Macbridea alba
(White birds-in-a-nest)

5-Year Review:
Summary and Evaluation

Lathrop Management Area, Bay County. Photo by Vivian Negrón-Ortiz

U.S. Fish and Wildlife Service
South Atlantic-Gulf Basin
Panama City Field Office
Panama City, Florida

5-YEAR REVIEW
***Macbridea alba* (White birds-in-a-nest)**

I. GENERAL INFORMATION

A. Methodology used to complete the review: In conducting this 5-year review, we relied on the best available information pertaining to historical and contemporary distributions, life histories, genetics, habitats, and threats of this species. We announced initiation of this review and requested information in a published *Federal Register* notice with a 60-day comment period (83 FR 20092). We received no public comments during the 60-day open comment period. We used a variety of information resources, including the previous 5-yr review of 2009, Recovery Plan (Service 1994); peer reviewed scientific publications; unpublished field observations by Federal, State, and other experienced biologists; unpublished studies and survey reports; and notes and communications from other qualified individuals. The completed draft review was sent to peer reviewers. Comments were evaluated and incorporated into this final document as appropriate (see Appendix A).

B. Reviewers

Lead Region: South Atlantic-Gulf

Lead Field Office: Panama City Field Office, Dr. Vivian Negrón-Ortiz, 850-769-0552

C. Background:

1. **Federal Register Notice citation announcing initiation of this review:** May 7, 2019, 83 FR 20092.

2. **Species status:** For the past few years, many Element Occurrences (EOs) were surveyed throughout the range of the species. In summary: *Macbridea alba* is most abundant in the Apalachicola National Forest (ANF), Liberty Co (Fig. 1); two EOs are extirpated and 14 were found without plants; most Bay County EOs have been extirpated except for Lathrop Island, it has about 168 plant stems, all in great conditions. Based on current survey effort *M. alba* is Stable, with plant stems ranging from 7,686 to 11,000.

3. **Recovery achieved:** 2 = 26-50%

4. **Listing history**

   Original Listing
   FR notice: 57 FR 19813 (May 8, 1992)
   Date listed: June 8, 1992
   Entity listed: species
   Classification: threatened

5. **Associated rulemakings:** None.

6. Review History:

Previous 5-year Review: March 10, 2009 (unknown)
Each year, the U.S. Fish and Wildlife Service (Service) reviews and updates listed species information to benefit the required Recovery Report to Congress. Through 2013, we performed a recovery data call that included status recommendations, such as "Stable" for this species. We continue to show this species' status recommendation in 5-year reviews. The last review conducted in 2019 showed this species as Unknown.

Final Recovery Plan: 1994
No formal 5-year reviews were conducted on *M. alba* prior to the Recovery Plan.

7. Species' Recovery Priority Number at start of review (48 FR 43098): 8C

Degree of Threat: moderate
Recovery Potential: high
Taxonomy: Species
C: conflict with development and growth

8. Recovery Plan

Name of Plan: Recovery Plan for four plants of the lower Apalachicola Region, Florida: *Euphorbia telephioides* (telephus spurge), *Macbridea alba* (white birds-in-a-nest), *Pinguicula ionantha* (Godfrey's butterwort), and *Scutellaria floridana* (Florida skullcap).]
Date Issued: June 22, 1994

II. REVIEW ANALYSIS

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

The ESA defines species as including any subspecies of fish or wildlife or plants, and any distinct population segment of any species of vertebrate wildlife. This definition limits listing DPSs to only vertebrate species of fish and wildlife. Because the species under review is a plant, the DPS policy is not applicable.

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 the 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 the available data at the time the plan was published. The plan is 26 years old and lacks recent published and unpublished scientific information.

   b. **Are all the 5 listing factors that are relevant to the species addressed in the recovery criteria?** No. The recovery plan only addressed factor 1 (Present or threatened destruction, modification or curtailment of its habitat or range).

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:**

   As stated above, the recovery plan lists a delisting criterion of adequately protect and manage 15 populations distributed throughout the species' historical range for 10 years. This recovery criterion addresses factor 1. Factor 2 was addressed in the recovery plan as a threat, but recovery criteria were not stipulated (see section II.C.2.b). Factor 3 is not relevant to *M. alba*. Factors 4 and 5, although relevant to this species, were not addressed by the Recovery Plan. We are going to summarize our progress under existing recovery actions. Recovery actions 1-5 address factor 1.

   Recovery Action 1: Protect population in ANF and on other public lands

   See Table 1 and section C.1 for details on number EOs, plant stems, and distribution.

