitat loss from projected SLR. Therefore, locating new populations and identifying prospective sites for reintroductions such as areas that will not be affected by SLR and future development are necessary to conserve this species.

Land conversion coupled with disruption of fire regimes of the longleaf pine-wiregrass ecosystem is responsible for the rapid decline of the ecosystem where *P. ionantha* is known to occur. Demographic studies indicated that *P. ionantha* is a fire-dependent species (Kesler et al. 2008). Lack of fire, or reduced fire frequency, and subsequent growth of shrubs and saplings in the understory, reduces *P. ionantha* abundance. Where proper fire management is implemented, it stimulates the emergence of individuals and maintains healthy, stable populations and ecosystems (e.g., populations at ANF, SJBSBP, and THSF).

The species occurs on both private and public lands. At present, most EOs with *P. ionantha* are found in ANF and THSF, although 13% of these EOs are reported extirpated. Protected areas are considered the cornerstone of species conservation, but whether these areas really prevent extinction is debatable. A stand-alone plan for managing *P. ionantha* (and other listed plants) at the ANF and THSF is necessary to show that protecting areas does work and represent a key strategy.

Current survey information indicates an increase in the number of populations. Survey information shows 22 (33%) of the 66 EOs appear to be extirpated due to development and/or habitat modification. However, since surveys were conducted irregularly and based on either presence/absence and/or qualitative visual estimate (Jenkins et al. 2007); with most sites visited only once; and the actual counts of plants rarely provided, a comprehensive population survey is needed in order to better assess the current status of this species. Studies have demonstrated variation among the number of plants necessary for a population to survive risks of extinction (Given 1994, Matthies et al. 2004, Menges 1990). Matthies et al. (2004) study of 379 populations of eight threatened plant species in northern Germany demonstrated that very small populations face a considerable risk of extinction, while the risk for populations with more than 1000 individuals was very small. Because most of the *P. ionantha* populations have less than 1000 individuals, any impact to existing populations (specifically sites outside the ANF) could cause extirpation of these populations. Furthermore, the relatively low level of genetic diversity associated with this species is a concern as it may impair fitness and evolutionary adaptability in a changing environment (Zaya et. al 2016). Therefore, a long-term monitoring study is necessary to assess population trends and trajectories, and where in the life cycle the management should be targeted (action 3).

For the species to be considered for delisting, the general criterion is to adequately protect and manage 15 populations distributed throughout the species' historical range for 10 years. This criterion has not been met (see action 3 below). For the reasons summarized here, *P. ionantha* meets the definition of a threatened species

III. RESULTS

A. Recommended Classification

 x No change is needed

B. Recovery Priority Number: 8C

IV. RECOMMENDATIONS FOR FUTURE ACTIONS

1. Manage ROW

Continue fostering conservation practices for utility and highway ROWs with the Forest Service, FDOT, and USFWS; a ROW Best Management Practices plan should be developed and implemented.

2. Develop a stand-alone plan for managing listed plants at the ANF and THSF, and integrate it to their Management Plan.

3. Conduct a long-term study using 15 populations distributed throughout the species' historical range for 10 years to determine whether the observed declines in abundance reflect acceptable stochasticity or if they are indicative of dangerously declining populations. This study could use the sites from Kesler and Trusty (2008) study, and will address the delisting criterion.

4. Since habitat loss and degradation are leading causes of endangerment for *P. ionantha*, designating habitat that is critical for survival and recovery is recommended.

5. Complete a comprehensive census (e.g., the total number of individuals, number of flowering vs. non-flowering plants, and whether seedling recruitment is occurring) throughout the present distribution including all the historical locations to determine the species' status.

6. Conduct surveys/inventories on potentially new sites. This action can include the use of aeriels and species distribution modeling methods to initially determine potential sites, with subsequent field inventory of the site using a consistent, statistically valid, repeatable inventory method. If new populations are discovered, protection should be sought, and identify sites for reintroductions such as areas that will not be affected by SLR and future development

7. Establish (or continue) frequent growing-season fire regimes (i.e., 2-3 yr interval) on selected areas such as ANF, SJBSBP, THSF, and Tyndall AFB to maintain optimal

conditions of *P. ionantha* populations. Re-visit sites shortly after a burn event, and mark and count individual plants. Populations tend to be more evident after a fire event.

8. Garden propagation and reintroduction. An *ex-situ* plant collection should be actively pursued and implemented with a botanical garden.
9. Investigate if there is a soil seed bank persistence of *P. ionantha* seeds throughout the species geographic range.
10. Conduct population biology studies at ANF

Compare the demographic performance of *P. ionantha* in pinelands and road habitats. Survey for seedling recruitment and survival of tagged individuals (plant height and reproduction) for a period of 3-5 years in or near roadside populations of SR 65 and pinelands.

11. The recovery plan should be updated to define objective measurable criteria and better address the five listing factors.

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U.S. FISH AND WILDLIFE SERVICE 5-YEAR REVIEW
***Pinguicula ionantha* (Godfrey's butterwort)**

Current Classification: Threatened

Recommendation resulting from the 5-Year Review

☒ No change is needed

Reclassification Priority Number: 8C

The review was completed by botanist Dr. Vivian Negrón-Ortiz, Panama City Field Office.

FIELD OFFICE APPROVAL:

Lead Field Supervisor, Fish and Wildlife Service

Approve _____ Date _____

APPENDIX A
Summary of peer review for the 5-year review of
***Pinguicula ionantha* (Goffrey's butterwort)**

A. Peer Review Method

The document was peer-reviewed internally by Melanie Kaeser and Dr. Sean Blomquist of the Panama City Field Office and comments were integrated to the document. A draft version of the 5-year review was sent to five independent reviewers; only three provided reviews. The outside peer reviewers were chosen based on their qualifications and knowledge of the species.

B. Peer Review Charge:

We indicated our interest in all comments the reviewers may have about the document, including validity of the data used, and identification of any additional new information on the *P. ionantha* that has not been considered in this review.

C. Summary of Peer Review Comments/Report

The three reviewers provided editorial comments. Allix North (FDEP) provided current survey data for the Apalachicola River WMA.

D. Response to Peer Review

All peer reviewer comments were evaluated and incorporated where appropriate.