   1.1. **Management/general monitoring in ANF**

   Management is an ongoing action conducted by the U.S. Forest Service (USFS). The ANF has a yearly goal of burning 100,000 acres with prescribed fire. From 2012 to 2018, the USFS burned annually on average 83,744 acres, with an average of 32,431 of those acres being in the growing season (J. Anderson, USFS, 6/12/2019, calculated from the Forest Service Tracking System). As of August 7, 2020, more than 59,100 acres have been treated in FY 2020 (https://www.fs.usda.gov/detail/florida/news-events/?cid=FSEPRD777764). USFS will continue to apply prescribed fire (dormant and growing season), in addition to include rare plant locations on their prescribed fire maps for both protection and to prioritize habitat areas for hand lighting prescribed fire (J. Drake, USFS, 08/26/2020).

   Several years of monitoring data, i.e. documenting the number of white-birds-in-a-nest plant stems, have been collected in five permanent plots (S. Johnson, Univ. Illinois Urbana-Champaign, 07/2020, pers. comm.) by Florida Natural Areas Inventory (FNAI). On average, numbers have been stable.

   1.2. **Conduct population biology studies**

This action has been partially met.

2019-2020: Three seed germination studies are currently ongoing (Johnson and Molano-Flores 2020). Seed collection from bagged fruits were carried out in 2019 at ANF. 1) Five germination replicates containing 5 – 20 seeds per replicate were established in Oct 2019. Ex-situ seed germination ranged from 60-83%; of the 137 transplants, only 22% seedlings survived to date; 2) Thirty seeds were planted in the ANF as an experimental in-situ project; as of February 2020, evidence of germination and seedling survivorship was observed; 3) Since vivipary (seeds germinating while they are still inside or attached to the plant or fruit) was observed while processing the collecting fruits, viviparous seedling survival was monitored. Preliminary results revealed approximately 42% (of the 135 viviparous transplants) survived to date.

2002: Studies of germination and seed bank, one aspect of population biology, have been conducted by Schulze et al. (2002). Since seed production has been documented for this species, but seedlings have rarely been observed in natural populations, the authors investigated the viability of dry-stored and of experimentally buried seeds, the timing of germination, and whether a persistent seed bank was present. The authors observed in the field that seeds germinated while in the infructescences (the fruiting stage of the inflorescence), suggesting that the matured ovules lack dormancy, in addition to the possibility of viviparous seedlings. About 87% of dry-stored seeds were viable for six months after dispersal, but viability of dry-stored and of buried seeds was insignificant after one year. They concluded that a persistent seed bank is not present, based on the lack of emergence of seedlings from soil that was field collected prior to seed dispersal. This lack of seed dormancy and seed bank means that if the established individuals are eliminated, a population cannot re-establish itself. In addition, preserving genetic diversity in an *ex-situ* facility is not recommended due to the poor viability of dry-stored seeds. In general, Schulze et al. (2002) recommend preserving and protecting established individuals.

Other population biology studies have not been carried out (see section IV).

Recovery Action 2: Manage rights-of-way

This is an ongoing action. *Macbridea alba* is found scattered under the Apalachicola National Forest Utility ROW of SR 65, and the Forest Service only allows spot treatment application of herbicide in the ANF.

Management for other *M. alba* elements of occurrences found in ROW outside SR 65 has not been initiated. However, mowing is the common practice to maintain ROWs in Florida, and Florida Department of Transportation (FDOT) has implemented a program of reduced mowing along state highways in order to decrease costs for maintenance roadsides and to encourage the growth of native wildflowers.

Recovery Action 3: Protect and manage these plants outside Apalachicola National Forest.

3.1. Secure protection

As of 2020, 13 protected EO's have been secured (Table 1): one population at Lathrop Bayou (LB), Bay County; three at Box-R Wildlife Management Area (Box-R WMA) and four at Apalachicola River Wildlife and Environmental Area (ARWEA), Franklin County; one on the St. Joseph State Buffer Preserve (SJSBP), Gulf County; and four populations at Tate's Hell State Forest (THSF), Franklin County. Some of these EOs were revisited and found without plant stems (Fig. 1); habitat conditions are unknown.

According to Ryan Means [Coastal Plains Institute (CPI) president and ecologist, 8/24/2020 pers. comm.], the CPI owns and manages an 80-acre ecological preserve within the Apalachicola Lowlands eco-region. The preserve is located along Rowlett's Creek, approximately 2.5 miles NW of the town of Sumatra, Liberty County, FL, and is entirely inheld within ANF lands. The preserve supports longleaf and slash pine flatwoods, with wet flat bog and seepage slope habitats associated with stream and wetland edges. Regular May-June-July lightning season fires are prescribed for the property every 1-3 years. *Macbridea alba* exists in relative abundance and is widespread on the CPI property; abundance has increased over the long-term management history of the CPI property, apparently in response to prescribed fire.

No land acquisition has been accomplished for specific protection of *M. alba.*

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

This recovery action has been partially met. Management plans have been developed and implemented for the five locations outside ANF: Florida Fish and Wildlife Conservation Commission (FWCC) for the ARWEA (FWCC 2014-2024) and Box-R WMA (FWCC 2006-2016); Bureau of Land Management (BLM) and the St. Joe Timberland Company (Timberland Company) for the LB (BLM 2003); Florida Department of Agriculture and Consumer Services for the THSF (FDACS 2007-2017); and Florida Department of Environmental Protection for SJBSBP (FDEP 2016-2026).

Permanent marked plots were established in 2008 at the SJSBP (USFWS 2009) to monitor *M. alba* seasonal changes and response to prescribed burning. Plots were visited once a year, without official monitoring or data taken from these plots (S. Fonseca, SJSBP, 8/25/2020, pers. comm.).

Observations indicate that most *M. alba* plants have migrated from those plots. SJSBP monitors the zones after they burn and record any new plants observed anywhere within the burn zone (D. Shoemaker, SJSBP, 8/25/2020, pers. comm).

Long-term monitoring has not been initiated for the other sites. This recovery action will be completed when the sites are revisited, and the status of the populations / plants provided.

Recovery Action 4: Systematics and other studies

4.1. Genetic structure of *M. alba*
This recovery action has been partially met. Godt et al. (2004, see section II.C.1.b) assessed allozyme diversity and genetic structure of 10 populations, 9 of which were in Apalachicola National Forest. Additional genetic studies that include the entire range of the species are recommended.

4.2. **Comparison of *M. alba* and *M. carolinensis***
This action is complete.
Chromosome studies of the two species of *Macbridea* indicated that they have the same ploidy level, i.e., 2n=18, with nearly identical chromosome length range (2.5-4 μm for both species) (Cantino 1985).

A genetic study comparing *M. caroliniana* (Weeks 2009) to *M. alba* allozyme study of Godt et al. (2004) indicated that the level of population structure found in *M. caroliniana* was higher (GST = 0.41) than in *M. alba* (GST= 0.10). Weeks (2009) argued that the levels of population differentiation are likely a function of the distance or proximity to populations. Most *M. alba* occurrences were within a mean distance of 6.9 km (Godt et al. 2004) whereas *M. caroliniana* populations are separated by a mean distance of 276 km. In addition, most *M. alba* samples were from ANF.

Recovery Action 5: Garden propagation and reintroduction.
This recovery action is ongoing.

Propagation.
2020: Preliminary seed propagation has been carried by Johnson and Molano-Flores (2020). See recovery action 1.2.

2002: According to Schulze et al. (2002) study, an e*x-situ* collection of seeds is not recommended due to the lack of dormancy, and poor viability of dry-stored seeds (seeds are recalcitrant). Stored and buried seeds maintain viability for up to six months, but viability rapidly declines after one year. However, *ex-situ* collection of established seedlings and adults is recommended for future conservation strategies. An *ex-situ* plan will be developed in collaboration with the Atlanta Botanical Garden (ABG) and other Agencies.

Reintroduction. Reintroduction has not been initiated, but if necessary, results from the habitat suitability model (Johnson and Molano-Flores 2020) using Maxent may inform this process. The model alluded a few potential reintroduction sites at Bald Point State Park, St. Marks Wildlife Refuge, THSF, SJBSBP, and the ARWEA.

C. Updated Information and Current Species Status

1. Biology and Habitat

a. New information on the species' biology and life history (see section 3**)**

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

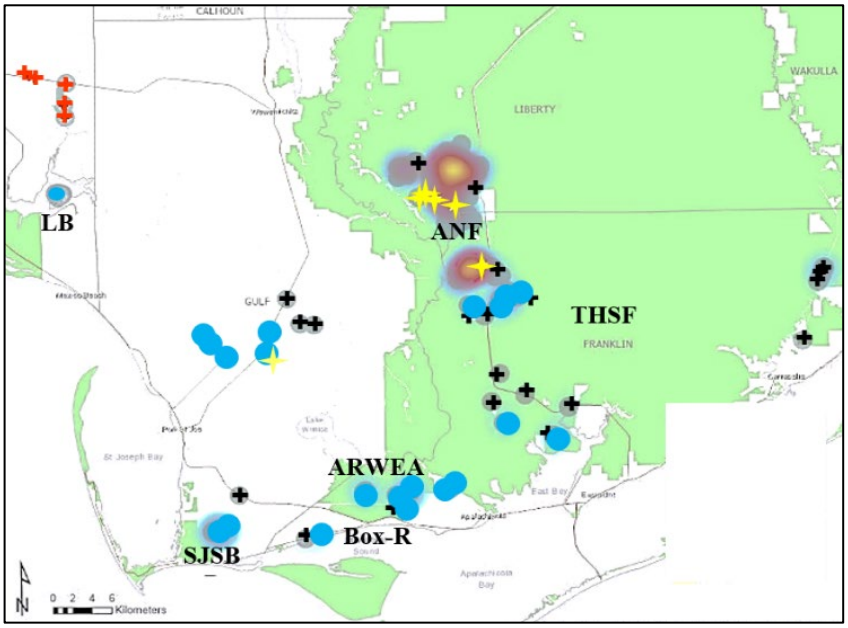

Figure 1. Map showing *M. alba* locations: new (yellow), with (blue) and without (absent, black) plant stems, extirpated (red), and most dense (reddish to yellow gradient). Apalachicola National Forest (ANF), Apalachicola River Wildlife Management Area (ARWEA), Box-R Wildlife Management Area (Box-R), Lathrop Bayou (LB), Tate's Hell State Forest (THSF).

Macbridea alba is endemic to the Florida Panhandle, and occurs in Bay, Gulf, Franklin, and Liberty Counties. As of 2008, about 10,000 plant stems were estimated throughout the entire range of *M. alba*. The highest density of sites with plants is found in Apalachicola National Forest (ANF), Liberty Co. (Fig. 1, USFWS 2008). Several locations have been extirpated (Figs. 1 & 2, Bay Co.) due to habitat loss (development, cattle grazing) or habitat modification.

Currently, there are 42 historic element of occurrence (EO) records (Table 1). Each EO varies in size and is comprised of one or many SF datasets representing subpopulations. Some SF (hereafter 'subpopulation') locations overlap or are in proximity to each other; in addition, terminology used to describe individuals (individuals, clumps,

ramets, stems) have been used interchangeable (USFWS 2008). Thus, substantial variation in methodology including surveying methods limits population estimates. The current EOs is comprised of about 349 source features (SF) (Johnson and Molano-Flores (2020). Table 1 provides several trends per county.

Table 1. *Macbridea alba s*urveys and current element of occurrences (EO) per county. Total*** EOs = 42; one EO overlaps: * into Liberty County, ** into Franklin County, ***within 2 counties. ANF: Apalachicola National Forest; ARWEA: Apalachicola River Wildlife and Environmental Area; Box-R WMA: Box-R Wildlife Management Area; LB: Lathrop Bayou; SJSBP: St. Joseph State Buffer Preserve; THSF: Tate's Hell State Forest. Information provided by FNAI.

County	**Surveys**				**FNAI Biotics**		
	1963-2008		**2010-2020**		**Element of occurrence (EO)**		
	EOs	# stems	EOs	# stems	Current	Absence (A), Extirpated (E)	Protected
Bay	3	26 - 41	3	168 (LB 2020)	3	1A; 1E	LB: 1
Gulf	10	956 - 1,176	2	66	11	4A; 1E	SJSBP: 1
Franklin	16	1,335 - 1,784	11	2,062 - 2122	*21	7A	ANF: 6; THSF: 4; ARWEA: 4; Box-R WMA: 3
Liberty	3	5,429 -5,970+	4	5390 -7110+	**8	2A	ANF: 8
Total	32	7,746 - 8971	20	7,686 - 9,466	***42	2E;14A	27

- Most of Bay Co. EOs were documented in the 1970s and 1980s by FNAI, with sites referred to as 'competition very severe, population size reduced'. Plants were not located during 2008 surveys (USFWS 2009). Currently, the sites have been cleared and converted to cattle pasture (Fig. 2), and so extirpated.
- 70% of Gulf Co. EOs surveyed between 1988 and 2008 were only visited once or twice, and a few found in moderate to dense pine plantations, or with a 'habitat drastically changed' (FNAI 2008). Currently, the status of five EOs is unknown; only one EO is protected (Table 1) and well-managed with fire; one new subpopulation (Fig. 1) was documented; and five EOs are either extirpated or without plants.
- Eleven of the 21 historical EOs reported for Franklin Co. are found outside the ANF and considered protected. Eight percent the EOs surveyed between 1963 and 2008 were found in dense, lightly bedded pine plantation and showed about 98 % decline in plant number (USFWS 2009). Plants were not observed for 7 EOs, most of which were located at THSF (Fig. 1). Prescribed fire is needed for most locations to reverse shrub encroachment.
- *Macbridea alba* is almost continuously spread throughout large sections of the ANF, Liberty Co. These occurrences are protected and managed with prescribed fire, although two EOs were found without plants.
- *Extirpations & EOs without plants*. Currently, there are two extirpated EOs (Bay & Gulf Counties; Table 1, Figs. 1 & 2). Of the 40 EOs remaining, plants were not observed (during the most recent surveys) for 14 EOs (Table 1, Fig. 1).

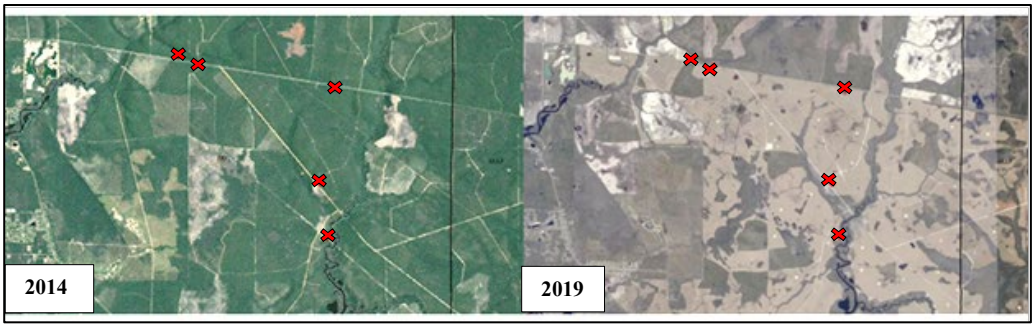

Figure 2. *Macbridea alba* extirpated locations (red) and corresponding habitat in Bay Co. Florida. At these locations, *Macbridea alba* were last recorded in the 1980's. Managed timberlands (present habitat in 2014) were cleared and converted to cattle pasture (2019) within 5 years of the land being sold. Image provided by S. Johnson (Univ. Illinois Urbana-Champaign).

- *Protected EOs.* Since one EO overlaps between Franklin and Liberty Co, currently there are 26 protected EOs (Table 1); the majority are found in the ANF (Fig. 1).
- Overall, surveys between 2010 to 2020 estimated a range of 7,686 to 9,466 stems for 20 EOs, a similar range for 32 EOs reported from 1963 to 2008 (Table 1).
- *Subpopulations surveys by Johnson and Molano-Flores (2020)*
  - *2019*. Johnson and Molano-Flores (2020) surveyed 94 subpopulations representing a subset of 32 EOs; these surveys were facilitated by an award from Section 6 Reverted Funds. They estimated about 4,000 plant stems within the 94 EO sub-populations surveyed.
    They also generated a habitat suitability model using Maxent. A total of 75 sites (ranging in suitability from low to high) were surveyed and resulted in the addition of six new subpopulations (Fig. 1) with about 500-700 individuals.
  - *2015 and 2019*. Overall surveys for 62% of the estimated 349 known historic subpopulations suggested about 11,000 *M. alba* stems, a similar number to that reported in 2008 (USFWS 2008).

Based on current survey effort, the number of plant stems for surveyed EOs range from 7,686 to 11,000. The number of genetically distinct individuals may be considerably fewer regardless of the number of stems reported here. This has profound implications on the long-term viability, and conservation importance and management of populations.

c. Genetics, genetic variation, or trends in genetic variation:

Godt et al. (2004) used starch gel electrophoresis to describe allozyme diversity and genetic structure in this threatened species. Ten populations (of which nine were from ANF) were analyzed with an average sample size of 47 plants per population, resulting in 22 loci. Fifty percent (11) of the 22 allozyme loci were found to be polymorphic, with 32 % to 50 % of loci polymorphic within populations. Despite a relatively high proportion of polymorphic loci, gene diversity is low possibly due to the restricted range of the species. Among populations gene diversity ranged from 0.078 to 0.123, thus genetic identity was

high. Therefore, compared to other mints the data indicate that *M. alba* is genetically depauperate.

Additional studies are recommended to clarify clonality and genetic diversity across its range.

d. Taxonomic classification or changes in nomenclature:

Kingdom:	Plantae
Division:	Magnoliophyta
Class:	Rosopsida
Order:	Lamiales
Family:	Lamiaceae
Genus:	*Macbridea* Elliott ex Nutt.
Species:	*alba* Chapman
Common name:	White birds-in-a-nest

Recent molecular studies attempted to clarify the relationships within and among members of the subtribe Melittidinae (Lamiaceae) and whether the members form a monophyletic group. Phylogenetic studies indicated that *Macbridea* Elliott ex Nutt. in addition to four other mints endemic to North America form a monophyletic group within the tribe Synandreae (Scheen et al. 2008). Within this natural group, *Synandra* is sister to *Macbridea*, and the two species, *M. alba* and *M. caroliniana*, are sister to a group consisting of *Brazoria, Warnockia, and Physostegia*. This monophyletic group is strongly correlated with their geography (Scheen et al. 2008). No other taxonomic studies have been conducted on *Macbridea.*

Description: This perennial herb usually has one stem (often clothed with long, multicellular hairs), which may be branched. The leaves are oblanceolate or spatulate, mostly in 6-8 pairs. White flowers are borne from May through July in compressed thyrses (dense flower cluster in which the main axis is racemose and the branches are cymose). The small clusters of white buds and flowers look like eggs and little bird heads in a nest. Each flower is bisexual, has a green calyx and a white two lipped-corolla of about 2.5-3 cm long; the pistil and filaments are white, and the anthers purple basally. Each flower can produce four nutlets of about 2-2.5 mm long, narrowly obovate in outline, and light brown (Godfrey and Wooten 1981, Godt et al. 2004).

e. Spatial distribution, trends in spatial distribution, or historical range:

Macbridea alba is endemic to the Florida panhandle and is still restricted to the same four counties: Bay, Gulf, Franklin, and Liberty. In 1992 when the species was listed, most of the sites (65 % of the occurrences) were found or known to occur at the ANF, Liberty Co. (57 FR 19813). To date, about 31% of the occurrences are reported for ANF. However, this number could be misleading because this species is quite abundant, almost continuously distributed throughout

large sections of the forest (Fig. 1), specifically in areas properly managed with prescribed burns.

Johnson and Molano-Flores (2020) created a habitat suitability model including a heat map of suitability using Maxent. A total of 75 sites were examined and several new subpopulations with *M. alba* were located within ANF (Fig. 1, yellow stars), increasing the size of some EOs.

The present locations for Bay, Gulf, and Franklin counties are separated by clear cuts, pine plantations or residential/commercial development. Development and timberland conversion to pasture for cattle grazing have resulted in extirpation of several current sites (Fig. 2) and have left other sites fragmented.

f. Habitat:

White birds-in-a-nest is restricted to the Gulf coastal lowlands near the mouth of the Apalachicola River in the Florida Panhandle. This area provides the grassy habitat on poorly drained, infertile soils that is required by *M. alba*. The wettest sites occupied by these plants are grassy seepage bogs on gentle slopes at the edge of forested or shrubby wetlands. The plants are also found in savanna, or less permanently wet sites. White birds-in-a-nest also occurs in dryer, mesic flatwoods sites with longleaf pine and runner oaks (USFWS 1992).

In general, plants are found in mesic pine flatwoods, wet savannas, seepage slopes, and ecotones between pine flatwoods and titi-swamps (Schulze et. al 2002). Consistently, it has been observed in longleaf pine savannas and in transitional habitats with associative species including wiregrass (*Astrida stricta*), saw palmetto (*Serenoa repens*), meadow beauties (*Rhexia* spp.), and toothache grass (*Ctenium aromaticum*) (A. Johnson, FNAI, pers. observ.).

According to Anderson et al. (2020), *M. alba* prefers moderate shrub and litter cover, rather than frequently burned, highly herbaceous sites dominated by wiregrass (*Aristida stricta*).

g. Other:

2004: *Macbridea alba* is a hermaphroditic species capable of both sexual and vegetative (via rhizomes) reproduction (Godt et al. 2004). This species is capable of both outcrossing and selfing. However, selfed seeds exhibit inbreeding depression (Godt et al. 2004).

2002: Pitts-Singer et al. (2002) studied the pollinator-plant relationship at two sites located on the Apalachicola National Forest. Twenty inflorescences were observed for 34 hrs over five days. The authors observed 70 visits of nine insects and spider species. Since only bumble bees (*Bombus* spp.) were large enough to make contact with the reproductive structures of the flowers, the authors concluded that bumble bees are the potential pollinators of *M. alba*.

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

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

Habitat destruction, fragmentation, and modification are the primary threats identified in the Recovery Plan for *M. alba*, and remains the main threats to date for this plant. Timbering, urban development, and fire management and suppression in this region have changed the ecosystems. The threats are discussed in more detail below:

Pulpwood production in the outer Coastal Plain in the Apalachicola Basin
The timber industry in North Florida became well established in the 1850s (FNAI 2005). It started in Franklin County in the 1870s and continued to be a prominent industry until the mid-1990s (Howell and Hartsell 1995). Tree farming, i.e., privately owned forest managed (clearcutting, mechanical site preparation, and planting of pine plantations) for timber production, is a primary threat since there still is a mill in Panama City (Bay County) and there are many thousands of acres of tree farms; the paper mill in Port St. Joe was sold and shut down in 1999.

Hurricane Michael in October 2018 (described below in e) caused extensive damage to the timberlands in the affected area and will affect the timber market in the coming decades. However, the extent of this affect is unknown. *Macbridea alba* has the capability of a prolonged vegetative dormancy persisting in dense pine plantation, but reintroduction of fire to these areas has been the only way to determine the species was not extirpated. Additionally, the compatibility of specific timber management practices (e.g., clearcutting, site preparation) on this species persistence is unknown. Therefore, tree farming is a threat to this species.

Conversion of timberlands to cattle grazing
A recent threat is the conversion of Florida Panhandle timberlands to open pasture for cattle grazing. Private timberlands totaling over 300,000 acres in Bay, Calhoun, Franklin, Gadsden, Gulf, Jefferson, Leon, Liberty and Wakulla counties have been sold and some parcels converted. Figure 2 provides an example of habitat modification/degradation caused by land conversion to cattle pasture. Livestock activities such as trampling, herbivory, congregation, soil disturbance and compaction have been a cause of major habitat destruction and species endangerment in western land. Therefore, conversion of timberlands to cattle grazing and associated activities pose a threat to this species.

Coastal real estate and road development
Urban development continues to threaten white birds-in-a-nest, and commercial and residential development is especially prevalent 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 growth of about 33.7 million residents–almost 15 million more people than in 2010.

Many historical *M. alba*'s locations are found along US 98 and other state roads (Fig. 1). Construction activity may directly kill individual plants or convert habitat to unsuitable space; widening may convert native habitat to managed roadside; and culvert modification may change drainage patterns, which may change seasonal hydrology. Therefore, because they contribute to habitat loss, road widening and new roads continue to pose a threat to the species.

Fire suppression
Suppression of fire continues to threaten the pineland and savanna's flora since fire is essential for 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.

Fire suppression continues to be a threat to *M. alba*. Lack of fire, and subsequent growth of shrubs (such as encroachment of *Cyrilla racemiflora* L., commonly known as swamp titi) and saplings in the understory, inhibits this species emergence (FNAI 2008). In recently burned areas, plant emergence is prolific within two years of the fire event. The ANF utilizes a 3-5 yr interval burn rotation; LB uses a 2 to 7-yr interval; and SJBSBP uses a 2 to 5-yr interval. Declining fire frequency reduces *M. alba* abundance, so fire suppression continues to pose a threat.

Several studies have shown that frequent prescribed fire regimes are important for maintenance of flatwoods diversity (Hiers et al. 2007). Therefore, frequent prescribed burnings, i.e., 4-5 yr intervals, are needed to maintain optimal *M. alba* populations (Anderson et al. 2020, USFWS 2009).

c. **Overutilization for commercial, recreational, scientific, or educational purposes:**

The Recovery Plan suggested that the use of the savannas in ANF for educational purposes and tourism could create risks of casual collecting during the flowering season. Currently, there is no evidence to suggest that this factor is a threat, but this could eventually become a concern.

c. Disease or predation:

Foliar, stem, and fruits herbivore damage was observed by Johnson and Molano-Flores (2020). Fruits, i.e., seed collection plots, showed extensive damage to over 25% of infructescences. Damage appears to be caused by *Endothenia hebesana,* a micro-lepidoptera (Walker); all three life stages were witnessed on the plant. The moth appears to lay eggs within the inflorescence and the larvae consumes some or all the fruit or seed within. Based on this information, herbivore damage is an increasing threat to the species.

d. **Inadequacy of existing regulatory mechanisms:**

Sections 7(b)(4) and 7(b)(2) of the Act generally do not apply to listed plants 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.

Several populations of *M. alba* 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. Neither section of the Act provides protection for plants on private lands if the activity is permissible under state/local laws. The State requires permission of private landowners for collecting of state-listed plants from their property.

Macbridea alba 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). 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 under the Act to the FDOT. The FDOT routinely consults with the Service on all major road construction activities. Currently, these protections are inadequate; see section IV, action 6.

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

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 to *M. alba* because mowing is now the common practice to maintain ROWs in Florida. Franklin County allows only

"spot treatment" due to impacts concerning the ANF and waters within Apalachicola Bay and River basin.

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. Using the NOAA Sea Level Rise and Coastal Flooding Impacts Viewer (https://coast.noaa.gov/digitalcoast/tools/slr), the projections indicated that coastal habitat areas in Bay, Franklin, and Gulf Counties would be largely inundated beginning at 0.305 m (one foot) of SLR. These projections will most likely extirpate populations located in Gulf (1 EO) and Franklin (4 EOs) counties by intrusion of saltwater beginning at one foot SLR.

Catastrophic events. Hurricanes have impacted the Florida Panhandle and this threat is expected to continue. On October 10, 2018, Hurricane Michael made landfall along the Florida Panhandle as a massive Category 5 hurricane with maximum sustained winds of 161 mph and a pressure of 919 millibars (https://www.weather.gov/tae/HurricaneMichael2018). The scale and severity of this hurricane impacted residents as well as plants and wildlife in the Florida Panhandle. According to pre/post-hurricane analyses by C. Anderson (FNAI, 8/21/2019, pers. comm.), natural communities such as sandhills were more affected, whereas scrub, scrubby flatwoods, wet flatwoods, and coastal grasslands were found more resistant to damage. *Macbridea alba* occurs in mesic pine flatwoods, wet savannas, seepage slopes, and ecotones between pine flatwoods, so possibly it has some resistant to this disturbance. However, the effect of this disturbance on documented EOs in Gulf and Bay counties, areas that were severely affected by Hurricane Michael, has not been examined and therefore it is unknown.

D. Synthesis

Macbridea alba is presently located in five Florida panhandle counties (Table 1). It is mainly threatened by habitat destruction/modification. Urban development, timbering, conversion of land to cattle grazing, and inadequate fire management, i.e., fire suppression, are the main pressures reducing or eliminating individual populations. Of the 42 historical EOs, 2 has been extirpated and 35% were found without plants. Surveys for sites lacking plants are key to help evaluate the current status of this species.

Land conversion coupled with disruption of fire regimes of the longleaf pine ecosystem is responsible for the decline of the ecosystems where this species occurs. *Macbridea alba* occurs in fire-prone habitats. Where fire management is implemented, it stimulates the emergence of individuals and maintains healthy, stable populations (e.g., ANF, LB, SJSBP, and some THSF). An emergent threat was detected with predation by a micro-lepidoptera, damaging several plant parts including over 25% of the fruits.

The species occurs on both private and public lands. The populations at ANF, which are the largest, are protected and adequately managed; these represent 50% of the total

protected populations. Habitat on private lands has deteriorated in quality and extent due to conversion of much of the forest land to pulpwood plantations (e.g., clearcutting, conversion to improved pasture, drainage, and fire exclusion), and some to cattle grazing. Informal consultation has resulted in minimizing impacts from timbering.

As an endemic species restricted to four counties with populations occurring on private lands and ROWs, white birds-in-a-nest is threatened by intense development pressures, since urbanized land is projected to increase two-fold in the near future. In addition, the populations cannot re-establish themselves due to the lack of seed dormancy and seed bank. Thus, permanent protection and management are necessary to conserve this species, as is surveying for current and potentially new sites.

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). Presently, we have some estimation of stem counts per county, but because: 1) it is not possible to determine which plants belong to the same genetic individual (genet) in the field and the extent of sexual and asexual (clonality) reproductive strategies is unknown, appropriate identification and characterization of genets should be accomplished with genetic analysis (section IV, action 1) and 2) current surveys are based on stem counts using several estimation approaches, a comprehensive population survey throughout the species range using the same sampling method (section IV, action 5) is needed. These top actions will help evaluate the current status of this species in addition to improve population trends and trajectories.

Macbridea alba should remain as a threatened species because the present threat of habitat modification via development and road construction and maintenance remains significant. 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.

III. RESULTS

A. Recommended Classification:

__X__ No change needed

IV. RECOMMENDATIONS FOR FUTURE ACTIONS

1. Estimate the levels of clonality and distribution of genetic diversity. Knowledge of the levels and distribution of genetic variation in species of conservation concern can be important for the development of efficient and effective conservation practices, i.e., establish a representative percentage of the total genetic variation of *M. alba*. Sampling should occur across the range; testing clonality could involve sampling the established monitoring plots at ANF and SJSBP.
    a. By understanding clonality, the Service will be able to determine what is an individual and evaluate abundance. Specifically, we will be able to 1) relate

flowering stems (both vegetative and flowering) to number of individuals in a given area, and 2) infer the effect of fire on flowering stems/individuals.

b. The identification of populations with rare alleles or with elevated levels of genetic diversity may lead to greater efforts for their preservation relative to less genetically unique populations.

2. Establish an *ex-situ* collection of seeds, seedlings, and adults. There is an ongoing conversation among FDACS, ABG, FWS, and Univ. Illinois Urbana-Champaign to establish an ex-situ collection at the ABG.
3. Clarify limits of desiccation and cold tolerance for ex-situ seed storage recommendations.
4. Understand in-situ seed germination and seedling survival vs. the role of viviparous seed germination and offspring survival, and the implications of both reproductive strategy for *M. alba.*
5. Monitoring. Implement monitoring for selected populations outside of ANF: Bay, Gulf, and Franklin counties. It is recommended to set up more subplots and monitor abundance and survival of both flowering and nonflowering individuals over time, whether seedling recruitment is occurring, and the effect of mechanical site preparation and hurricane disturbances.
6. Censuses. Censuses are most critical for populations outside ANF and for EOs found without plants. 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 population numbers and range. A consistent and repeatable method should be employed.
7. Manage ROWs. Continue fostering conservation practices for utility and highway ROWs with the Forest Service, Talquin Electric, FDOT, and the Service and document commitment to these conservation practices in land management plans or agreements.

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Acknowledgements

Thanks to reviewers and contributors; they provided their time, knowledge, and updates.

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U.S. FISH AND WILDLIFE SERVICE
5-YEAR REVIEW of
***Macbridea alba* (White birds-in-a-nest)**

Current Classification:

Recommendation resulting from the 5-Year Review:
__X__ No change needed

Reclassification Priority Number, if applicable: Not applicable.

Review Conducted By: Dr. Vivian Negron-Ortiz, Panama City Field Office.

FIELD OFFICE APPROVAL:

Lead Field Supervisor, U.S. Fish and Wildlife Service

Approve: JAY HERRINGTON Digitally signed by JAY HERRINGTON Date: 2020.08.28 12:14:43 -04'00' Date: 8/28/20

Appendix A
Summary of peer review for the 5-year review of
***Macbridea alba* (White birds-in-a-nest)**

A. Peer Review Method:

The document was peer-reviewed internally by Dr. Sean Blomquist of the Panama City Field Office. The document was sent to outside reviewers that were chosen based on their qualifications and knowledge of the species.

B. Peer Review
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 *M. alba* that has not been considered in this review.

C. Summary of Peer Review Comments
Reviewers provided comments related to plots monitored by FNAI, updated information for the 1) Coastal Plains Institute site, 2) plots at the SJSBP, 3) management at ANF, and 4) EO abundance; suggested a recovery action and a few editorial comments.

D. Response to Peer Review
All peer reviewer comments were evaluated and incorporated to the document.